

Prevalence and determinants of allergic diseases in a Congolese population

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Background: Allergic rhinitis (AR) is increasing worldwide, but little is known about AR in Africa. We aimed to establish the prevalence of AR and related allergic diseases, to classify AR according to the Allergic Rhinitis and Its Impact on Asthma (ARIA) guidelines, and to determine factors associated with allergy in Congo.

Methods: We conducted a cross-sectional clustered survey of the population of 8 randomly chosen health zones of Kinshasa. Information was collected on demographics, home environment, participant characteristics, atopic history, and allergic symptoms. Skin-prick testing (SPT) was done.

Results: Of 1508 screened individuals, 1412 (5–83 years of age) were interviewed and 1005 underwent SPT. Of the participants, 65.6% and 34.4% lived in urban and rural areas, respectively. Mean ($\pm$ standard deviation [SD]) of age was 29 ($\pm$ 16) years and 52% were female. The 12-month prevalence of rhinitis, rhinoconjunctivitis, wheeze, and skin itch-rash was 30.8%, 24.4%, 15.4%, and 6.2%, respectively. Rhinoconjunctivitis and wheeze were more prevalent in urban than rural individuals. Of skin-tested respondents, 23.2% showed positive results, with mainly

Dermatophagoides pteronyssinus and cockroach being involved. AR and non-AR prevalence was reported in 13.9% and 27.9%, respectively. Of AR individuals, 59.7% and 48.0% expressed moderate to severe and persistent symptoms, respectively. Independent determinants of having any allergic diseases in multivariate analysis were active smoking, presence of cockroach in home, history of atopy in siblings, personal history of atopy, using straw or herb mattress, and positive SPT responses.

Conclusion: This study revealed a high prevalence of allergic diseases in Congolese individuals. It is important to increase awareness toward allergic disorders and to ensure adequate management. © 2012 ARS-AAOA, LLC.

Key Words: prevalence; rhinitis; rhinoconjunctivitis; wheeze; itch-rash; Congo

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Allergic rhinitis (AR) and related allergic diseases¹ constitute a worldwide health problem, affecting quality of life and causing great economic burden. Prevalence

of the immunoglobulin E (IgE)-mediated diseases is well-documented in industrialized settings. In Western Europe,² AR affects 17% to 29% of the general population. There is a clear relation between allergen sources/pattern and allergic symptoms, but prevalence of AR is also influenced by many other factors such as local allergen and exposure intensity, environmental factors (air pollution, temperature, and climate), and age and genetic characteristics of the population. An allergic inflammation of the nose is characterized by rhinorrhoea, sneezing, nasal blockage, and/or itching, which are reversible spontaneously or with treatment. Nose symptoms are often associated with itchy or watery eyes. Diagnosis of AR is based on interrogation, examination, and IgE testing to common allergens in clinical settings. For epidemiological studies,³ questionnaires are used to assess AR despite the fact that nonallergic conditions can provide similar symptoms. AR is strongly linked to lung disease as reported in the new concept of “one airway–one disease.”^{4,5} Clinically,

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both diseases share increased prevalence and common pathological and physiological features, and partially respond to the same medication. AR commonly exacerbates asthma or bronchial hyperresponsiveness and is associated with other upper-airway comorbidities.⁶ Among African schoolchildren 13 to 14 years old, an international study of asthma and allergies in childhood (Isaac) phase III⁷ reported allergic rhinoconjunctivitis in 7.2% to 33.3%. This prevalence of allergic symptoms is higher than in surveys carried out previously in African countries such as Morocco,⁸ Kenya,⁹ and South Africa.¹⁰ Moreover, there is a lack of diagnostic tools and only a few physicians are trained in diagnosis and management of AR including allergy-related disorders in central Africa,¹¹ where immunological laboratories are inappropriate or nonexistent. Local allergen sources are not well-known. Furthermore, priority in developing countries is given toward transmissible diseases, malnutrition, and maternal and infant mortality. In the Democratic Republic of Congo (DRC), the prevalence of specific IgE-mediated diseases and AR in particular is not well-known, because of the lack of an allergy-screening program and the quasi-absence of allergy testing in daily practice. Neither measurement by serum-specific IgE nor skin-prick testing (SPT) is currently available. One study⁷ carried out among 13- to 14-year-old schoolchildren in Kinshasa (the capital), reported 11.8%, 10.9%, and 7.5% of rhinoconjunctivitis, eczema, and wheeze symptoms, respectively. Moreover, the management of allergic diseases remains inappropriate and immunotherapy is not available. This study aimed to determine the prevalence of AR, allergy-related diseases, and their relationship, to classify AR according to the Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines, and to evaluate factors associated with allergic symptoms in the general population of Kinshasa.

Patients and methods

Study population

This clustered cross-sectional survey in the general population of Kinshasa, the capital of the DRC, was carried out from February to May 2010. Kinshasa has a surface area of 10,000 km² with about 10 million inhabitants. The largest part of Kinshasa has a rural ecology while the inhabited urban surface is limited to 459 km² located along the river Congo (Institut National de Statistique de la RDC, 2009, unpublished report). The Kinshasa's climate is tropical wet and dry, characterized by 2 seasons: a rainy and dry season. The administrative organization of Kinshasa is subdivided into 35 health zones (zones de santé) and each health zone is split into several health areas (aires de santé) (Ministère de la Santé de la RDC, 2003, unpublished report). Because of the lack of a reliable census, household sampling was taken using a multistage random in 4 degrees. Eight health zones were randomly selected (first-degree); 2 health areas were randomly selected in every health zone (second-degree); 3 streets were randomly selected in each health area accord-

ing to the list of all streets (third-degree); and the inhabited parcels were randomly selected (fourth-degree) according to the list of whole parcels of the chosen streets. In the case of several households in a selected parcel, 1 household only was randomly chosen. From the list of household members, we randomly recruited 1 individual who met the inclusion criteria (aged ≥ 5 years and living in Kinshasa for ≥ 1 year). The number of participants varied proportionally with the size of the selected health zones. Each selected health area was visited 4 times. The first visit was to inventory the number of streets, the inhabited parcels, and the primary medical center where SPT would be done. During the later visits, participants were interviewed and, if agreed, referred to local primary medical center for SPT.

Procedure

The survey questions were from the Isaac study¹² translated into French and Lingala (predominant local language) by an independent language center and back-translated by health workers. The main question used to assess the prevalence of rhinitis was "Have you had problems with sneezing or a runny or blocked nose when you did not have a cold or the flu in the last 12 months?" If yes, rhinoconjunctivitis was defined by a positive answer to the following question: "In the past 12 months, has this nose problem been accompanied by itchy, watery eyes?" Wheeze was assessed by: "Have you had wheezing or whistling in the chest in the last 12 months?" And skin itch-rash was evaluated by the 2 questions: "Have you ever had an itchy rash which was coming and going for at least 12 months?" If yes, followed by "Has this itchy rash affected any of the following places: the folds of the elbows, behind the knees, in front of the ankles, under the buttocks, or around the neck, ears, or eyes?" Additionally, we recorded data on age, sex, education level, profession, number of persons and number of rooms in house, keeping pets (dog/cat), using fan/air conditioning, having carpet in the living room, presence of trees/flowers around the house, and self-assessment of the house's aeration. Furthermore, respondents were questioned about the presence of insects/rodents in the house, type of mattress used, material/fuel used for cooking, active/passive smoking, and alcohol consumption. Experienced interviewers were recruited and underwent 1-week training comprising a detailed review of the questionnaire and interview techniques. A pilot study was conducted in 62 subjects from 1 health area. Afterward, weaknesses were corrected and a standardized explanation was supplemented to the study guidelines.

SPT

The allergy screening was done with allergen extracts of *Dermatophagoides pteronyssinus* (DPT), cockroach, dog, cat, guinea pig, rabbit, grass pollen mix (cocksfoot, vanilla, timothy, ray, and meadow), *Artemisia vulgaris*, *Parietaria judaica*, *Cupressus sempervirens*, *Alternaria alternata*,

Aspergillus mix (*Aspergillus fumigatus*, *Aspergillus nidulans*, and *Aspergillus niger*), crab, soybean, and wheat flour (Stallergenes, Waterloo, Belgium). Histamine solution and saline solution were used as positive and negative controls, respectively. A drop of each allergen was placed on the volar side of the forearm and a sterile lancet was pressed on it perpendicularly for at least 1 second. The cutaneous mean wheal reaction size was measured after 15 minutes.¹³ All SPTs were performed by 1 trained nurse and interpreted by 1 ear-nose-throat (ENT) specialist.

Operational definitions

Sensitization was defined as the presence of a positive test (mean wheal diameter ≥ 3 mm) to at least 1 of the allergens. AR diagnosis was based on the presence of 2 or more symptoms of rhinitis/rhinoconjunctivitis with 1 or more positive SPT responses, whereas negative SPT results without such symptoms were considered as non-allergic rhinitis (NAR). AR was classified into 4 subgroups according to ARIA¹ guidelines. Household is defined as a set of people living under the same roof and sharing the same meals.

Ethical issues

The research section of the medical school of Kinshasa University approved the study protocol. From the Provincial Medical Inspection of Kinshasa, we obtained the authorization to visit the selected health areas and to use the primary medical center for SPT. Informed consent was required from all participants or from legal representatives responsible for individuals less than 18 years old.

Statistical analysis

Statistical analyses were performed using STATA software version 11.0 (Stata Corp., College Station, TX). Qualitative variables were expressed as percentages and their 95% confidence intervals (CI). Mean $\pm$ standard deviation (SD) or median and 25–75 percentiles were used for continuous variables. Comparison of proportions was tested by χ^2 test or Fisher's exact test if the χ^2 conditions were not fulfilled. Nonparametric Mann-Whitney test was applied to assess differences between 2 continuous variables. Odds ratio (OR) for potential risks factors were calculated. All variables associated with having any allergic diseases in the past year ($p \leq 0.10$ in univariate analysis) were included in a backward stepwise multivariable regression model. The following binary variables were included: sex, keeping pets, passive and active smoking, cooking with oil, house aeration, presence of cockroach, presence of bedbug, mattress used, atopy history (mother, siblings, and personal), and positive SPT results. Age groups and education level were classified as scaled variables. Cooking with gas was not modeled because missing values. The model started with all suspected predictors and removed those with $p \geq 0.10$. The goodness of fit was verified with the Hosmer and Lemeshow method. All tests were done considering a double-sided significance level of 0.05.

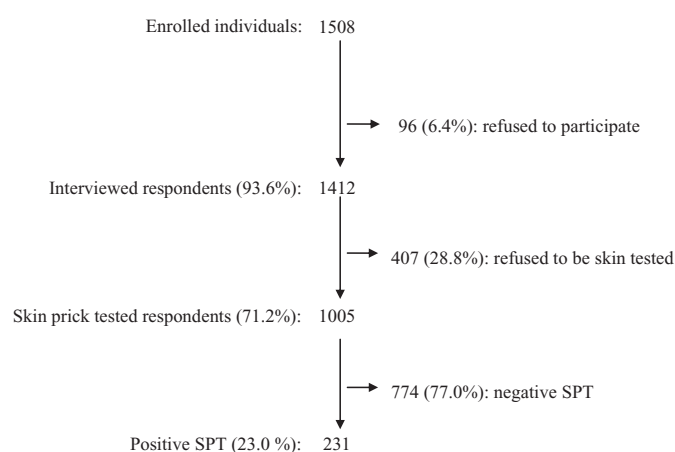


FIGURE 1. Flowchart of the participants. SPT = skin-prick testing.

Results

Characteristics of participants

Of 1508 screened individuals (Fig. 1), 1412 (737 females, 675 males) were interviewed. Of participants, 65.6% and 34.4% were from urban and rural health areas, respectively. The participants' mean age ($\pm$ SD) was 29 ($\pm$ 16) years ranging from 5 to 83 years. About 64.3% of households included at least 6 persons for a mean of 2 bedrooms. Other respondents' characteristics are shown in Table 1.

Participants with and without allergic diseases

Among all participants, 62.6% reported at least 1 allergic disease in the 12 previous months. Complaining individuals more frequently reported: personal and sibling history of atopy, insufficient house aeration, presence of bedbugs and cockroaches at home, active smoking, higher-level education, keeping pets, cooking with oil, and cooking with gas than the noncomplaining group. Other characteristics did not statistically differ between the 2 groups (Table 1). Table 2 shows the characteristics that are significantly different between urban and rural participants. Allergic diseases were found prevalent in urban area, except rhinitis, which was similar in 2 groups.

Prevalence of allergic diseases reported in the 12 previous months

The 12-month prevalence of rhinitis, rhinoconjunctivitis, wheeze, and skin itch-rash diseases are shown in Table 3. Females reported significantly rhinoconjunctivitis than males (27.3% vs 21.2%; $p = 0.008$). Other diseases were equally distributed between both sexes (all $p =$ nonsignificant [NS]). The 12-month prevalence of rhinitis (χ^2 for trend, $p < 0.001$) and rhinoconjunctivitis (χ^2 for trend, $p = 0.03$) decreased significantly with increasing age, whereas wheeze increased with age (χ^2 for trend, $p = 0.03$). However, skin itch-rash did not change with age (χ^2 for trend, $p = 0.07$). There is an overlap between different

TABLE 1. Characteristics of 1412 respondents with and without allergic diseases

	All respondents (N = 1412)		Individuals with allergic diseases		Individuals without allergic diseases		p ^a
	n	%	n	%	n	%	
Age group (years)							0.07
≤ 9	122	8.6	76	62.3	46	37.7	
10–19	318	22.5	198	62.3	120	37.7	
20–29	375	26.6	234	62.4	141	37.6	
30–39	256	18.1	170	66.4	86	33.6	
40–49	160	11.3	107	66.9	53	33.1	
50–59	107	7.6	65	60.7	42	39.3	
≥ 60	74	5.2	34	45.9	40	54.1	
Highest level of education reached							0.04
No education	59	4.2	32	54.2	27	45.8	
Primary school	352	24.9	202	57.4	150	42.6	
Secondary school	776	55.0	500	64.4	276	35.6	
University	225	15.9	150	66.7	75	33.3	
Profession							NS
Students	510	36.1	318	62.4	192	37.6	
Independent activities	728	51.6	449	61.7	279	38.3	
Employed	174	12.3	117	67.2	57	32.8	
Mattress used							NS
Sponge/cotton	1308	92.6	828	63.3	480	36.7	
Straw/herbs	104	7.4	56	53.8	48	46.2	
Presence of insects/rodents in house							
Mouse	1200	85.0	756	63.0	444	37.0	NS
Cockroach	1188	84.1	771	64.9	417	35.1	<0.001
Bedbug	415	29.4	279	67.2	136	32.8	0.02
Cooking with							
Embers	1283	90.9	808	63.0	475	37.0	NS
Electricity	825	58.4	516	62.5	309	37.5	NS
Wood	399	28.3	249	62.4	150	37.6	NS
Oil	103	7.3	77	74.8	26	25.2	0.008
Gas	8	0.6	8	100.0	0	0.0	0.03
Atopic history of							
Father	74	5.2	49	66.2	25	33.8	NS
Mother	97	6.9	69	71.1	28	28.9	NS
Siblings	214	15.2	164	76.6	50	23.4	<0.001
Personal	157	11.1	121	77.1	36	22.9	<0.001
House aeration							0.007
Insufficient	573	40.6	383	66.8	190	33.2	
Sufficient	839	59.4	501	59.7	338	40.3	
Alcohol	568	40.2	363	63.9	205	36.1	NS
Carpet	332	23.5	216	65.1	116	34.9	NS
Fan	692	49.0	424	61.3	268	38.7	NS

(Continued)

TABLE 1. Continued

	All respondents (N = 1412)		Individuals with allergic diseases		Individuals without allergic diseases		p ^a
	n	%	n	%	n	%	
Air conditioning	31	2.2	22	71.0	9	29.0	NS
Pets	381	27.0	258	67.7	123	32.3	0.016
Active smoke	275	19.5	196	71.3	79	28.7	0.001
Passive smoke	325	23.0	215	66.2	110	33.8	NS

Data expressed in number and (percentage by column for all respondents and by row for individuals with and without allergic diseases).

^aTesting difference between individuals with and without complaints.

NS = not significant.

TABLE 2. Difference between urban and rural participants

	Urban individuals (N = 926)		Rural individuals (N = 486)		p
	n	%	n	%	
Insufficient house aeration	422	45.6	151	31.1	<0.001
Mattress used					<0.001
Straw/herbs	43	4.6	61	12.6	
Sponge/cotton	883	95.4	425	87.4	
Cooking with					
Electricity	666	71.9	159	32.7	<0.001
Woods	159	17.2	240	49.4	<0.001
Embers	882	95.2	401	82.5	<0.001
Trees/flowers around house	686	74.1	439	90.3	<0.001
Active smoke	200	21.6	75	15.4	0.005
Alcohol	394	42.5	174	35.8	0.014
Complaints					
Rhinitis	273	29.5	162	33.3	0.136
Rhinoconjunctivitis	246	26.6	98	20.2	0.008
Wheeze	165	17.8	53	10.9	0.001
Skin itchy rash	48	5.2	39	8.0	0.035

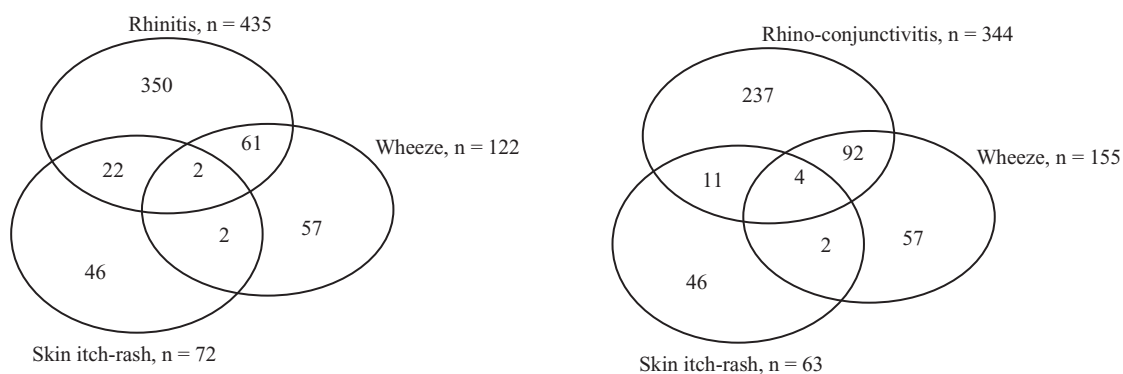


FIGURE 2. Association between rhinitis (A) or rhinoconjunctivitis (B) with other groups of allergic diseases in 884 participants complaining during the last year.

TABLE 3. Prevalence of 12-months allergic diseases reported by respondents according to SPT responses

	All respondents (N = 1412)		Respondents attending SPT (N = 1005)	Negative SPT (N = 774)	Positive SPT (N = 231)	<i>p</i> ^a
	n (%)	95% CI	n (%)	n (%)	n (%)	
Rhinitis	435(30.8)	28.4–33.2	298 (29.7)	201 (26.0)	97 (42.0)	<0.001
Rhinoconjunctivitis	344 (24.4)	21.1–26.6	292 (29.1)	193 (24.9)	99 (42.9)	<0.001
Wheeze	218 (15.4)	13.6–17.3	178 (17.7)	133 (17.2)	45 (19.5)	0.422
Skin itchy rash	87 (6.2)	4.9–7.6	67 (6.7)	49 (6.3)	18 (7.8)	0.435
No allergic diseases	528 (37.4)	34.9–39.9	338 (33.6)	311 (40.2)	27 (11.7)	<0.001
Any allergic diseases	884 (62.6)	60.1–65.1	667 (66.4)	463 (59.8)	204 (88.3)	<0.001

Percentages within a column do not sum to 100 because of specific diseases are not mutually exclusive.

^aTesting difference between negative and positive SPT.

CI = confidence interval; SPT = skin-prick testing.

allergic diseases reported during the previous 12 months (Fig. 2A and B). Of symptomatic individuals, 78.0%, 21.3%, and 0.7% reported 1, 2, and 3 allergic diseases, respectively. The respondents having 2 or 3 allergic diseases during the last 12 months more frequently were active smokers (28.3% vs 20.8%; $p = 0.03$), reported an atopy history of siblings (25.9% vs 17.4%; $p = 0.009$) and a personal history of atopy (30.0% vs 9.5%; $p < 0.001$) than individuals having 1 allergic disease. Wheezing was significantly associated with rhinoconjunctivitis than with rhinitis (27.9% vs 14.5%; $p < 0.001$), while skin itch-rash was as frequently associated with rhinitis and rhinoconjunctivitis (4.4% vs 5.5%; $p = \text{NS}$).

Allergic diseases according to SPT responses

From respondents who underwent SPT, 23.0% showed positive responses to at least 1 allergen with DPT and cockroach being the prevalent allergens (Table 4). Sensitization was higher among urban individuals than rural (25.1% vs 19.0%; $p = 0.028$). Atopic history of siblings (17.5% vs 11.2%; $p = 0.004$), personal history of atopy (12.7% vs 7.6%; $p = 0.007$), cooking with wood (29.9% vs 24.3%; $p = 0.04$), and cooking with oil (8.4% vs 4.7%; $p = 0.02$) were statistically more reported by individuals who underwent SPT. In contrast, having carpet (28.0% vs 21.7%; $p = 0.01$), using fan (55.3% vs 46.5%; $p = 0.003$) and using air-conditioning (3.4% vs 1.7%; $p = 0.04$) were predominantly prevalent in those who did not undergo SPT. Respondents who underwent SPT reported more frequently rhinoconjunctivitis (29.1% vs 12.8%; $p < 0.001$) and wheezing (17.7% vs 9.8%; $p < 0.001$) in the 12 previous months than those who did not. Moreover, rhinitis (29.7% vs 33.7%) and skin itchy-rash (6.7% vs 4.9%) were identically reported in both groups (all $p = \text{NS}$).

Prevalence and characteristics of AR and NAR

Of 590 individuals reported rhinitis/rhinoconjunctivitis during the previous 12 months, 33.2% and 66.8% had positive and negative SPT, respectively. The 12-month preva-

TABLE 4. Prevalence of allergens among 1005 skin-prick-tested participants

Allergens	Skin-prick-tested participants (N = 1005)	
	n (%)	95% CI
<i>Dermatophagoides pteronyssinus</i>	128 (12.7)	10.7–14.8
Cockroach	110 (10.9)	9.0–12.9
Crab	26 (2.6)	1.7–3.8
Grass pollen mix	15 (1.5)	0.4–2.5
Rabbit	14 (1.4)	0.8–2.3
<i>Alternaria alternata</i>	9 (0.9)	0.4–1.7
Soybean	8 (0.8)	0.4–1.6
Dog	6 (0.6)	0.2–1.3
<i>Aspergillus mix</i>	6 (0.6)	0.2–1.3
Cat	3 (0.3)	0.1–0.9
Guinea pig	3 (0.3)	0.1–0.9
<i>Artemisia vulgaris</i>	3 (0.3)	0.1–0.9
<i>Cupressus semperviens</i>	2 (0.2)	0.0–0.7
Wheat flour	2 (0.2)	0.0–0.7
<i>Parietaria judaica</i>	1 (0.1)	0.0–0.6
At least 1 allergen	231 (23.0)	20.4–25.6

CI = confidence interval.

lence of AR and NAR was 13.9% (95% CI, 12.1–15.7) and 27.9% (95% CI, 25.6–30.2), respectively, among all respondents. Keeping pets at home (34.7% vs 24.6%; $p = 0.01$) was predominantly associated with AR compared to the NAR group. AR was as frequent in males (33.8%) as females (32.7%), $p = \text{NS}$. Despite the fact that AR did not change according to age groups (χ^2 for trend, $p = \text{NS}$); 57.1% of AR individuals are less than 30 years old. Other characteristics did not differ between AR and NAR groups (all $p = \text{NS}$, data not shown). Table 5 shows that 35.2% of AR individuals reported persistent and moderate to severe

TABLE 5. Duration and severity (ARIA classification) of 196 respondents with 12-month allergic rhinitis and positive skin-prick-testing

	Moderate/severe	Mild	Total
Persistent	69 (35.2)	25 (12.8)	94 (48.0)
Intermittent	48 (24.5)	54 (27.5)	102 (52.0)
Total	117 (59.7)	79 (40.3)	196 (100.0)

Data expressed as n (%).

ARIA = Allergic Rhinitis and Its Impact on Asthma.

symptoms, while 27.5% reported intermittent and mild illness.

Determinants of having any allergic diseases

The factors associated with having any allergic diseases in multivariate analysis are shown in Table 6. Active smoking, presence of cockroach at home, atopy history of siblings, personal history of atopy, using straw or herbs mattress, and positive SPT responses independently increased the risk of having any allergic diseases during the 12 previous months.

Discussion

This first survey in the general population of Kinshasa demonstrated a high prevalence of allergic diseases, with 30.8%, 24.4%, 15.4%, and 6.2% for rhinitis, rhinoconjunctivitis, wheezing, and skin itch-rash, respectively. Allergic diseases were equally distributed over different age groups. Rhinoconjunctivitis and wheezing were significantly higher among urban individuals. Sensitization was reported in about one-quarter of skin prick-tested participants, with DPT and cockroach being the major allergens. The current rhinitis rate is lower than the 37.8% reported in Morocco, where 58.1% of rhinitis individuals reported simultaneous conjunctivitis symptoms.¹⁴ Adults Nigerians¹⁵ aged from 18 to 45 years old reported 29.6% of AR symptoms. Our 12-month prevalence of rhinoconjunctivitis and wheeze are 2 times higher than prevalence reported previously among 13- to 14-year-old schoolchildren of Kinshasa.⁷ The present findings corroborate the fact that allergic symptoms are increasing in Africa as reported in some African countries^{8–10} where Isaac phase I and III were done. However, the current 12-month prevalence of rhinoconjunctivitis (Table 7) is lower than reported in other African cities.⁷ Furthermore, our 12-month prevalence of wheeze is in agreement with reports from Grand Tunis and Casablanca (Table 7) but differs to the prevalence reported elsewhere.⁷ The current skin itch-rash prevalence was lower than eczema reported in 13- to 14-year-old schoolchildren in Kinshasa and other African cities (Table 7). Govaere et al.¹⁶ reported 23.3% of eczema in Belgian schoolchildren, which is a lot higher than current skin itch-rash rate. This discrepancy is in accordance with the worldwide variability of allergic diseases in relation to different environmental

TABLE 6. OR of determinants associated with any allergic diseases in Kinshasa (multivariate analysis)*

Determinants	Adjusted OR	95% CI	Z-test p value
Sex			0.06
Female	1		
Male	0.7	0.5–1.0	
Age groups (years)			
≤9	1.0		
10–19	0.8	0.4–1.4	0.386
20–29	0.6	0.3–1.2	0.172
30–39	0.6	0.3–1.3	0.189
40–49	0.7	0.3–1.5	0.347
50–59	0.6	0.3–1.2	0.146
≥60	0.3	0.1–0.6	0.001
Education level			
No education	1		
Primary school	0.7	0.3–1.6	0.416
Secondary school	1.4	0.6–3.2	0.387
University	1.3	0.5–3.2	0.540
Mattress used			0.02
Sponge/cotton	1		
Straw/herbs	2.0	1.1–3.4	
Active smoking			0.01
No	1		
Yes	1.7	1.1–2.6	
Cockroach in home			0.01
No	1		
Yes	1.7	1.1–2.4	
Atopy history of siblings			0.004
No	1		
Yes	2.0	1.2–3.1	
Personal history of atopy			0.02
No	1		
Yes	1.9	1.1–3.2	
Positive SPT results			<0.001
No	1		
Yes	5.5	3.5–8.6	

*Goodness of fit by Hosmer and Lemeshow method: $p = 0.96$. Keeping pets, passive smoking, cooking with oil, self-evaluation house aeration, bedbug, and atopy history of mother were removed from the model.

CI = confidence interval; OR = odds ratio; SPT = skin-prick test.

factors. The high prevalence of allergic diseases in urban areas could be attributed to the increased exposure to air pollution, reduced incidence of infections, sedentary behavior, and higher socioeconomic level associated with urbanization diet and lifestyle.^{17,18} It has been suggested that the

TABLE 7. Prevalence of rhinitis/rhinoconjunctivitis, wheeze, and eczema in African cities

Location (reference)	Rhinitis	Rhinoconjunctivitis	Wheeze	Eczema
Morocco ^a	37.8			
Kinshasa ^b		11.8	7.5	10.9
Brazzaville ^b		33.3	19.9	16.2
Casablanca ^b		28.1	16.0	23.0
Urban Ivory Coast ^b		27.6	19.3	18.2
Nairobi ^b		19.8	18.0	14.9
Yaounde ^b		8.9	5.7	7.2
Ibadan ^b		16.4	13.0	7.7
Lome ^b		14.6		
Grand Tunis ^b		14.7	15.4	13.0
Cape Town ^b		20.7	20.3	13.3
Kenya ^c	25.3			

^aEl Kettani et al.¹⁴ (2009).^bAit-Khaled et al.⁷ (2007).^cEsamai et al. (2002).

increased hygiene and healthcare in western countries has altered the pattern of exposure to infection in early life, in such a way to predispose the immune system toward an atopic response. The urban area of Kinshasa is mainly polluted by road engineering, uncontrolled expansion of old vehicles, biomass combustion, and light industries. Further, a high level of lead was reported in vegetables growing near urban roads and in the blood of urban inhabitants of Kinshasa compared to rural areas.^{19,20} The reported increasing allergic diseases surveyed in Kinshasa is real, possibly due to the pollution and environmental factors which can trigger allergic symptoms in predisposed individuals. AR in the present work was found more frequently in individuals less than 30 years old. Other studies confirmed this observation that AR is common in childhood, peaks in the early 20s, and then decreases.^{1,15} Our sensitization rate was not far from the 26.5% and 24.9% reported in Rwanda²¹ and Italy, respectively,²² where allergy to house dust mites remains prevalent.

Different factors were associated with having allergic diseases such as active smoking, presence of cockroach in home, using straw or herbs as mattress, positive SPT results, atopy history of siblings, and personal history of atopy. Environmental characteristics in poor cities such as Kinshasa, where straw or herbs are used as mattresses, encourages cockroaches, bedbugs, and mites to thrive and

could explain the risk for allergic symptoms. The association between cockroach allergen in room and symptoms of asthma or wheezing^{23,24} has been shown before. It was demonstrated that the high level of cockroach allergen seem to be associated with lower socioeconomic status.²⁵ Smoking is known as a factor altering mucociliary clearance, causing eye irritation and allergic like-inflammation in the nasal mucosa even in the absence of atopy.^{26,27} About one-third of AR individuals expressed persistent and moderate/severe symptoms. Allergic complaints could have a significant patient discomfort and impairment in work productivity, school performance, sleep, and social interactions similar to other chronic conditions.²⁸ This high rate of bothersome disease without medical help in our series could be explained by low income and the absence of medical insurance in our country.

The present study has some limitations. First, the interviewers could influence in some extent the respondents during face-to-face questioning. Second, exotic allergens like pollens not necessary found in DRC were used. This could underestimate the prevalence of positive SPT results and AR rate, especially in monosensitized individuals. In the coming years we expected to use the specific tropical allergens in a screening tool. Third, the current study was conducted during the rainy season, making the results not able to be extrapolated all year round. This choice was done to avoid the frequent common cold because of the cold temperature and abundant dust and air pollution related to the dry season. Nevertheless, the present work is the first to provide a detailed report on allergic diseases in randomly selected Congolese individuals living in Kinshasa.

Conclusion

This study demonstrates that atopic conditions were common in Kinshasa particularly in urban areas, with a negative impact on quality of life. Greater awareness of allergic diseases is needed for effective diagnosis and management in developing countries. 

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