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 allergological African data are limited.[4] However, an increase of allergic symptoms has been reported in African countries.[5,6] Allergic rhinoconjunctivitis symptoms[7] 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 Zimbabwean[4] 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 rhinosinusitis[8] 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.

From the [1]University Hospital of Kinshasa, Ear, Nose, and Throat Department, Kinshasa, Democratic Republic of Congo, [2]Saint Joseph Hospital of Kinshasa, Kinshasa, Democratic Republic of Congo, [3]University Hospital of Leuven, Department of Otorhinolaryngology Head and Neck Surgery, and [4]Laboratory of Experimental Immunology, Katholieke Universiteit Leuven, Leuven, Belgium
Funded by the Belgian Technique Corporation
The authors have no conflicts of interest to declare pertaining to this article
Address correspondence and reprint requests to Nyembue Tshipukane Dieudonné, M.D., University Hospital of Kinshasa, Ear, Nose, and Throat Department, Box 123, Kinshasa XI, Democratic Republic of Congo 00243
E-mail address: dieunyembue@yahoo.fr
Published online May 3, 2012
Copyright © 2012, OceanSide Publications, Inc., U.S.A.

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 through Kinshasa.[8] During the study period, consecutive outpatients presenting with nasal symptoms related to

rhinitis/rhinosinusitis 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 tuberculosis. Finally, the patient's complaints have been registered. The level of symptoms related to allergy was reported on a visual analog scale (VAS). [9,10] To categorize AR[3] according to the duration of symptoms, the number of days per weeks and weeks per year with symptoms was reported. The severity was evaluated by questioning the patient's quality of life: sleep, leisure/sport, daily activities, work, and school attendance.

Allergy Testing

SPTs were performed with 15 allergens (Stallergenes, Waterloo, Belgium). The allergen extracts included *Dermatophagoides pteronyssinus* (DPT), grass pollen mix, artemisia vulgaris, *Parietaria judaica*, *Cupressus sempervirens*, dog, cat, guinea pig, rabbit, cockroach, crab, soybean, wheat flour, *Alternaria alternata*, and *Aspergillus* mix. Histamine dihydrochloride at 10 mg and saline were used as positive and negative control, respectively. The drop of each allergen was placed on the volar side of the forearm, and a sterile lancet was pressed for at least 1 second through the allergen's drop by one trained nurse. Fifteen minutes after, one ENT specialist evaluated the mean size of the cutaneous reaction.[11] A positive reaction was defined as a mean weal diameter of $\geq$3 mm.

Operational Definitions

Sensitization was defined as the presence of a positive test to one or more allergens. AR diagnosis[3] was based on nasal symptoms including clear nasal discharge, nasal obstruction, sneezing, and/or itching with positive SPT results. Patients with similar symptoms and negative SPTs were considered to be non-AR (NAR). Intermittent AR was defined as symptoms that lasted for up to 4 days/week or symptoms lasting $<$4 consecutive weeks/year, whereas persistent AR was defined as symptoms that lasted for $>$4 days/week and for $>$4 weeks/year. Depending on the quality of life, patients were classified as moderate/severe AR if one or more of the following items (sleep, leisure/sport, daily activities, work, and school attendance) were disturbed. When symptoms did not impair the quality of life, then AR was taken as mild. Rhinosinusitis[12] including nasal polyps included two or more of the following symptoms: nasal blockage/congestion, anterior discharge or postnasal drip, facial pain, smell impairment and endoscopic signs such as polyps, mucopurulent discharge, and edema/mucosal obstruction. We assessed for acute rhinosinusitis when symptoms lasted $<$12 weeks and for chronic rhinosinusitis (CRS) when they lasted for $>$12 weeks.

Statistical Analysis

Analyses were conducted using STATA software Version 11.0 (Statacorp, College Station, TX). Qualitative variables were expressed as percents, and mean $\pm$ SD or median were used for quantitative variables. Comparison of proportions was tested by chi-squared test and Fisher's exact test was used if the chi-square conditions were not fulfilled. For continuous variables, Student's *t*-test was used to assess differences between two means. However, Mann-Whitney *U* test was applied in the case of not normally distributed data or unequal variances. Odds ratio and its 95% confidence intervals for potentials risks factors for sensitization were assessed by univariate analysis and independent association confirmed by multivariable analysis. Variables significantly ($p \leq 0.05$) 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 factors, presence of flowers/trees around home, active smoking, medical antecedents of asthma, and rhinoconjunctivitis. The backward stepwise selection process started with all suspected variables and removed those with values of $p \geq 0.10$. The significance level was set with a value of $p \leq 0.05$.

RESULTS

Four hundred twenty-three patients were included. They ranged from 4 to 89 years with a mean age $\pm$ SD of 36 $\pm$ 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.

Table 1 **Patients' characteristics in accordance to SPT responses**

	All Patients (n = 423)		Patients with Positive SPT (n = 149)		Patients with Negative SPT (n = 274)		p Value
	n	%	n	%	n	%	
Sex							NS
Male	158	37.4	54	36.2	104	38.0	
Female	265	62.6	95	63.8	170	62.0	
Age group (yr)							<0.001
1–19	55	13.0	30	20.1	25	9.1	
20–39	199	47.0	77	51.7	122	44.5	
40–59	142	33.6	35	23.5	107	39.1	
60–89	27	6.4	7	4.7	20	7.3	
No. of persons by household							NS
1–5	150	35.5	55	36.9	95	34.7	
>6	273	64.5	94	63.1	179	65.3	
No. of persons by bedroom							NS
1–2	191	45.2	65	43.6	126	46.0	
>3	232	54.8	84	56.4	148	54.0	
Study level							0.043
University	216	51.1	86	57.7	130	47.4	
Under university	207	48.9	63	42.3	144	52.6	
Profession of patients							NS
Students	167	39.5	54	36.2	113	41.2	
Paid work	100	23.6	40	26.8	60	21.9	
Unpaid work	156	36.9	55	36.9	101	36.9	
Home environment							
Grow flowers/trees around house	282	66.7	89	59.7	193	70.4	<0.05
Self-declared dampness in house	67	15.8	30	20.1	37	13.5	NS

SPT = skin-prick tests.

Table 2 **Sensitization pattern among rhinitis/rhinosinusitis patients**

	Positive SPT n (%)	Negative SPT n (%)	All Patients n (%)
Rhinitis	101 (45.3)	122 (54.7)	223 (52.7)
Nonallergic	—	122 (100.0)	122 (28.8)
Allergic	101 (100.0)	—	101 (23.9)
Rhinosinusitis	48 (24.0)	152 (76.0)	200 (47.3)
Chronic	39 (23.4)	128 (76.6)	167 (39.5)
Acute	8 (31.8)	18 (69.2)	26 (6.1)
Nasal polyps	1 (14.3)	6 (85.7)	7 (1.7)
Total	149 (35.2)	274 (64.8)	423 (100.0)

SPT = skin-prick tests.

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).

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)	
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.

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 5 **The average score level of patient's autoevaluation complaints according to visual analogue scale**

Complaints	Sensitized Patients	Nonsensitized Patients	Tests	*p* Value
Sneezing*	6 (4–7)	4 (3–6)	Mann-Whitney	<0.001
Nasal obstruction/blockage#	5.9 ± 1.9	5.5 ± 2.0	*t*-Test	0.073
Itching nose#	5.8 ± 2.1	5.1 ± 2.0	*t*-Test	0.027
Clear nasal discharge#	6.5 ± 1.8	5.1 ± 1.9	*t*-Test	<0.001
Itching eyes#	5.5 ± 2.1	4.9 ± 2.1	*t*-Test	0.049
Itching ears#	6.1 ± 2.3	6.1 ± 2.6	*t*-Test	0.999
Shortness of breath#	4.8 ± 1.8	4.4 ± 1.9	*t*-Test	0.303
Purulent/discolored nasal discharge#	5.5 ± 1.9	5.3 ± 2.1	*t*-Test	0.79
Wheezing*	5 (3–7)	3 (3–5)	Mann-Whitney	0.113

*Data presented as *median (percentile 25–75) and #mean ± SD.*

Table 6 **Duration and severity according to ARIA subdivision in 101 allergic rhinitis patients**

	Moderate/severe *n* (%)	Mild *n* (%)	Total *n* (%)
Persistent	48 (47.5)	14 (13.9)	62 (61.4)
Intermittent	22 (21.7)	17 (16.8)	39 (38.6)
Total	70 (69.3)	31 (30.7)	101 (100.0)

ARIA = Allergic rhinitis and its impact on asthma.

(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/pressure 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 ± SD, 5.4 ± 2.1 versus 4.6 ± 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[13] 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,

Table 7 **OR (95% CI) of covariables associated with sensitization (univariate and multivariate analysis; $n = 423$; 149 sensitized patients)**

Variable	No.	OR (univariate analysis)	95% CI	p Value	OR* (multivariate analysis)	95% CI	p Value
Sex				0.727			
Male	54/158	1					
Female	95/265	1.07	0.70–1.67				
Age group in years				0.0006			
≤19	30/55	1			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			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			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			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			1		
Yes	89/282	0.62	0.4 0–0.96		0.54	0.33–0.86	
Rhinoconjunctivitis in the past				0.014			0.027
No	130/388	1			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							
No	119/356	1					
Yes	30/67	1.61	0.91–2.83	0.074			
No. of person by household							
1–5	55/150	1					
>6	94/273	0.91	0.59–1.41	0.645			

**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[19] with AR were predominantly sensitive to HDMs and cockroach. In the U.S.[20] population, HDMs were reported as the main allergen followed by pollens. In contrast, the Norwegian schoolchildren[21] were mostly sensitive to pollens, pets, and lowly to mite and mold. Similarly, the Belgian[14] patients with rhinologic 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,[22] abundant in low-income housing and in warm and humid areas. Also, cockroaches may be present in western countries.[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[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[26] 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.[4,13,27,28] The prevalence of AR (23.9%) in our series was <33.0 and 48.6% reported among Zimbabwean[4] and Kenyan[27] patients, respectively. AR was three times self-declared more than NAR in Europeans studies.[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,[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[31] 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 *et al.*[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[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,[32] during the pollen season. Also, Bachert *et al.*[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.[33,34] After adjustment, sensitization is strongly associated with younger age, history of rhinoconjunctivitis, and reaction to nonspecific trigger factors. Arbes *et al.*[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[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,[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[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 Nyembue.

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, Olbrecht J, and van Schoor J. Prevalence, classification and perception of allergic and nonallergic rhinitis in Belgium. Allergy 61:693–698, 2006.
3. Bousquet J, Khaltaev 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, Björkstén 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 RI, 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, Odhiambo 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 système des soins de santé primaires: Cas du Bureau Diocésain des Œuvres Médicales de Kinshasa. Congo Med IV:1210–1214, 2007.
9. Spector SL, Nicklas RA, Chapman JA, et al. Symptom severity assessment of allergic rhinitis: Part 1. Ann Allergy Asthma Immunol 91:105–114, 2003.
10. Bousquet PJ, Combescure C, Neukirch3 F, 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:S543–S625, 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. Nyembue TD, Vinck AS, Corvers K, et al. Sensitization to common aeroallergens in tertiary referral outpatient ENT clinic. B-ENT 7:79–85, 2011.
15. Awotedu AA, Ooyejide C, Ogunlesi 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, Nejjari 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, Kuschnir FC, Arruda LK, et al. Sensitisation to aeroallergens in Brazilian adolescents living at the periphery of large subtropical urban centres. Allergol Immunopathol (Madr) 36:9–16, 2008.
20. Arbes SJ Jr, Gergen PJ, Elliott L, and Zeldin DC. Prevalences 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, Nafstad P, Bolle R, and Nystad W. Skin sensitization in school children in northern and southern Norway. J Asthma 44:23–27, 2007.
22. Sarpong 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. Riario-Sforza GG, Della Torre F, Antonicelli L, et al. Sensitization to cockroach in Italy: A multicentric study. Allergy Asthma Proc 18:23–28, 1997.
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 sensiti-

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. Bråbäck 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. □