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Sensitisation to mites in a group of patients with asthma in Yaounde, Cameroon: a cross-sectional study

Short title: Mites sensitisation in asthma

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ABSTRACT

Objectives: Sensitisation of asthmatic patients to mites in sub-Saharan Africa has been less described. The aim of this study was to assess the prevalence and determinants of sensitisation to mites in asthmatic adolescents and adults in Yaounde, Cameroon.

Design: This was cross-sectional study. Logistic regressions models were employed to investigate the determinants of sensitisation to mites.

Setting: This study was carried out at the Jamot Hospital and CEDIMER private centre, in Yaounde, capital city of Cameroon.

Participants: All asthmatic patients received in consultations from January 2012 to June 2013 and in whom prick-skin tests for perennial aeroallergens were performed, were included.

Outcome measures: prevalence of sensitisation to mites and associated factors.

Results: In all 201 patients (132 being women, 65.7%), with a median age of 36 (25^{th}-75^{th} percentiles: 20-54) years were included, with 135 (67.2%) having a positive skin test for mites. Sensitisation to *Dermatophagoïdes pteronyssinus*, *Dermatophagoides farinae* and *Blomia tropicalis* were found in 53.2%, 49.8% and 47.8% of the patients respectively. Intermittent rhinitis (16.3% vs. 7.6%) and persistent rhinitis (43.0% vs. 22.7%) were more frequent in sensitised patients than in the non-sensitised ones ($p<0.010$). Independent allergologic determinants of sensitisation to mites were sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence intervals 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

Conclusions: Sensitisation to mites was found in about $2/3^{rd}$ of asthmatic patients in this setting, with a frequent multiple sensitisations to *Alternaria alternata* and *Blattella germanica*. Systematically investigating asthmatic patients for mites' sensitisation and determinants will help optimising the care in this setting by combining the aetiological treatment for the allergy with symptomatic treatment for asthma, in order to modify the natural course of the disease.

Key words – asthma, mites, sensitisation, Cameroon

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ARTICLE SUMMARY

Article focus

- To investigate current prevalence and determinants of sensitisation to mites in patients with asthma in a sub-Saharan Africa country.

Key messages

- Two out of three asthmatic patients in Yaounde have a sensitisation to mites;
- Intermittent and persistent rhinitis are more frequent in patients sensitised to mites;
- Sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

Strengths and limitations

- This was a first study exploring sensitization to mites in Cameroon.
- This study uses robust methods to assess determinants of sensitisation in asthma patients.
- The study was conducted only in two centres

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INTRODUCTION

Allergy to aeroallergens is one of the determining factors for the occurrence of asthma.[1-4] In most parts of the world, mites are the commonest source of perennial respiratory allergies.[4-6] Of the many species of mites known to date, only a few are responsible for respiratory allergies. These include for dust mites the following: *Dermatophagoides pteronyssimus (DP), Dermatophagoides farinae (DF) et Euroglyphus maynei* and for storage mites: *Blomia tropicalis* (BT), *Lepidoglyphus destructor, Glycyphagus domesticus, Tyrophagus putrescenciae, Acarus siro.*[5, 7, 8]

The prevalence of sensitisation to different species of mites varies across regions in the world, mostly influenced by differences in climatic and environmental conditions.[9-12] Allergenic sensitisation and particularly sensitisation to mites has been less investigated in patients with respiratory atopy in sub-Saharan Africa, causing the management of these patients to be less than optimal in this part of the world. The aims of the current study was to determine the prevalence of sensitisation to mites and the distribution of such sensitisation across the three commonest mites (DP, DF, BT) among adolescents and adults with asthma in Yaounde, Cameroon; and additionally, to investigate the determinants of sensitisation to mites in these patients.

MATERIALS AND METHODS

Study setting and participants

The study was conducted in the outpatient department of the pneumology service of the Yaounde Jamot Hospital (YJH) and the CEDIMER private centre. YJH is a public hospital and the referral centre for chest diseases for the capital city of Cameroon (Yaounde) and surrounding areas. CEDIMER is a private medical practice which offers ambulatory care to patients in Yaounde. The study was approved by the ethics committee of the two participating health facilities.

Methods

This was a cross-sectional study involving all consenting adolescents (age ≥10 years) and adults Cameroonians followed for asthma from January 2012 through June 2013 (18 months). Diagnosis of asthma was confirmed by a specialist physician, and was based on the criteria of the Global Initiative for Asthma (GINA).[13] Demographic and clinical data were collected including: age, sex, ethnic group, known duration of asthma, family history of asthma, other existing allergic conditions (rhinitis, conjunctivitis, and atopic dermatitis) and smoking.

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Diagnosis of rhinitis was based on the following nasal symptoms: clear rhinorrhoea, nasal obstruction, sneezing and itching. Persisting rhinitis was retained for a patient who reported symptoms for at least four days per week and during four weeks or more; otherwise rhinitis was considered as intermittent.[14] Diagnosis of atopic dermatitis was based on the criteria of the United Kingdom Working Party.[15]

The control of asthma was assessed with the use of the Asthma Control Questionnaire (ACQ).[16, 17] Asthma was considered to have been insufficiently controlled in the week preceding the inclusion, in the presence of an ACQ score of one or greater.[16, 17] The baseline forced expiratory volume in the first second (FEV1) was recorded for all patients in the absence of any exacerbation. Predicted FEV1 was based on the 2012 equations of the Global Lung Initiative for Blacks subjects.[18]

Prick-test and standardised allergenic extracts of Stallergenes Laboratories (Anthony, France) were used for skin tests. The following perennial aeroallergens were tested: mites (*Dermatophagoïdes pteronyssinus*, *Dermatophagoïdes farinae* and *Blomia tropicalis*), moist (*Alternaria alternata*), *Blattella germanica*, cat dander and dog dander. Dilution solution of the allergenic extracts and histamine were used respectively as negative and positive controls. A prick test was considered positive if the diameter of the papula was greater than 3 mm, relative to the diameter of the negative control; or 50% that of the positive control. Patients for whom skin allergologic tests were not performed were excluded from the study.

Statistical methods

Data were analysed with the use of SPSS statistical software v.17 for Windows (SPSS Inc, Chicago, USA). Results are reported as mean (standard deviation) or median (25^{th}-75^{th} percentiles) and count (percentages). The chi square and Fisher exact tests were used to compare qualitative variables and the Mann-Whitney U test used for quantitative variables. Logistic regressions models were employed to investigate the determinants of sensitisation to mites. A p-value <0.05 was used to characterise statistically significant results.

RESULTS

General characteristics of the study population

Of the 209 asthmatic adolescent and adults received in consultations during the inclusion period, eight (3.8%) did not receive the skin allergologic tests and were excluded. Clinical and demographic characteristics for the 201 patients in the final analytic sample are summarised in Table 1. They comprised 132 (65.7%) women and 69 (34.3) men and the median age (25^{th}-

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75th percentiles) was 36 (20.5-54.0) years. Twenty-seven (13.4%) patients had intermittent rhinitis and 73 (36.3%) had persistent rhinitis. Asthma was not well controlled during the last week preceding the inclusion in 77 (42.8%) patients and the mean FEV1 (standard deviation) was 84.1% (22.3%), Table 1.

Prevalence of the sensitisation to mites

The prevalence of the sensitisation to the three mites tested in the current study was 67.2% (135/201), with a 95% confidence interval of 60.7-73.7%. The prevalence of the sensitisation to each of the species was 53.2% for DP, 49.8% for DF and 47.8% for BT. The distribution of the sensitisation of our participants to different species of mite is presented in Table 2. Thirty-seven (27.4%) patients had an isolated sensitisation to one of the three species of mites and mono-sensitisation to mites (i.e. absence of sensitisation to other perennial aeroallergens) was present in 70 (51.9%) patients. Isolated sensitisation to BT was the most frequent and was found in 15 (11.1%) patients. The most common sensitisation to two species of mites was the co-sensitisation to DP and DF, which was found in 17 (12.6%) patients. Seventy (51.9%) patients had a sensitisation to the three species of mites tested.

Determinants of the sensitisation to mites

The prevalence of the sensitisation to mites was similar between women and men (63.6% vs. 73.9%, p=0.157) and the median age was similar between sensitised patients and non-sensitised ones (33 vs. 40 years, p=0.204). Sensitised patients were more likely to have intermittent (16.3% vs. 7.6%) or persisting rhinitis (43.0% vs. 22.7%) than non-sensitised patients (p<0.001 for the distribution of rhinitis). The frequency of asthma control and mean FEV1 were not significantly different between sensitised and non-sensitised patients (Table 1). In multivariable logistic regression analyses, the main determinants of sensitisation to mites were: sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence interval 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

DISCUSSION

This cross-sectional study conducted in a sub-Saharan African country has revealed that: 1) two out of three asthmatic patients in Yaounde have a sensitisation to mites; 2) about a third of patients have an isolated sensitisation to one of the three mites tested; 3) intermittent and persistent rhinitis are more frequent in patients sensitised to mites; 4) sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

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Mites are minuscule cosmopolite arthropods which leave and prosper in humid zones (optimal humidity of 60-80%) and at an optimal temperature of 20 to 30°C.[5, 8] Of the hundreds of species of mites identified so far, a few are responsible for over 90% of allergenic sensitisation.[5] In most parts of the world, DP and DF account for over 70-80% of sensitisations due to mites.[7] However, during the last decade, sensitisation to BT has been increasingly reported in inter-tropical and temperate zones.[10, 19] The prevalence of the sensitisation to mites to difference species of mites among atopic patients varies substantially across regions around the world. For instance, the prevalence of sensitisation to mites in patients with asthma varies between 31% and 88% in Europe,[9] between 39% and 56% in America,[9, 10] and between 53 to 88% in Asia and Oceania.[9, 11, 12] The prevalence in our study was 67.2%, with a sensitisation to each of the three species (DP, DF and BT) found in about half of our patients. Inclusion of these three mites in the pool of allergologic test appears to be primordial in this setting, considering the fact that more than a third of the patients had an isolated sensitisation to one of the three mites. This could possibly reflect a cross-sensitisation due to shared allergens across species, or a true multiple sensitisation to major allergens of these mites.[7]

While about half of our patients with asthma had rhinitis, the proportion was much higher among patients sensitised to mites, and regardless of the clinical form of rhinitis. This suggests that respiratory allergy to mites affects the entire respiratory tract including both the upper and the lower respiratory airways. We did not find other significant differences in the clinical characteristics between patients who were sensitised to mites and those who were not. For instance, sensitisation to mites was not associated with age at the clinical onset of asthma, sex, family history of asthma, ethnicity or alteration of lung functions. Therefore, unlike the presence of rhinitis, other clinical variables may not be useful for the screening of patients for allergy to mites.

In our sample, sensitisation to mites was independently associated with sensitisation to *Alternaria* and sensitisation to *Blattella germanica*. Indeed, a third and patients sensitised to mites were also sensitised to *Blattella germanica*. These associations at least in part could be explained by the cross reactivity between mites and cockroaches via tropomyosin, but could also reflect multiple sensitisation.[20-22] The association between sensitisation to mites and sensitisation to *Alternaria* likely reflects a multiple sensitisation, considering the phylogenic distance between the two species. Not so much has been reported on this association which deserved further investigation and confirmation in other setting in tropical Africa.

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This study has some limitations including the reliance on skin tests alone to diagnose sensitisation and enrolment of patients from only two health facilities in the city of Yaounde. Indeed, measurements of specific immunoglobulin E could reveal more sensitisations, in particular in patients with hyporeactivity to skin tests. The two recruitment health facilities for this study are referral centres for chest diseases in Yaounde. It is therefore possible that patients recruited from these facilities are representative of the population of patients with asthma seen across all health facilities in the city.

In conclusion, sensitisation to mites is frequent among patients with asthma in Yaounde, where it is frequently associated with a sensitisation to *Alternaria* and/or sensitisation to *Blattella germanica*. The presence of rhinitis in patients with asthma is suggestive of a sensitisation to mites. Systematically investigating patients with asthma for an allergy to mites as well as the determinants of such an allergy will help optimising the care of patients with asthma in this setting through a combination an aetiological treatment for the allergy with a symptomatic treatment for asthma, in order to modify the natural history of the disease.

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Competing interests: None for all authors.

Ethics approval: Ethics approval was provided by the Institutional Review Board of Yaounde Jamot Hospital and CEDIMER medical centre.

Contributors: EWPY conceived the study, collected data, co-analysed the data and drafted the manuscript. APK contributed to study design, data analysis, drafting and critical revision of the manuscript. CK supervised data collection and critically revised the manuscript. All authors approved the final version of the manuscript.

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Table 1: Demographic and clinical characteristics of asthmatic patients in Yaounde according to the sensitisation to mite

Characteristics	Overall	Mite sensitisation	No mite sensitisation	p
N	201	135	66	
Sex				0.157
Men, n (%)	69 (34.3)	51 (37.8)	18 (28.3)	
Women, n (%)	132 (65.7)	84 (62.2)	48 (72.7)	
Median age, years (25^{th}-75^{th} percentiles)	36 (20.5-54)	33 (20-51)	40 (21-56)	0.204
Ethnic groups				0.604
Semi-bantou, n (%)	141 (70.9)	92 (68.1)	49 (74.2)	
Bantou, n (%)	42 (21.1)	29 (21.5)	13 (19.7)	
Fulani/Sudanese, n (%)	16 (8.0)	12 (8.9)	4 (6.0)	
Others, n (%)	2 (1.0)	2 (1.5)	0 (0)	
Median age at the onset of asthma, years (25^{th}-75^{th} percentiles)	20 (10-39)	20 (10-36)	21.5 (12.5-43.5)	0.475
Rhinitis				<0.001
None, n (%)	101 (50.2)	55 (40.7)	46 (69.7)	
Intermittent rhinitis, n (%)	27 (13.4)	22 (16.3)	5 (7.6)	
Persistent rhinitis, n (%)	73 (36.3)	58 (43.0)	15 (22.7)	
Atopic dermatitis				>0.999
Yes, n (%)	4 (2.0)	3 (2.2)	1 (1.5)	
No, n (%)	197 (98.0)	132 (97.8)	65 (98.5)	
Smoking				0.200
Non-smoker, n (%)	194 (96.5)	129 (95.6)	65 (98.5)	
Smoker/ex-smoker, n (%)	3 (1.5)	2 (1.5)	1 (1.5)	
Second hand smoker, n (%)	4 (2.0)	4 (3.0)	0 (0)	
Family history of asthma				0.250
Yes, n (%)	37 (18.4)	28 (20.7)	9 (13.6)	
No, n (%)	164 (81.6)	107 (79.3)	57 (86.4)	
Asthma control				0.748
Well controlled, n (%)	107/184 (58.2)	76/129 (58.9)	31/55 (56.4)	
Not well controlled, n (%)	77/184 (41.8)	53/129 (41.1)	24/55 (43.6)	
FEV1, %, mean (SD)	84.1(22.3)	84,2 (22.3)	88.4 (21.7)	0.294

SD, standard deviation

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Table 2: Frequency and association of sensitisation to mites in asthma patients in Yaounde, Cameroon

Type of mite sensitisation	Frequency (%)
N	135 (100)
Monosensitisation to *Dermatophagoïdes pteronyssinus*	13 (9.6)
Monosensitisation to *Dermatophagoïdes farinae*	9 (6.7)
Monosensitisation to *Blomia tropicalis*	15 (11.1)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Dermatophagoïdes farinae*	17 (12.6)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Blomia tropicalis*	7 (5.2)
Sensitisation to *Dermatophagoïdes farinae* and *Blomia tropicalis*	4 (3.0)
Sensitisation to 3 mites	70 (51.9)

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Table 3 : Univariable and multivariable analysis of perennial allergenic factors associated to mite sensitisation

Factors	Crude odds ratio (IC à 95%)	p	Adjusted Odds ratio (95% CI)	p
Sensitisation to Alternaria	21.03 (2.81-157.51)	0.003	14.98 (1.96-114.4)	0.009
Sensitisation to cockroaches	5.00 (2.01-12,45)	0.001	3.48 (1.34-9.00)	0.010
Sensitisation to cat dander	7.52 (0.97-58.48)	0.054	5.96 (0.73-48.86)	0.096
Sensitisation to dog dander	0.98 (0.24-4.03)	0.974	/	/

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	pages
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	*1,2*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	*2*
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	*4*
Objectives	3	State specific objectives, including any prespecified hypotheses	*4*
Methods			
Study design	4	Present key elements of study design early in the paper	*1,4*
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	*4,5*
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	*4,5*
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	*5*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5*
Bias	9	Describe any efforts to address potential sources of bias	*5,8*
Study size	10	Explain how the study size was arrived at	*Convenience sample*
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	*5*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	*5*
		(*b*) Describe any methods used to examine subgroups and interactions	*5*
		(*c*) Explain how missing data were addressed	*Not applicable*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	*Not applicable*
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	*5*
		(b) Give reasons for non-participation at each stage	*5*
		(c) Consider use of a flow diagram	*/*
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	*5,6*
		(b) Indicate number of participants with missing data for each variable of interest	*/*
Outcome data	15*	Report numbers of outcome events or summary measures	*6*

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	*6*
		(*b*) Report category boundaries when continuous variables were categorized	*Not applicable*
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	/
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	/
Discussion			
Key results	18	Summarise key results with reference to study objectives	*6*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	*8*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	*6,7,8*
Generalisability	21	Discuss the generalisability (external validity) of the study results	*8*
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	*8*

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Sensitisation to mites in a group of patients with asthma in Yaounde, Cameroon: a cross-sectional study

Short title: Mites sensitisation in asthma

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ABSTRACT

Objectives: Sensitisation of asthmatic patients to mites in sub-Saharan Africa has been less described. The aim of this study was to assess the prevalence and determinants of sensitisation to mites in asthmatic adolescents and adults in Yaounde, Cameroon.

Design: This was cross-sectional study. Logistic regressions models were employed to investigate the determinants of sensitisation to mites.

Setting: This study was carried out at the Jamot Hospital and CEDIMER private centre, in Yaounde, capital city of Cameroon.

Participants: All asthmatic patients received in consultations from January 2012 to June 2013 and in whom prick-skin tests for perennial aeroallergens were performed, were included.

Outcome measures: prevalence of sensitisation to mites and associated factors.

Results: In all 201 patients (132 being women, 65.7%), with a median age of 36 (25^{th}-75^{th} percentiles: 20-54) years were included, with 135 (67.2%) having a positive skin test for mites. Sensitisation to *Dermatophagoïdes pteronyssinus*, *Dermatophagoides farinae* and *Blomia tropicalis* were found in 53.2%, 49.8% and 47.8% of the patients respectively. Intermittent rhinitis (16.3% vs. 7.6%) and persistent rhinitis (43.0% vs. 22.7%) were more frequent in sensitised patients than in the non-sensitised ones ($p<0.010$). Independent allergologic determinants of sensitisation to mites were sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence intervals 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

Conclusions: Sensitisation to mites was found in about $2/3^{rd}$ of asthmatic patients in this setting, with a frequent multiple sensitisations to *Alternaria alternata* and *Blattella germanica*. Systematically investigating asthmatic patients for mites' sensitisation and determinants will help optimising the care in this setting by combining the aetiological treatment for the allergy with symptomatic treatment for asthma, in order to modify the natural course of the disease.

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ARTICLE SUMMARY

Article focus

- To investigate current prevalence and determinants of sensitisation to mites in patients with asthma in a sub-Saharan Africa country.

Key messages

- Two out of three asthmatic patients in Yaounde have a sensitisation to mites;
- Intermittent and persistent rhinitis are more frequent in patients sensitised to mites;
- Sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

Strengths and limitations

- This was a first study exploring sensitization to mites in Cameroon.
- This study uses robust methods to assess determinants of sensitisation in asthma patients.
- The study was conducted only in two centres

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INTRODUCTION

Allergy to aeroallergens is one of the determining factors for the occurrence of asthma.[1-4] In most parts of the world, mites are the commonest source of perennial respiratory allergies.[4-6] Of the many species of mites known to date, only a few are responsible for respiratory allergies. These include for dust mites the following: *Dermatophagoides pteronyssimus (DP), Dermatophagoides farinae (DF) et Euroglyphus maynei* and for storage mites: *Blomia tropicalis* (BT), *Lepidoglyphus destructor, Glycyphagus domesticus, Tyrophagus putrescenciae, Acarus siro.*[5, 7, 8]

The prevalence of sensitisation to different species of mites varies across regions in the world, mostly influenced by differences in climatic and environmental conditions.[9-12] Allergenic sensitisation and particularly sensitisation to mites has been less investigated in patients with respiratory atopy in sub-Saharan Africa, causing the management of these patients to be less than optimal in this part of the world. The aims of the current study was to determine the prevalence of sensitisation to mites and the distribution of such sensitisation across the three commonest mites (DP, DF, BT) among adolescents and adults with asthma in Yaounde, Cameroon; and additionally, to investigate the determinants of sensitisation to mites in these patients.

MATERIALS AND METHODS

Study setting and participants

The study was conducted in the outpatient department of the pneumology service of the Yaounde Jamot Hospital (YJH) and the CEDIMER private centre. YJH is a public hospital and the referral centre for chest diseases for the capital city of Cameroon (Yaounde) and surrounding areas. CEDIMER is a private medical practice which offers ambulatory care to patients in Yaounde. The study was approved by the ethics committee of the two participating health facilities.

Methods

This was a cross-sectional study involving all consenting adolescents (age ≥10 years) and adults Cameroonians followed for asthma from January 2012 through June 2013 (18 months). Diagnosis of asthma was confirmed by a specialist physician, and was based on the criteria of the Global Initiative for Asthma (GINA).[13] Demographic and clinical data were collected including: age, sex, ethnic group, known duration of asthma, family history of asthma, other existing allergic conditions (rhinitis, conjunctivitis, and atopic dermatitis) and smoking.

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Diagnosis of rhinitis was based on the following nasal symptoms: clear rhinorrhoea, nasal obstruction, sneezing and itching. Persisting rhinitis was retained for a patient who reported symptoms for at least four days per week and during four weeks or more; otherwise rhinitis was considered as intermittent.[14] Diagnosis of atopic dermatitis was based on the criteria of the United Kingdom Working Party.[15]

The control of asthma was assessed with the use of the Asthma Control Questionnaire (ACQ).[16, 17] Asthma was considered to have been insufficiently controlled in the week preceding the inclusion, in the presence of an ACQ score of one or greater.[16, 17] The baseline forced expiratory volume in the first second (FEV1) was recorded for all patients in the absence of any exacerbation. Predicted FEV1 was based on the 2012 equations of the Global Lung Initiative for Blacks subjects.[18]

Prick-test and standardised allergenic extracts of Stallergenes Laboratories (Anthony, France) were used for skin tests. The following perennial aeroallergens were tested: mites (*Dermatophagoïdes pteronyssinus*, *Dermatophagoïdes farinae* and *Blomia tropicalis*), moist (*Alternaria alternata*), *Blattella germanica*, cat dander and dog dander. Dilution solution of the allergenic extracts and histamine were used respectively as negative and positive controls. A prick test was considered positive if the diameter of the papula was greater than 3 mm, relative to the diameter of the negative control; or 50% that of the positive control. Patients for whom skin allergologic tests were not performed were excluded from the study.

Statistical methods

Data were analysed with the use of SPSS statistical software v.17 for Windows (SPSS Inc, Chicago, USA). Results are reported as mean (standard deviation) or median (25^{th}-75^{th} percentiles) and count (percentages). The chi square and Fisher exact tests were used to compare qualitative variables and the Mann-Whitney U test used for quantitative variables. Logistic regressions models were employed to investigate the determinants of sensitisation to mites. A p-value <0.05 was used to characterise statistically significant results.

RESULTS

General characteristics of the study population

Of the 209 asthmatic adolescent and adults received in consultations during the inclusion period, eight (3.8%) did not receive the skin allergologic tests and were excluded. Clinical and demographic characteristics for the 201 patients in the final analytic sample are summarised in Table 1. They comprised 132 (65.7%) women and 69 (34.3) men and the median age (25^{th}-

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75th percentiles) was 36 (20.5-54.0) years. Twenty-seven (13.4%) patients had intermittent rhinitis and 73 (36.3%) had persistent rhinitis. Asthma was not well controlled during the last week preceding the inclusion in 77 (42.8%) patients and the mean FEV1 (standard deviation) was 84.1% (22.3%), Table 1.

Prevalence of the sensitisation to mites

One hundred and forty (69.7%) patients had sensitisation to at least one of non-pollinic allergens. The prevalence of the sensitisation to the three mites tested in the current study was 67.2% (135/201), with a 95% confidence interval of 60.7-73.7%. The prevalence of the sensitisation to each of the species was 53.2% for DP, 49.8% for DF and 47.8% for BT. The distribution of the sensitisation of our participants to different species of mite is presented in Table 2. Thirty-seven (27.4%) patients had an isolated sensitisation to one of the three species of mites and mono-sensitisation to mites (i.e. absence of sensitisation to other perennial aeroallergens) was present in 70 (51.9%) patients. Isolated sensitisation to BT was the most frequent and was found in 15 (11.1%) patients. The most common sensitisation to two species of mites was the co-sensitisation to DP and DF, which was found in 17 (12.6%) patients. Seventy (51.9%) patients had a sensitisation to the three species of mites tested.

Determinants of the sensitisation to mites

The prevalence of the sensitisation to mites was similar between women and men (63.6% vs. 73.9%, p=0.157) and the median age was similar between sensitised patients and non-sensitised ones (33 vs. 40 years, p=0.204). Sensitised patients were more likely to have intermittent (16.3% vs. 7.6%) or persisting rhinitis (43.0% vs. 22.7%) than non-sensitised patients (p<0.001 for the distribution of rhinitis). The frequency of asthma control and mean FEV1 were not significantly different between sensitised and non-sensitised patients (Table 1). In multivariable logistic regression analyses, the main determinants of sensitisation to mites were: sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence interval 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

DISCUSSION

This cross-sectional study conducted in a sub-Saharan African country has Shown that: 1) two out of three asthmatic patients in Yaounde have a sensitisation to mites; 2) about a third of patients have an isolated sensitisation to one of the three mites tested; 3) intermittent and

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persistent rhinitis are more frequent in patients sensitised to mites; 4) sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

Mites are minuscule cosmopolite arthropods which live and prosper in humid zones (optimal humidity of 60-80%) and at an optimal temperature of 20 to 30°C.[5, 8] Of the hundreds of species of mites identified so far, a few are responsible for over 90% of allergenic sensitisation.[5] In most parts of the world, DP and DF account for over 70-80% of sensitisations due to mites.[7] However, during the last decade, sensitisation to BT has been increasingly reported in inter-tropical and temperate zones.[10, 19] The prevalence of the sensitisation to mites to difference species of mites among atopic patients varies substantially across regions around the world. For instance, the prevalence of sensitisation to mites in patients with asthma varies between 31% and 88% in Europe,[9] between 39% and 56% in America,[9, 10] and between 53 to 88% in Asia and Oceania.[9, 11, 12] The prevalence in our study was 67.2%, with a sensitisation to each of the three species (DP, DF and BT) found in about half of our patients. Inclusion of these three mites in the pool of allergologic test appears to be important in this setting, considering the fact that more than a third of the patients had an isolated sensitisation to one of the three mites. This could possibly reflect a cross-sensitisation due to shared allergens across species, or a true multiple sensitisation to major allergens of these mites.[7]

While about half of our patients with asthma had rhinitis, the proportion was much higher among patients sensitised to mites, and regardless of the clinical form of rhinitis. This suggests that respiratory allergy to mites affects the entire respiratory tract including both the upper and the lower respiratory airways. We did not find other significant differences in the clinical characteristics between patients who were sensitised to mites and those who were not. For instance, sensitisation to mites was not associated with age at the clinical onset of asthma, sex, family history of asthma, ethnicity or alteration of lung functions. Therefore, unlike the presence of rhinitis, other clinical variables may not be useful for the screening of patients for allergy to mites.

In our sample, sensitisation to mites was independently associated with sensitisation to *Alternaria* and sensitisation to *Blattella germanica*. Indeed, a third and patients sensitised to mites were also sensitised to *Blattella germanica*. These associations at least in part could be explained by the cross reactivity between mites and cockroaches via tropomyosin, but could also reflect multiple sensitisation.[20-22] The association between sensitisation to mites and

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sensitisation to *Alternaria* likely reflects a multiple sensitisation, considering the phylogenic distance between the two species. Not so much has been reported on this association which deserved further investigation and confirmation in other setting in tropical Africa.

This study has some limitations including the reliance on skin tests alone to diagnose sensitisation and enrolment of patients from only two health facilities in the city of Yaounde. Indeed, measurements of specific immunoglobulin E could reveal more sensitisations, in particular in patients with hyporeactivity to skin tests and may also help to differentiate between cross-sensitization and multiple sensitisations to major mite allergens. The two recruitment health facilities for this study are referral centres for chest diseases in Yaounde. It is therefore possible that patients recruited from these facilities are representative of the population of patients with asthma seen across all health facilities in the city. It remains however that recruitment from health facilities as opposed to a community-based sample could potentially bias our estimates of the prevalence of mite sensitisation. The direction of the effect of such a bias is difficult to predict, and the challenges and logistics for conducting a study of this nature in a setting with a possibly low prevalence of asthma at the population level, have to be considered.In conclusion, sensitisation to mites is frequent among patients with asthma in Yaounde, where it is frequently associated with a sensitisation to *Alternaria* and/or sensitisation to *Blattella germanica*. The presence of rhinitis in patients with asthma is suggestive of a sensitisation to mites. Systematically investigating patients with asthma for an allergy to mites as well as the determinants of such an allergy will help optimising the care of patients with asthma in this setting through a combination an aetiological treatment for the allergy with a symptomatic treatment for asthma, in order to modify the natural history of the disease.

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Competing interests: None for all authors.

Ethics approval: Ethics approval was provided by the Institutional Review Board of Yaounde Jamot Hospital and CEDIMER medical centre.

Contributors: EWPY conceived the study, collected data, co-analysed the data and drafted the manuscript. APK contributed to study design, data analysis, drafting and critical revision of the manuscript. CK supervised data collection and critically revised the manuscript. All authors approved the final version of the manuscript.

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Table 1: Demographic and clinical characteristics of asthmatic patients in Yaounde according to the sensitisation to mite

Characteristics	Overall	Mite sensitisation	No mite sensitisation	p
N	201	135	66	
Sex				0.157

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Men, n (%)	69 (34.3)	51 (37.8)	18 (28.3)	
Women, n (%)	132 (65.7)	84 (62.2)	48 (72.7)	
Median age, years (25^{th}-75^{th} percentiles)	36 (20.5-54)	33 (20-51)	40 (21-56)	0.204
Ethnic groups				0.604
Semi-bantu, n (%)	141 (70.9)	92 (68.1)	49 (74.2)	
Bantu, n (%)	42 (21.1)	29 (21.5)	13 (19.7)	
Fulani/Sudanese, n (%)	16 (8.0)	12 (8.9)	4 (6.0)	
Others, n (%)	2 (1.0)	2 (1.5)	0 (0)	
Median age at the onset of asthma, years (25^{th}-75^{th} percentiles)	20 (10-39)	20 (10-36)	21.5 (12.5-43.5)	0.475
Rhinitis				<0.001
None, n (%)	101 (50.2)	55 (40.7)	46 (69.7)	
Intermittent rhinitis, n (%)	27 (13.4)	22 (16.3)	5 (7.6)	
Persistent rhinitis, n (%)	73 (36.3)	58 (43.0)	15 (22.7)	
Atopic dermatitis				>0.999
Yes, n (%)	4 (2.0)	3 (2.2)	1 (1.5)	
No, n (%)	197 (98.0)	132 (97.8)	65 (98.5)	
Smoking				0.200
Non-smoker, n (%)	194 (96.5)	129 (95.6)	65 (98.5)	
Smoker/ex-smoker, n (%)	3 (1.5)	2 (1.5)	1 (1.5)	
Second hand smoker, n (%)	4 (2.0)	4 (3.0)	0 (0)	
Family history of asthma				0.250
Yes, n (%)	37 (18.4)	28 (20.7)	9 (13.6)	
No, n (%)	164 (81.6)	107 (79.3)	57 (86.4)	
Asthma control				0.748
Well controlled, n (%)	107/184 (58.2)	76/129 (58.9)	31/55 (56.4)	
Not well controlled, n (%)	77/184 (41.8)	53/129 (41.1)	24/55 (43.6)	
FEV1, %, mean (SD)	84.1(22.3)	84,2 (22.3)	88.4 (21.7)	0.294

SD, standard deviation

Table 2: Frequency and association of sensitisation to mites in asthma patients in Yaounde, Cameroon

Type of mite sensitisation	Frequency (%)
N	135 (100)

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Monosensitisation to *Dermatophagoïdes pteronyssinus*	13 (9.6)
Monosensitisation to *Dermatophagoïdes farinae*	9 (6.7)
Monosensitisation to *Blomia tropicalis*	15 (11.1)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Dermatophagoïdes farinae*	17 (12.6)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Blomia tropicalis*	7 (5.2)
Sensitisation to *Dermatophagoïdes farinae* and *Blomia tropicalis*	4 (3.0)
Sensitisation to 3 mites	70 (51.9)

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Table 3 : Univariable and multivariable analysis of perennial allergenic factors associated to mite sensitisation

Factors	Crude odds ratio (IC à 95%)	p	Adjusted Odds ratio (95% CI)	p
Sensitisation to Alternaria	21.03 (2.81-157.51)	0.003	14.98 (1.96-114.4)	0.009
Sensitisation to cockroaches	5.00 (2.01-12,45)	0.001	3.48 (1.34-9.00)	0.010
Sensitisation to cat dander	7.52 (0.97-58.48)	0.054	5.96 (0.73-48.86)	0.096
Sensitisation to dog dander	0.98 (0.24-4.03)	0.974	/	/

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	pages
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	*1,2*
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	*2*
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	*4*
Objectives	3	State specific objectives, including any prespecified hypotheses	*4*
Methods			
Study design	4	Present key elements of study design early in the paper	*1,4*
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	*4,5*
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	*4,5*
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	*5*
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*5*
Bias	9	Describe any efforts to address potential sources of bias	*5,8*
Study size	10	Explain how the study size was arrived at	*Convenience sample*
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	*5*
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	*5*
		(*b*) Describe any methods used to examine subgroups and interactions	*5*
		(*c*) Explain how missing data were addressed	*Not applicable*
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	*Not applicable*
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	*5*
		(b) Give reasons for non-participation at each stage	*5*
		(c) Consider use of a flow diagram	*/*
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	*5,6*
		(b) Indicate number of participants with missing data for each variable of interest	*/*
Outcome data	15*	Report numbers of outcome events or summary measures	*6*

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Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	*6*
		(*b*) Report category boundaries when continuous variables were categorized	*Not applicable*
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	/
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	/
Discussion			
Key results	18	Summarise key results with reference to study objectives	*6*
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	*8*
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	*6,7,8*
Generalisability	21	Discuss the generalisability (external validity) of the study results	*8*
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	*8*

*Give information separately for exposed and unexposed groups.

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Sensitisation to mites in a group of patients with asthma in Yaounde, Cameroon: a cross-sectional study

Short title: Mites sensitisation in asthma

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ABSTRACT

Objectives: Sensitisation of asthmatic patients to mites in sub-Saharan Africa has been less described. The aim of this study was to assess the prevalence and determinants of sensitisation to mites in asthmatic adolescents and adults in Yaounde, Cameroon.

Design: This was cross-sectional study. Logistic regressions models were employed to investigate the determinants of sensitisation to mites.

Setting: This study was carried out at the Jamot Hospital and CEDIMER private centre, in Yaounde, capital city of Cameroon.

Participants: All asthmatic patients received in consultations from January 2012 to June 2013 and in whom prick-skin tests for perennial aeroallergens were performed, were included.

Outcome measures: prevalence of sensitisation to mites and associated factors.

Results: In all 201 patients (132 being women, 65.7%), with a median age of 36 (25^{th}-75^{th} percentiles: 20-54) years were included, with 135 (67.2%) having a positive skin test for mites. Sensitisation to *Dermatophagoïdes pteronyssinus*, *Dermatophagoides farinae* and *Blomia tropicalis* were found in 53.2%, 49.8% and 47.8% of the patients respectively. Intermittent rhinitis (16.3% vs. 7.6%) and persistent rhinitis (43.0% vs. 22.7%) were more frequent in sensitised patients than in the non-sensitised ones ($p<0.010$). Independent allergologic determinants of sensitisation to mites were sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence intervals 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

Conclusions: Sensitisation to mites was found in about $2/3^{rd}$ of asthmatic patients in this setting, with a frequent multiple sensitisations to *Alternaria alternata* and *Blattella germanica*. Systematically investigating asthmatic patients for mites' sensitisation and determinants will help optimising the care in this setting by combining the aetiological treatment for the allergy with symptomatic treatment for asthma, in order to modify the natural course of the disease.

Key words – asthma, mites, sensitisation, Cameroon

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ARTICLE SUMMARY

Article focus

- To investigate current prevalence and determinants of sensitisation to mites in patients with asthma in a sub-Saharan Africa country.

Key messages

- Two out of three asthmatic patients in Yaounde have a sensitisation to mites;
- Intermittent and persistent rhinitis are more frequent in patients sensitised to mites;
- Sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

Strengths and limitations

- This was a first study exploring sensitization to mites in Cameroon.
- This study uses robust methods to assess determinants of sensitisation in asthma patients.
- The study was conducted only in two centres

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INTRODUCTION

Allergy to aeroallergens is one of the determining factors for the occurrence of asthma.[1-4] In most parts of the world, mites are the commonest source of perennial respiratory allergies.[4-6] Of the many species of mites known to date, only a few are responsible for respiratory allergies. These include for dust mites the following: *Dermatophagoides pteronyssimus (DP), Dermatophagoides farinae (DF) et Euroglyphus maynei* and for storage mites: *Blomia tropicalis* (BT), *Lepidoglyphus destructor, Glycyphagus domesticus, Tyrophagus putrescenciae, Acarus siro.*[5, 7, 8]

The prevalence of sensitisation to different species of mites varies across regions in the world, mostly influenced by differences in climatic and environmental conditions.[9-12] Allergenic sensitisation and particularly sensitisation to mites has been less investigated in patients with respiratory atopy in sub-Saharan Africa, causing the management of these patients to be less than optimal in this part of the world. The aims of the current study was to determine the prevalence of sensitisation to mites and the distribution of such sensitisation across the three commonest mites (DP, DF, BT) among adolescents and adults with asthma in Yaounde, Cameroon; and additionally, to investigate the determinants of sensitisation to mites in these patients.

MATERIALS AND METHODS

Study setting and participants

The study was conducted in the outpatient department of the pneumology service of the Yaounde Jamot Hospital (YJH) and the CEDIMER private centre. YJH is a public hospital and the referral centre for chest diseases for the capital city of Cameroon (Yaounde) and surrounding areas. CEDIMER is a private medical practice which offers ambulatory care to patients in Yaounde. The study was approved by the ethics committee of the two participating health facilities.

Methods

This was a cross-sectional study involving all consenting adolescents (age ≥10 years) and adults Cameroonians followed for asthma from January 2012 through June 2013 (18 months). Diagnosis of asthma was confirmed by a specialist physician, and was based on the criteria of the Global Initiative for Asthma (GINA).[13] Demographic and clinical data were collected including: age, sex, ethnic group, known duration of asthma, family history of asthma, other existing allergic conditions (rhinitis, conjunctivitis, and atopic dermatitis) and smoking.

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Diagnosis of rhinitis was based on the following nasal symptoms: clear rhinorrhoea, nasal obstruction, sneezing and itching. Persisting rhinitis was retained for a patient who reported symptoms for at least four days per week and during four weeks or more; otherwise rhinitis was considered as intermittent.[14] Diagnosis of atopic dermatitis was based on the criteria of the United Kingdom Working Party.[15]

The control of asthma was assessed with the use of the Asthma Control Questionnaire (ACQ).[16, 17] Asthma was considered to have been insufficiently controlled in the week preceding the inclusion, in the presence of an ACQ score of one or greater.[16, 17] The baseline forced expiratory volume in the first second (FEV1) was recorded for all patients in the absence of any exacerbation. Predicted FEV1 was based on the 2012 equations of the Global Lung Initiative for Blacks subjects.[18]

Prick-test and standardised allergenic extracts of Stallergenes Laboratories (Anthony, France) were used for skin tests. The following perennial aeroallergens were tested: mites (*Dermatophagoïdes pteronyssinus*, *Dermatophagoïdes farinae* and *Blomia tropicalis*), moist (*Alternaria alternata*), *Blattella germanica*, cat dander and dog dander. Dilution solution of the allergenic extracts and histamine were used respectively as negative and positive controls. A prick test was considered positive if the diameter of the papula was greater than 3 mm, relative to the diameter of the negative control; or 50% that of the positive control. Patients for whom skin allergologic tests were not performed were excluded from the study.

Statistical methods

Data were analysed with the use of SPSS statistical software v.17 for Windows (SPSS Inc, Chicago, USA). Results are reported as mean (standard deviation) or median (25^{th}-75^{th} percentiles) and count (percentages). The chi square and Fisher exact tests were used to compare qualitative variables and the Mann-Whitney U test used for quantitative variables. Logistic regressions models were employed to investigate the determinants of sensitisation to mites. A p-value <0.05 was used to characterise statistically significant results.

RESULTS

General characteristics of the study population

Of the 209 asthmatic adolescent and adults received in consultations during the inclusion period, eight (3.8%) did not receive the skin allergologic tests and were excluded. Clinical and demographic characteristics for the 201 patients in the final analytic sample are summarised in Table 1. They comprised 132 (65.7%) women and 69 (34.3) men and the median age (25^{th}-

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75th percentiles) was 36 (20.5-54.0) years. Twenty-seven (13.4%) patients had intermittent rhinitis and 73 (36.3%) had persistent rhinitis. Asthma was not well controlled during the last week preceding the inclusion in 77 (42.8%) patients and the mean FEV1 (standard deviation) was 84.1% (22.3%), Table 1.

Prevalence of the sensitisation to mites

One hundred and forty (69.7%) patients had sensitisation to at least one of non-pollinic allergens. The prevalence of the sensitisation to the three mites tested in the current study was 67.2% (135/201), with a 95% confidence interval of 60.7-73.7%. The prevalence of the sensitisation to each of the species was 53.2% for DP, 49.8% for DF and 47.8% for BT. The distribution of the sensitisation of our participants to different species of mite is presented in Table 2. Thirty-seven (27.4%) patients had an isolated sensitisation to one of the three species of mites and mono-sensitisation to mites (i.e. absence of sensitisation to other perennial aeroallergens) was present in 70 (51.9%) patients. Isolated sensitisation to BT was the most frequent and was found in 15 (11.1%) patients. The most common sensitisation to two species of mites was the co-sensitisation to DP and DF, which was found in 17 (12.6%) patients. Seventy (51.9%) patients had a sensitisation to the three species of mites tested.

Determinants of the sensitisation to mites

The prevalence of the sensitisation to mites was similar between women and men (63.6% vs. 73.9%, p=0.157) and the median age was similar between sensitised patients and non-sensitised ones (33 vs. 40 years, p=0.204). Sensitised patients were more likely to have intermittent (16.3% vs. 7.6%) or persisting rhinitis (43.0% vs. 22.7%) than non-sensitised patients (p<0.001 for the distribution of rhinitis). The frequency of asthma control and mean FEV1 were not significantly different between sensitised and non-sensitised patients (Table 1). In multivariable logistic regression analyses, the main determinants of sensitisation to mites were: sensitisation to *Alternaria alternata* [adjusted odd ratio 14.98 (95% confidence interval 1.96-114.4)] and sensitisation to *Blattella germanica* [3.48 (1.34-9.00)].

DISCUSSION

This cross-sectional study conducted in a sub-Saharan African country has ~~revealed~~ Shown that: 1) two out of three asthmatic patients in Yaounde have a sensitisation to mites; 2) about a third of patients have an isolated sensitisation to one of the three mites tested; 3) intermittent

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and persistent rhinitis are more frequent in patients sensitised to mites; 4) sensitisation to *Alternaria* and to *Blattella germanica* are the main predictors of sensitisation to mites.

Mites are minuscule cosmopolite arthropods which ~~leave~~ live and prosper in humid zones (optimal humidity of 60-80%) and at an optimal temperature of 20 to 30°C.[5, 8] Of the hundreds of species of mites identified so far, a few are responsible for over 90% of allergenic sensitisation.[5] In most parts of the world, DP and DF account for over 70-80% of sensitisations due to mites.[7] However, during the last decade, sensitisation to BT has been increasingly reported in inter-tropical and temperate zones.[10, 19] The prevalence of the sensitisation to mites to difference species of mites among atopic patients varies substantially across regions around the world. For instance, the prevalence of sensitisation to mites in patients with asthma varies between 31% and 88% in Europe,[9] between 39% and 56% in America,[9, 10] and between 53 to 88% in Asia and Oceania.[9, 11, 12] The prevalence in our study was 67.2%, with a sensitisation to each of the three species (DP, DF and BT) found in about half of our patients. Inclusion of these three mites in the pool of allergologic test appears to be important ~~primordial~~ in this setting, considering the fact that more than a third of the patients had an isolated sensitisation to one of the three mites. This could possibly reflect a cross-sensitisation due to shared allergens across species, or a true multiple sensitisation to major allergens of these mites.[7]

While about half of our patients with asthma had rhinitis, the proportion was much higher among patients sensitised to mites, and regardless of the clinical form of rhinitis. This suggests that respiratory allergy to mites affects the entire respiratory tract including both the upper and the lower respiratory airways. We did not find other significant differences in the clinical characteristics between patients who were sensitised to mites and those who were not. For instance, sensitisation to mites was not associated with age at the clinical onset of asthma, sex, family history of asthma, ethnicity or alteration of lung functions. Therefore, unlike the presence of rhinitis, other clinical variables may not be useful for the screening of patients for allergy to mites.

In our sample, sensitisation to mites was independently associated with sensitisation to *Alternaria* and sensitisation to *Blattella germanica*. Indeed, a third and patients sensitised to mites were also sensitised to *Blattella germanica*. These associations at least in part could be explained by the cross reactivity between mites and cockroaches via tropomyosin, but could also reflect multiple sensitisation.[20-22] The association between sensitisation to mites and

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sensitisation to *Alternaria* likely reflects a multiple sensitisation, considering the phylogenic distance between the two species. Not so much has been reported on this association which deserved further investigation and confirmation in other setting in tropical Africa.

This study has some limitations including the reliance on skin tests alone to diagnose sensitisation and enrolment of patients from only two health facilities in the city of Yaounde. Indeed, measurements of specific immunoglobulin E could reveal more sensitisations, in particular in patients with hyporeactivity to skin tests and may also help to differentiate between cross-sensitization and multiple sensitisations to major mite allergens. The two recruitment health facilities for this study are referral centres for chest diseases in Yaounde. It is therefore possible that patients recruited from these facilities are representative of the population of patients with asthma seen across all health facilities in the city. It remains however that recruitment from health facilities as opposed to a community-based sample could potentially bias our estimates of the prevalence of mite sensitisation. The direction of the effect of such a bias is difficult to predict, and the challenges and logistics for conducting a study of this nature in a setting with a possibly low prevalence of asthma at the population level, have to be considered.

In conclusion, sensitisation to mites is frequent among patients with asthma in Yaounde, where it is frequently associated with a sensitisation to *Alternaria* and/or sensitisation to *Blattella germanica*. The presence of rhinitis in patients with asthma is suggestive of a sensitisation to mites. Systematically investigating patients with asthma for an allergy to mites as well as the determinants of such an allergy will help optimising the care of patients with asthma in this setting through a combination an aetiological treatment for the allergy with a symptomatic treatment for asthma, in order to modify the natural history of the disease.

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Ethics approval: Ethics approval was provided by the Institutional Review Board of Yaounde Jamot Hospital and CEDIMER medical centre.

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Contributors: EWPY conceived the study, collected data, co-analysed the data and drafted the manuscript. APK contributed to study design, data analysis, drafting and critical revision of the manuscript. CK supervised data collection and critically revised the manuscript. All authors approved the final version of the manuscript.

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Table 1: Demographic and clinical characteristics of asthmatic patients in Yaounde according to the sensitisation to mite

Characteristics	Overall	Mite sensitisation	No mite sensitisation	p
N	201	135	66	
Sex				0.157
Men, n (%)	69 (34.3)	51 (37.8)	18 (28.3)	
Women, n (%)	132 (65.7)	84 (62.2)	48 (72.7)	
Median age, years (25^{th}-75^{th} percentiles)	36 (20.5-54)	33 (20-51)	40 (21-56)	0.204
Ethnic groups				0.604
Semi-bantu, n (%)	141 (70.9)	92 (68.1)	49 (74.2)	
Bantu, n (%)	42 (21.1)	29 (21.5)	13 (19.7)	
Fulani/Sudanese, n (%)	16 (8.0)	12 (8.9)	4 (6.0)	
Others, n (%)	2 (1.0)	2 (1.5)	0 (0)	
Median age at the onset of asthma, years (25^{th}-75^{th} percentiles)	20 (10-39)	20 (10-36)	21.5 (12.5-43.5)	0.475
Rhinitis				<0.001
None, n (%)	101 (50.2)	55 (40.7)	46 (69.7)	
Intermittent rhinitis, n (%)	27 (13.4)	22 (16.3)	5 (7.6)	
Persistent rhinitis, n (%)	73 (36.3)	58 (43.0)	15 (22.7)	
Atopic dermatitis				>0.999
Yes, n (%)	4 (2.0)	3 (2.2)	1 (1.5)	
No, n (%)	197 (98.0)	132 (97.8)	65 (98.5)	
Smoking				0.200
Non-smoker, n (%)	194 (96.5)	129 (95.6)	65 (98.5)	
Smoker/ex-smoker, n (%)	3 (1.5)	2 (1.5)	1 (1.5)	
Second hand smoker, n (%)	4 (2.0)	4 (3.0)	0 (0)	
Family history of asthma				0.250
Yes, n (%)	37 (18.4)	28 (20.7)	9 (13.6)	
No, n (%)	164 (81.6)	107 (79.3)	57 (86.4)	
Asthma control				0.748
Well controlled, n (%)	107/184 (58.2)	76/129 (58.9)	31/55 (56.4)	
Not well controlled, n (%)	77/184 (41.8)	53/129 (41.1)	24/55 (43.6)	
FEV1, %, mean (SD)	84.1(22.3)	84,2 (22.3)	88.4 (21.7)	0.294

SD, standard deviation

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Table 2: Frequency and association of sensitisation to mites in asthma patients in Yaounde, Cameroon

Type of mite sensitisation	Frequency (%)
N	135 (100)
Monosensitisation to *Dermatophagoïdes pteronyssinus*	13 (9.6)
Monosensitisation to *Dermatophagoïdes farinae*	9 (6.7)
Monosensitisation to *Blomia tropicalis*	15 (11.1)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Dermatophagoïdes farinae*	17 (12.6)
Sensitisation to *Dermatophagoïdes pteronyssinus* and *Blomia tropicalis*	7 (5.2)
Sensitisation to *Dermatophagoïdes farinae* and *Blomia tropicalis*	4 (3.0)
Sensitisation to 3 mites	70 (51.9)

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Table 3 : Univariable and multivariable analysis of perennial allergenic factors associated to mite sensitisation

Factors	Crude odds ratio (IC à 95%)	p	Adjusted Odds ratio (95% CI)	p
Sensitisation to Alternaria	21.03 (2.81-157.51)	0.003	14.98 (1.96-114.4)	0.009
Sensitisation to cockroaches	5.00 (2.01-12,45)	0.001	3.48 (1.34-9.00)	0.010
Sensitisation to cat dander	7.52 (0.97-58.48)	0.054	5.96 (0.73-48.86)	0.096
Sensitisation to dog dander	0.98 (0.24-4.03)	0.974	/	/

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