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Assessing olfactory function in patients with smell disorders in the South Kivu province of the Democratic Republic of Congo

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ABSTRACT

Objective: Olfactory disorders may be associated with different etiologies, including upper respiratory infections, sinonasal conditions, head injuries, exposure to toxins, and congenital anosmia. This study aimed to evaluate the prevalence of different etiologies for olfactory dysfunction as observed in a sub-Saharan African population.

Methods: This descriptive cross-sectional study was conducted in a series of 116 consecutive patients with an olfactory disorder who lived in the city of Bukavu in the South Kivu province of the Democratic Republic of the Congo. The study was conducted from June 1, 2016 to May 30, 2017. We used the Sniffin' Sticks test, adapting the identification (I) test to our population but retaining the standard threshold (T) and discrimination (D) tests. The patients were classed as anosmic if their composite T + D + I score was <16, hyposmic if it was 16–30, and normosmic if it was >30. Informed consent was obtained in accordance with the Declaration of Helsinki II. We calculated proportions for each olfactory disorder.

Results: Median age (minimum–maximum) in our 116 patients was 42.5 (18–83) years. Women made up 60% of our sample. It was observed that 70.7% of patients had anosmia and 29.3% hyposmia. In descending order, the main causes were upper respiratory infections (49.1%), congenital causes (34.5%), nasal polyps (6%), nose and/or sinus surgery (3.4%), head injuries (2.6%), metabolic causes (2.6%), and occupational exposure to toxins (1.7%). Hyposmia predominated when the cause was upper respiratory infection, whereas anosmia did when the cause was congenital and noninfectious.

Conclusion: In our study population, upper respiratory infections were the main cause of dysosmia. The anosmic cases we observed tended to be congenital in nature, suggesting that there existed other etiological factors that require further investigation.

Keywords: Dysosmia, etiologies, Sniffin' Sticks test, sub-Saharan Africa

Introduction

The sense of smell is a warning system for detecting potential dangers such as spoiled food, gas, smoke, and so on. If it is lost, it has been reported that around 40% of patients are involved in domestic accidents (1). Several studies have shown that roughly 5% of the population has total anosmia, and 10% to 15% have hyposmia (2, 3).

What's more, the prevalence of the etiologies of decreased olfactory sensitivity varies with age and sex (4). It is estimated that anosmia and hyposmia affect 3% to 20% of the population. Additionally, the risk of olfactory dysfunction increases with age (5). Recent data has suggested that anosmia affects 3.2% of adult Americans aged over 40 (3.4 million people). This figure increases with age, reaching 14% to 22% among people over 60 (5). Various studies have shown an association between sex and olfactory sensitivity, with most showing that women display a greater ability to identify and discriminate between odors (6). In a previous study conducted in our part of the world, we observed that olfactory sensitivity diminished with age and was better among women (7).

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Olfactory disorders may be associated with different etiologies, including upper respiratory infections (18%-45%), sinonasal diseases (7%-56%), head injuries (8%-20%), exposure to toxins (2%-6%), and congenital etiologies (0%-4%) (8). However, very few studies have been conducted in sub-Saharan Africa. It was in this context that we conducted our study, which aimed to assess the prevalence of different etiologies of olfactory dysfunction observed in a sub-Saharan African population so as to compare them against those of a European population.

Methods

This was a descriptive cross-sectional study of a series of 116 consecutive Congolese patients with olfactory disorders. They were aged 18 to 83 years (median: 42.5) and lived in the health area of Bukavu, the capital of the South Kivu province of the Democratic Republic of the Congo. Of those patients, 70 (60%) were women and 46 (40%) were men. The study was conducted from June 1, 2016 to May 30, 2017. The otorhinolaryngology department of Bukavu provincial general hospital was where we conducted our physical examinations and olfactory tests using a culturally adapted version of the Sniffin' Sticks test (7). The study was approved by our institutional review board, all explanations were given in the local language, and signed informed consent was obtained in accordance with the Declaration of Helsinki II. All clinical investigations and olfactory tests were performed by an otorhinolaryngologist.

Clinical Data

History-taking screened for the following: qualitative (parosmia, phantosmia, and cacosmia) and quantitative (hyposmia and anosmia) functional signs of an olfactory disorder; contributing factors and conditions (medical, surgical, psychiatric, neurological, sinonasal disease, familial, occupational exposure to chemicals or toxins, current medication, alcohol, and tobacco); and functional rhinologic signs of upper respiratory infection (rhinorrhea, nasal obstruction, and sneezing).

The nasal cavities were examined by means of anterior rhinoscopy and nasal endoscopy to check for significant anatomic abnormalities or signs of mucosal inflammation.

Sniffin' Sticks Olfactory Tests

Olfactory function was assessed by means of the approved Sniffin' Sticks test. We used a modified version of the identification test, which we adapted to our population (7), but we retained the standard threshold and discrimination tests (9) (Burghart Technology, Gilbertsville, PA, USA) In our version, the odors not recognized by at least 40% of participants in the standard test (cinnamon, turpentine, clove, aniseed, and licorice) were replaced by culturally familiar odors (ginger, onion, honey, eucalyptus, and smoked meat), and the multiple choice options were changed accordingly (Table 1). However, the threshold and discrimination tests were not changed. The odors were presented to the patients as markers placed approximately 2 cm from the nostrils. This test uses the following three approaches to assess olfactory function:

Measure of the threshold (T) for odor detection (out of 16): T was determined using different concentrations of n-butanol. Three sticks were presented to patients, one containing n-butanol diluted in propylene glycol, whereas the other two contained only propylene glycol, an odorless solvent. The patient had to identify which of the three sticks presented to them contained an odor. T was determined using a staircase method. For the test, 16 sets of three markers were presented to each patient.

Measure of the ability to discriminate (D) between odors (out of 16): D was assessed by presenting three odors to the patient. In this test, two sticks contained the same odor and one a different odor. Patients were asked to identify which stick was different using a forced-choice method. The patients were presented with 16 sets, with each set containing three odors.

Ability to identify (I) odors between four alternatives (out of 16): I was assessed by asking patients to identify 16 odors using a four-alternative forced-choice method. The alternatives were simultaneously presented as images and in verbal form.

The scores achieved on the T, D, and I test were summed to arrive at a composite TDI score (out of 48). The patients were classed as anosmic if TDI was <16, hyposmic if TDI was 16–30, and normosmic if TDI was >30 (9).

Statistical Analysis

Statistical analysis was conducted using SPSS (Statistical Package for Social Sciences) version 17.0 for Windows. Quantitative data was expressed as mean, standard deviation, and related extreme values. Qualitative data was expressed as number and percentage. The chi-square test of independence was used for our analysis. A p-value of 0.05 was taken as the cut-off for statistical significance.

Main Points:

- Olfactory disorders may be associated with different etiologies. However, very few studies have been conducted in sub-Saharan Africa.
- It was in this context that we conducted our study, which aimed to assess the prevalence of different etiologies of olfactory dysfunction observed in a sub-Saharan African population so as to compare them against those of a European population.

Results

The general characteristics of our study population are presented in Table 2. The patients were divided into three age groups: Group I (18–35 years), Group II (36–55 years), and Group III (>56 years). It was found that the patients of Groups I (47, 40.5%) and II (44, 37.9%) were better represented than those of Group III (25, 21.6%), and women (70, 60.3%) predominated.

Anosmia (82, 70.7%) was the predominant functional olfactory sign. Upper respiratory infections were the most frequently reported previous condition (57, 49.1%), followed by congenital disorders (40, 34.5%). Among patients with a history of upper respiratory infection, rhinorrhea (49.1%) was the most common functional rhinologic sign, followed by nasal obstruction (44.8%) and sneezing (36%).

Table 3 shows the associations between the olfactory disorders observed and their etiological factors.

Table 1. Sniffin'sticks test adapted version

Odor	Stick 1	Stick 2	Stick 3	Stick 4
Orange	Orange	Mango	Strawberry	Pineapple
Leather	Smoke	Glue	Leather	Grass
Honey	Avocado	Peanut	Chocolate	Honey
Mint	Incense	Mint	Cypress	Onion
Banana	Coconut	Banana	Peanut	Guava
Lemon	Mango	Apple	Lemon	Grapefruit
Ginger	Ginger	Guava	Mint	Biscuit
Eucalyptus	Celery	Gum	Menthol	Eucalyptus
Garlic	Onion	Chili pepper	Garlic	Carrot
Coffee	Cigarette	Coffee	Wine	Smoke
Apple	Tomato	Mango	Orange	Apple
Onion	Onion	Pepper	Honey	Celery
Pineapple	Papaya	Plum	Mango	Pineapple
Rose	Tea	Strawberry	Rose	Guava
Smoked meat	Smoked meat	Beer	Coffee	Cypress
Fish	Bread	Fish	Cheese	Sausage

Table 2. General characteristics of the study population

Variable	Number (n=116)	Percentage
Age		
18–35	47	40.5
36–55	44	37.9
>56	25	21.6
Sex		
Male	46	39.7
Female	70	60.3
Functional signs		
Anosmia	82	70.7
Hyposmia	34	29.3
Rhinorrhea	57	49.1
Nasal obstruction	52	44.8
Sneezing	42	36.2
History		
Upper respiratory infection	57	49.1
Congenital	40	34.5
Nasal polyps	7	6
Sinonasal surgery	4	3.4
Head injury	3	2.6
Diabetes	3	2.6
Exposure to toxins	2	1.7

Table 3. Association between olfactory disorders and their etiological factors

Variable	Anosmia (%)	Hyposmia (%)	Total n	p
Number of patients	(70.7)	(29.3)	116	
Age				
18–35	(59.6)	(40.4)	47	0.069
36–55	(75)	(32.3)	44	
>55	(84)	(11.8)	25	
Sex				
Male	(73.9)	(26.1)	46	0.536
Female	(68.6)	(31.4)	70	
Functional signs				
Rhinorrhea	(45.6)	(54.4)	57	0.000
Nasal obstruction	(46.2)	(53.8)	52	0.000
Sneezing	(54.8)	(45.2)	42	0.005
History				
Upper respiratory infection	(45.6)	(54.4)	57	0.000
Congenital	(100)	(0)	40	
Nasal polyps	(57.1)	(42.9)	7	
Sinonasal surgery	(100)	(0)	4	
Head injury	(100)	(0)	3	
Diabetes mellitus	(100)	(0)	3	
Occupational exposure to toxins	(100)	(0)	2	

A breakdown of the quantitative olfactory disorders according to age group found that Group I contained 28 (60%) cases of anosmia and 19 (40%) of hyposmia, Group II had 33 (75%) cases of anosmia and 11 (32%) of hyposmia, and Group III had 21 (84%) cases of anosmia and 4 (16%) of hyposmia. Women were more affected, accounting for 59% of the cases of anosmia and 65% of those with hyposmia.

Hyposmia was often associated with the functional rhinologic signs of upper respiratory infection, with 54% of cases having a history of rhinorrhea and nasal obstruction. Conversely, anosmia was often associated with patients who had previous noninfectious events or conditions. On univariate analysis, no statistically significant difference was found between either hyposmia or anosmia and age, sex, or prior noninfectious conditions. However, a statistically significant difference was observed between hyposmia and both upper respiratory infection (p=0.000) and functional rhinologic signs (rhinorrhea, p=0.000; nasal obstruction, p=0.000; and sneezing, p=0.005).

Discussion

This study reveals the characteristics of various olfactory disorders observed in an adult sub-Saharan population as well as the associations with their etiological factors.

In our study population, 70.7% of patients had anosmia and 29.3% had hyposmia. Anosmia predominated in all three age groups, increased with age, and was more pronounced among patients aged over 55 (Group III). In a previous study of healthy subjects, we observed a decrease in olfactory sensitivity with age (7). This corroborates a study conducted in more than 1,000 Asian patients that reported olfactory dysfunction in 3.7% of 18- to 35-year-olds, in 17.4% of 36- to 55-year-olds, and in 35.6% of people over 55 (6). It also supports cross-sectional studies conducted in the United States (US), which showed that half of the population aged between 65 and 80 had reduced olfactory sensitivity, as did three quarters of those aged over 80 (10). With regard to sex, an American study conducted in elderly subjects demonstrated that olfactory function is weaker in men than in women (11). This was also observed in our previous study (7). That said, in both this study and another study conducted in China (12), women were more affected. In sub-Saharan Africa and other disadvantaged regions, women are obviously more vulnerable and seek treatment more often than men. The influence of sex and age on olfactory sensitivity was borne out, even if the size of our sample prevented us from documenting a statistically significant association between either hyposmia or anosmia and sex or age group.

The prevalence of hyposmia following an upper respiratory infection in our study corroborates a study conducted in Belgium in a cohort of 122 patients (13), another conducted in Germany in 278 patients (14), and a retrospective study conducted in 791 patients (8). Indeed, the association observed in our study between hyposmia and nasal obstruction, rhinorrhea, and sneezing, coupled with the preponderance of women and of hyposmia relative to anosmia, suggests an infectious viral etiology. Loss of olfactory sensitivity after infection is the result of a loss of olfactory sensitivity after an upper respiratory infection, typically in the setting of influenza-related rhinitis (15).

In loss of olfactory sensitivity after an upper respiratory infection, typically in the setting of influenza-related rhinitis (15). Anosmia is found in 36% to 53% of patients and hyposmia in 47% to 64% (14). Patients who develop olfactory loss after a viral infection tend to be older, are predominantly women, and are usually hyposmic rather than anosmic. This contrasts with the other common causes of olfactory loss (15) and supports our study.

As regards genetic factors, of two studies conducted in the US, one reported a high prevalence of anosmia in elderly African-American subjects compared with whites (16). The other showed that olfactory sensitivity was lower among elderly African-Americans than whites (17). In sub-Saharan Africa, studies conducted in Chad have observed cases of genetically inherited anosmia among the Hadjarai (18). In our study, anosmia was reported as congenital in 40 (48.9%) patients and may be found among members of the same family. Those patients displayed no clinical signs of any related congenital disorder, such as Kallmann or Turner syndrome (19), nor any history of prior disease. An early idiopathic cause or isolated congenital anosmia are possible explanations. Isolated congenital anosmia is a diagnosis of exclusion, because the patients have no memory of ever being able to smell and the anosmia cannot be attributed to any underlying pathologic condition. In this group, it may have a genetic origin (20). In-depth etiological investigations may be considered at some later point to confirm this diagnosis in our population.

Anosmia was prevalent in patients with previous noninfectious conditions. In a clinical study conducted elsewhere in a series of patients with olfactory dysfunction, it was found that 57% of 78 patients were hyposmic and 43% were anosmic after a viral upper respiratory infection; 73% of 75 patients were anosmic and 27% hyposmic when olfactory loss was caused by trauma; and 58% of 60 patients were anosmic and 38% hyposmic when the loss was due to sinus disease (15). This corroborates our study.

Sinonasal diseases (rhinosinusitis, rhinitis, and nasal polyps) are some of the most common causes of anosmia. These disorders provoke anosmia by mucosal inflammation and direct obstruction (19). Dysosmia is a disordered smell perception, manifesting itself as hyposmia or anosmia. Anosmia is sometimes the only tell-tale symptom (21).

In our study, anosmia was observed in four (3.4%) patients who had undergone endonasal surgery without endoscopic guidance. In this context, iatrogenic surgical trauma probably caused a lesion of the olfactory neuroepithelium or neural pathways in the olfactory cleft. Hyposmia or anosmia may be caused by sinonasal procedures such as septoplasty, rhinoplasty, or turbinectomy. The rate of olfactory complications after such procedures is roughly 1%. Ethmoid surgery is more frequently associated with olfactory complications (21).

Additionally, we observed three (2.6%) patients with anosmia who had previously suffered head injuries (Tables 2 and 3). Such injuries are one of the causes of olfactory disorders (4), provoking anosmia in 48% to 78% of cases and hyposmia in 5% to 27.4% (22). Brain injury is one of the most common causes of olfactory dysfunction. The olfactory bulb, which is situated in the anterior region of the brain above the cribriform plate of the ethmoid, is particularly vulnerable to head injuries. The regions of the brain involved in olfaction may be affected. Smell loss after trauma is sudden and usually severe, resulting in a significant negative impact on patient quality of life (22).

We observed three cases of anosmia (2.6%) in patients with diabetes. In the US, a study conducted in 3,151 adults reported an association between diabetes and olfactory disorders in adults (19). Diabetes-related olfactory disorders are the result of microvascular manifestations of the disease, possibly because of ischemia of the olfactory neuroepithelium. Anosmia can occur in a rare entity known as Wolfram syndrome, which involves childhood-onset diabetes mellitus, optic atrophy, diabetes insipidus, and deafness (21), although this was not observed in our patients.

Anosmia and hyposmia may also occur in the wake of acute or chronic exposure to chemicals, particularly industrial chemicals (21). This was perhaps what caused the anosmia observed in two lab assistants in our study.

In conclusion, in our study population, upper respiratory infections were the most common etiological factor in dysosmia. Hyposmia tended to occur after upper respiratory infections,

whereas anosmia did in congenital and noninfectious settings. More in-depth etiological investigation may be undertaken in a larger population to gain a better understanding of the congenital anosmia observed.

In our study population, upper respiratory infections were the most common etiological factor in dysosmia. Hyposmia tended to occur after upper respiratory infections, whereas anosmia did in congenital and noninfectious settings. More in-depth etiological investigation may be undertaken in a larger population to gain a better understanding of the congenital anosmia observed.

Ethics Committee Approval: This study was approved by the institutional Ethics committee of the Catholic University of Bukavu (Approval No: UCB/CIES/NC/013/2014)

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Supervision – P.R., C.H., R.M., G.B., A.M.; Design – P.R., C.H., A.M., P.B.; Resources – P.R., C.H., H.R.; Materials – P.R., C.H.; Data Collection and/or Processing – P.B.; Analysis and/or Interpretation – G.B., R.M., P.B.; Literature Search – P.B.; Writing Manuscript – P.B., H.R.; Critical Review – P.R., C.H., R.M., G.B., A.M, H.R.

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