OPEN ACCESS

Orapuh Journal

ORIGINAL ARTICLE

Journal of Oral & Public Health

Olfactory disorders in patients with chronic rhinosinusitis in Kinshasa, Democratic Republic of the Congo: A cross-sectional study

Tshingamb, K. Y.[1], Mpiana, S. J.[1,2], Sekele, M. N. P.[3], Kayembe, K. E.[1,2], Banza, L. E.[1], Ntumba, M. A.[1], Omadjela, O. A.[4,5], & Nyembue, T. D.[1]

[1]*Department of Otorhinolaryngology, University Clinics of Kinshasa, Faculty of Medicine, University of Kinshasa, Kinshasa, Democratic Republic of the Congo*
[2]*Health Sciences Research Institute (IRSS), Kinshasa, Democratic Republic of the Congo*
[3]*Department of Dental Public Health, Faculty of Dental Medicine, University of Kinshasa, Kinshasa, Democratic Republic of the Congo*
[4]*Department of Otorhinolaryngology, Saint Joseph Hospital of Kinshasa, Kinshasa, Democratic Republic of the Congo*
[5]*Notre Dame University of Tshumbe, Sankuru, Democratic Republic of the Congo*

ARTICLE INFO

Received: *06 January 2025*
Accepted: *18 January 2025*
Published: *29 January 2025*

Keywords:
Olfactory disorders, chronic rhinosinusitis, patients, Democratic Republic of the Congo

Peer-Review: *Externally peer-reviewed*

Correspondence to:
Dr. Kamin Yasmin Tshingamb
yasminkamin@gmail.com

To cite:
Tshingamb, K. Y., Mpiana, S. J., Sekele, M. N. P., Kayembe, K. E., Banza, L. E., Ntumba, M. A., Omadjela, O. A., & Nyembue, T. D. (2025). Olfactory disorders in patients with chronic rhinosinusitis in Kinshasa, Democratic Republic of the Congo: A cross-sectional study. *Orapuh Journal, 6*(1), e1210
https://dx.doi.org/10.4314/orapj.v6i1.10

ISSN: *2644-3740*

Published by Orapuh, Inc. (info@orapuh.org)

Editor-in-Chief: Prof. V. E. Adamu
Orapuh, Inc., UMTG PMB 405, Serrekunda, The Gambia, editor@orapuh.org.

ABSTRACT

Introduction
Approximately three-quarters of patients with chronic rhinosinusitis (CRS) develop an olfactory disorder (OD). Due to its gradual onset and subtle nature, many CRS patients are unaware of their OD, making its assessment and prevalence difficult.

Objective
This study aimed to assess the frequency of ODs and the characteristics of CRS patients in a hospital setting in Kinshasa.

Methods
This was a cross-sectional and analytical study involving 105 CRS patients in two medical facilities in Kinshasa. Eligible patients were aged ≥18 years, diagnosed with CRS, had completed primary education, and provided informed consent. The ASOF questionnaire and the Sniffin' Sticks Test (SST) were used for subjective and/or objective olfactory assessment. Univariate analyses were performed to describe statistics for variables of interest. Frequencies were calculated for qualitative variables, while the mean (SD) was reported for quantitative variables. Proportions were compared using the Chi-square test, and the Student's t-test was used to compare means.

Results
The average age of patients was 40.3 ± 1.4 years, with a higher number of females. Allergic comorbidities were the most commonly reported in patient histories. Subjectively, only 22.9% of patients reported an altered sense of smell; however, using the SST, 63.8% of CRS patients were found to have an OD, primarily hyposmia. All mean scores for subjective and objective olfactory assessments were significantly higher ($p < 0.001$) among CRS patients with OD compared to those without. Additionally, the mean VAS level for loss of smell was higher in CRS patients with OD ($p < 0.001$). Patients with OD were significantly older than those without (42.6 ± 5.3 years vs. 36.3 ± 13.3 years; $p = 0.035$).

Conclusion
This study demonstrates that ODs are common in CRS, particularly among older patients. Olfactory assessment should be implemented to ensure effective diagnosis and management of rhinological conditions.

INTRODUCTION

Rhinosinusitis (RS) is an inflammation of the nasal and sinus mucosa (Fokkens et al., 2020), characterized by symptoms such as nasal congestion or obstruction, headaches, often posterior rhinorrhea, facial pain or a sensation of fullness, and olfactory disorders (OD). RS can be classified as acute (ARS) when symptoms last less than 12 weeks, and chronic (CRS) if symptoms persist continuously or intermittently for at least 12 weeks (Fokkens et al., 2020; Peters et al., 2021).

RS is one of the leading reasons for consultations in otolaryngology. Approximately 6% to 15% of the global population experiences ARS annually, while 5% to 12% suffer from CRS (Peters et al., 2021; Dietz de Loos et al., 2019). Over time, CRS negatively impacts quality of life (QoL) and leads to increased healthcare expenditures, with economic consequences related to absenteeism and reduced work performance (Fokkens et al., 2020; Kalala et al., 2024).

In recent decades, the study of olfaction has garnered significant interest from researchers, particularly with the emergence of Coronavirus Disease 2019 (COVID-19), which has led to an increase in ear, nose, and throat (ENT) consultations for OD (Giacomelli et al., 2020; Kim et al., 2021). Nevertheless, the methods for assessing the loss and quality of olfaction are not standardized and are infrequently utilized in clinical practice (Hummel et al., 2022).

Among patients with OD, post-CRS olfactory dysfunction accounts for approximately 14% to 30% of cases, followed by neurological, traumatic, toxic, and other causes (Dekeyser et al., 2024). The prevalence of OD in CRS patients is estimated at around 78% in the United States (Kholi et al., 2017) and 61% to 83% in Europe (Rombaux et al., 2016). However, most of these patients remain unaware of their condition due to its insidious nature and chronic onset (Rombaux et al., 2016).

In the Democratic Republic of the Congo, only one study using the SST test among the population in South Kivu reported rhinological causes as the most common etiology of OD (Balungwe et al., 2020). Although many CRS patients complain of OD, there are no available data on OD among CRS patients in Kinshasa.

Therefore, this study aimed to evaluate olfactory dysfunction, as well as the socio-demographic and clinical characteristics of CRS patients in our setting.

METHODS

Patients

This cross-sectional study was conducted in the ENT departments of Saint Joseph Hospital and the University Clinics of Kinshasa from April to September 2024. Patients aged 18 years and older, diagnosed with CRS according to the EPOS 2020 criteria, were included if they exhibited at least two of the following symptoms: nasal obstruction, anterior and/or posterior rhinorrhea, headaches or facial pressure, a sensation of fullness, and loss of smell (Fokkens et al., 2020). Additionally, patients were required to have completed at least primary school to ensure their ability to respond and collaborate during the olfactory tests. All patients provided informed consent.

Patients with conditions affecting olfactory evaluation were excluded, including those using corticosteroids within the last four weeks, those with sinonasal tumours, sinonasal surgery within the past six months, cranio-maxillofacial trauma, chronic systemic inflammatory conditions affecting the nasal cavity, and pregnancy.

Variables of Interest and Data Collection

A questionnaire on the socio-demographic and clinical characteristics of patients was administered by two trained ENT interns after a pre-test. This questionnaire included a subjective assessment of smell (the ASOF questionnaire) and a protocol sheet for the Sniffin' Sticks Test. The severity of major rhinological symptoms was measured using a visual analog scale (VAS) for major rhinosinusitis symptoms, the modified Lund-Kennedy endoscopic score, and the Lund-Mackay CT score.

Patients underwent a subjective smell evaluation using the Assessment of Olfactory Function and olfaction-related quality of life (ASOF) questionnaire, which consists of 12 items categorized into three groups: Subjective Olfactory Capability (SOC), Smell-Related Problems (SRP), and Olfactory-Related Quality of Life (ORQ). The Sniffin' Sticks Test (Extended test) ODOFIN Burghart MESSTECHNIK (mediSense, LOT FA23002862) measured the threshold, discrimination, and identification of odors. The composite TDI score was rated out of 48, obtained by

summing the scores of the three previous tests. Any patient with a TDI score less than or equal to 30.75 was considered to have an olfactory disorder, categorized as either hyposmia (TDI between 16 and 30.75) or anosmia (TDI < 16).

Two ENT residents were trained in the methodology and use of the questionnaire by the principal investigator. To ensure the consistency and validity of the questionnaire and olfactory test, a pre-test was conducted on 10% of the final sample size in a similar environment to the current study. Necessary corrections were made before the actual data collection, which was conducted using a structured interview.

Statistical Analysis

Data were entered using Microsoft Excel 365 and analyzed with SPSS version 27.0. The information was presented in the form of tables and figures. Qualitative variables were summarized as absolute and relative frequencies, while quantitative variables were summarized based on the normality of the distribution. For non-normal distributions, medians (with minimums and maximums) were used, and for normal distributions, means (with standard deviations) were reported. Additionally, some quantitative variables were summarized using measures of central tendency and dispersion (means, standard deviations, medians, minimums, and maximums), regardless of the distribution.

The Student's t-test was used to compare the means of quantitative variables based on the qualitative dependent variable (olfactory disorder), and the chi-square test was used to examine the association between independent variables (qualitative) and the dependent variable (qualitative).

Ethical Considerations

This research was part of a protocol that received ethical clearance from the National Health Ethics Committee (No. 536/CNES/BN/PMMF/202 of 20/05/2024), following the guidelines of the Declaration of Helsinki. Participants were provided with information through an informed consent statement that explained all important details of the study. All participants provided written informed consent prior to their involvement.

RESULTS

Of the 105 patients with chronic rhinosinusitis (CRS) included in the study, 67 (63.8%) had impaired olfaction.

Patient Characteristics

The cohort consisted of 67 women (63.8%) and 38 men (36.2%), with a mean age of 40.3 ± 1.4 years, as shown in **Table 1**. The most common age range was 36 to 55 years. Allergic comorbidities were the most prevalent. A minority of patients (21.9%) reported tobacco use, while nearly half reported some level of alcohol consumption **(Table 1)**.

Table 1:
Sociodemographic characteristics, history, and comorbidities

Characteristics	**N = 105, n**	**%**
Age* *(years)*	40.3 (±1.4)	
Sex		
Female	67	63.8
Male	38	36.2
Age group *(years)*		
18-35	41	39.1
36-55	44	41.9
56 and over	20	19.0
Level of education		
Non-University	57	54.3
University	48	45.7
Marital status		
In union	37	35.2
Lives alone	68	64.8
Financing of care		
Not insured	79	75.2
Insured	26	24.8
Occupation at risk of rhinosinusitis	13	12.4
History and comorbidities	n	%
Allergic diseases		
Atopy	28	26.7
Allergic rhinitis	19	18.1
Asthma	9	8.6
Drug allergy	9	8.6
Metabolic diseases		
High blood pressure	26	24.8
Known diabetes mellitus	2	1.9
Alcohol and smoking status		
Tobacco consumption	23	21.9
Form of tobacco consumed		
Socket	17	73.9
Cigarette	5	21.7
Mixed	1	4.3
Alcohol consumption	79	48.0

*Mean age (± Standard deviation)

https://dx.doi.org/10.4314/orapj.v6i1.10

Patient Clinic

Nasal symptoms were dominated by postnasal drip, pain, and nasal obstruction, as shown in Table 2.

Table 2:
Patient complaints

Complaints	N = 105, n	%
1. Rhinological		
Postnasal discharge	98	93.3
Pain	97	92.4
Nasal obstruction	94	89.5
Loss of smell	82	78.1
Anterior nasal discharge	74	70.5
Cacosmia	42	40
Sneeze	13	12.4
Nasal hyperreactivity	10	9.52
Epistaxis	4	3.81
Hemmage and closed rhinolalia	2	1.9
*2. Other complaints** (n)*	87	77.1
Dizziness	48	62
Pharyngeal paresthesias	6	7.8
Otorrhea	4	5.2
Tinnitus	3	3.9
Dysphonia	3	3.9
Earaches	3	3.9
Blurred visions	3	3.9
Ear itching	2	2.6
Eye itching	2	2.6
Feeling of blocked ears	2	2.6
Odynophagia	1	1.3

In Figure 1 below, the mean VAS scores for the SRMs were as follows: 4.98 (±0.27) for nasal obstruction, 3.8 (±0.32) for anterior nasal discharge, 5.28 (±0.26) for posterior nasal discharge, 4.29 (±0.32) for loss of smell, and 5.68 (±0.26) for headache (Figure 1).

Figure 1:
Visual Analogue Scale (VAS) scores for major rhinological symptoms

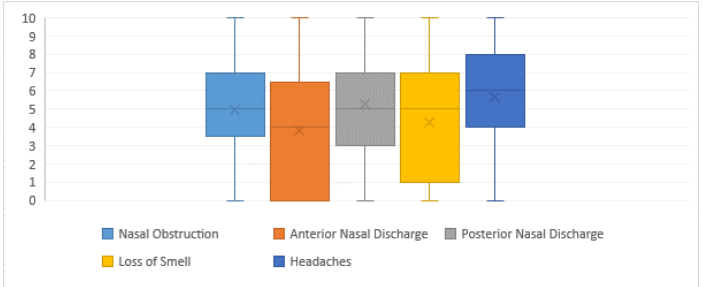

Table 3 indicates that nasal endoscopy findings were pathological in almost all patients. Nasal congestion and the presence of sero-mucous or mucous secretions were the most frequently observed features. However, hypertrophy of the inferior turbinates, septal deviation, and the presence of polyps were relatively uncommon. Additionally, approximately three out of four patients had an olfactory cleft accessible to examination (Table 4).

Table 3:
Findings from nasal endoscopy

Characteristics	LFN* n(%)	RFN** n(%)
Pathological nasal endoscopy	103 (98.1)	105 (100)
Condition of the nasal mucosa		
Congestive	66 (62.9)	67 (63.8)
Pale	25 (23.8)	26 (24.8)
Secretion in the nose		
Serous/seromucous secretions	41 (39)	44 (41.9)
Mucous membranes	18 (17.1)	12 (11.4)
Mucopurulent	27 (25.7)	33 (31.4)
Condition of the lower turbinate		
Hypertrophic	21 (20)	15 (14.3)
Nasal septum condition		
Deviated	10 (9.5)	2 (1.9)
Polyp	9 (8.6)	7 (6.7)
Accessibility of the olfactory cleft	73 (69.5)	74 (70.5)

Abbreviations: LFN*: Left false nostril; RFN**: Right false nostril

Evaluation of Olfaction

Subjectively, two out of ten patients reported impaired olfaction. About half of the patients experienced difficulty perceiving specific odours and reported impaired olfaction-related quality of life.

Objectively, two-thirds of the patients were diagnosed with olfactory dysfunction (OD). This indicates that about half of the patients were unaware of their olfactory impairment during self-assessment. Among those with OD, hyposmia was identified in 73.1% of cases (Table 4).

https://dx.doi.org/10.4314/orapj.v6i1.10

Table 4:
Assessment of olfactory function and quality of life

Settings	n	%
1. Subjective evaluation		
SOC		
Unaltered olfaction	81	77.1
Altered olfaction	24	**22.9**
SRP		
No difficulty in perceiving odors	55	52.4
Difficulty perceiving odors	50	**47.6**
ORQ		
No alteration of quality of life linked to smell	57	54.3
Alteration of quality of life related to smell	48	**45.7**
2. *Objective assessment of smell (TDI*)* (n)		
Normal sense of smell	38	36.2
Disturbed sense of smell	67	**63.8**
Anosmia	18	26.9
Hyposmia	49	**73.1**

Abbreviations: SOC: Subjective Olfactory Capability scale; SRP: Smell-Related Problems; ORQ: Olfactory-Related Quality of Life; TDI*: Threshold composite score, discrimination, identification

Subjective and Objective Assessment Scores

Using the ASOF questionnaire, the mean score for subjective assessment was 5.9 (±0.3) for SOC, 3.0 (±1.4) for SRP, and 3.6 (±1.3) for ORQ. The mean SST scores were 9.1 (±0.5) for T, 8.7 (±0.4) for D, 6.8 (±0.3) for I, and 25.5 (±1.1) for TDI. All mean scores obtained during the subjective and objective assessments were statistically lower (all $p < 0.001$) among patients with OD compared to those without OD **(Table 5)**.

Table 5:
Comparison of Mean Olfactory Scores Between the Patients' Group with and without OD

Olfactory Tests	All patients	Olfactory disorder		p
		Present	Absent	
Subjective				
SOC	5.9 (±0.3)	5.3 (±3.3)	7.5 (±2.4)	**<0.001**
SRP	3.0 (±0.1)	2.7 (±1.4)	3.7 (±1.9)	**<0.001**
ORQ	3.6 (±0.1)	3.2 (±1.3)	4.3 (±1.0)	**<0.001**
Objective				
T	9.1 (±0.5)	6.4 (±5.0)	13.7 (±3.1)	**<0.001**
D	8.7 (±0.4)	7.4 (±4.3)	11.1 (±2.1)	**<0.001**
I	6.8 (±0.3)	5.7 (±3.2)	8.9 (±2.0)	**<0.001**
TDI	25.5 (±1.1)	19.4 (±10.5)	33.6 (±4.4)	**<0.001**

Abbreviations: SOC: Subjective Olfactory Capability Scale; SRP: Smell-Related Problems; ORQ: Olfactory-Related Quality of Life; T: Threshold; D: Discrimination; I: Identification; TDI: TDI Composite Score.

Table 6:
Mean VAS Scores of Major Rhinologic Symptoms by Olfactory Disorder

Major rhinologic symptoms	With Olfactory disorder N=67	Without olfactory disorder N=38	p
	Mean (SD)	Mean (SD)	
Nasal obstruction	4.9 (±2.7)	5.1 (±2.9)	0.675
Anterior nasal discharge	3.4 (±3.3)	4.5 (±3.5)	0.130
Postnasal discharge	5.5 (±2.6)	4.9 (±2.7)	0.344
Loss of smell	5.1 (±3.3)	2.8 (±2.6)	<0.001
Headaches	5.5 (±2.7)	6.0 (±2.6)	0.281

Sociodemographic, Clinical Characteristics, and Severity of CRS

Age was significantly higher in the group of patients with olfactory disorder compared to the group without OD (42.6 ± 5.3 years vs. 36.3 ± 13.3 years; $p = 0.035$). Other characteristics were not different between the two groups (data not shown).

Considering age, patients older than 55 years had all subjective and objective mean scores lower compared to young patients **(Table 7)**.

Table 7:
Subjective and Objective Olfactory Tests According to Age

Olfactory tests	All patients	Age (years)		
		18-35	36-55	56 and over
Subjective				
SOC	5.9 (±0.3)	6.0 (±0.4)	6.6 (±0.5)	5.2 (±0.8)
SRP	3.0 (±1.4)	3.0 (±0.2)	3.2 (±0.2)	2.7 (±0.4)
ORQ	3.6 (±1.3)	3.7 (±0.2)	3.8 (±0.2)	3.2 ± (0.3)
Objective				
T	9.1 (±0.5)	10,0 (±5.0)	9.8 (±5.5)	5.7 (±6.1)
D	8.7 (±0.4)	10.3 (±3.2)	8.5 (±3.9)	5.8 (±4.5)
I	6.8 (±0.3)	7.8 (±2.8)	6,55 (±3.0)	5.4 (±3.9)
TDI	25.5 (±1.1)	27.9 (±9.2)	24,8 (±10.6)	16.9 (±12.8)

DISCUSSION

In this study, approximately two-thirds of patients with CRS (63.8%) had olfactory disorders. This result is similar to that found by Yuan et al. (2022), who reported 62.86% in a study conducted in China. However, our frequency is slightly higher than that of Soler et al. (2016) (58.2%) and lower than those of Kholi et al. (2016) (78.2%) and Schlosser et al. (2020) (73%), who used the same SST. This high frequency is not surprising because studies show that 61% to 83% of patients with CRS experience olfactory disorders (Rombaux et al., 2016). The difference seen between our group and others may be due to the lack of a consensus on how to assess olfactory dysfunction. The SST measures olfaction based on the composite TDI score, which combines results from threshold, discrimination, and identification tests. The SST is not a standardized test

and may be influenced by the local culture (familiar smells) of the studied population, which could explain the differences between groups. Olfactory test results for threshold and discrimination scores are not influenced by cultural behavior and environmental odors, but the identification test may be influenced by cultural context. This helps validate our results, as reported by many authors. However, the variation in the identification test according to familiar odors has been reported and could affect the overall TDI score to some extent (Balungwe et al., 2020). Balungwe et al. (2020) in the eastern population of the Democratic Republic of the Congo reported a small difference in the identification test using both the standardized SST and the SST modified with five local odors. This difference in the identification test had a small impact on the TDI score.

The average age of patients in our study was 40.3 ± 1.4 years, which is lower than the findings of Yuan et al. (2022), Loftus et al. (2020), and Soler et al. (2016), who reported average ages of 43.6 ± 12.9 years, 50 ± 16.1 years, and 52.7 ± 16.1 years, respectively, in studies conducted in China and the USA. This discrepancy may be attributed to differences in the populations studied, as the African population tends to be younger compared to the Western populations involved in the other studies. The female demographic was predominant in our study, accounting for 63.8% of participants. In contrast, Yuan et al. (2022) reported a male predominance of 65.7%. Loftus et al. (2020) and Zhang et al. (2023) noted a more balanced distribution between genders. This disparity in results could be due to the fact that women tend to be more concerned with appearance, illness, beauty, and/or odors compared to men. However, there was no difference in the mean scores obtained during olfactory tests between female and male patients.

In a study, only 22% of patients stated that they had trouble with their sense of smell based on the ASOF-SOC score. Almost half of the patients (47.6%) reported having trouble recognizing specific smells (ASOF-SRP). However, when their sense of smell was tested more objectively using the SST, about two-thirds of the patients (63.8%) showed disorders with their olfaction. This matches findings from Mattos et al. (2020), which suggest there is a difference between what patients report about their smell disorders and the results from objective smell tests. In fact, research shows that around one in four patients with smell disorders are not even aware of their condition (Rombaux et al., 2016). This highlights the limitations of self-assessment tests, which are not reliable enough on their own for diagnosing smell disorders. These findings about patients not realizing their smell problems emphasize the need for objective tests in the evaluation of smell, which is often overlooked in clinical settings. Having a good sense of smell is important for quality of life and for staying safe from dangerous situations.

Additionally, this study revealed that the mean scores obtained from the ASOF questionnaire were significantly lower when comparing patients with olfactory disorder (OD) to patients without OD. This result supports the conclusions of Pusswald et al. (2012), who indicated that the ASOF questionnaire could serve as a subjective evaluation tool for olfactory function. However, it is important to note that this questionnaire remains a subjective assessment that is highly dependent on the patient and should always be complemented by an objective olfactory test.

In this study, OD was independent of the patients' sex, whether assessed through threshold, discrimination, or identification tests. While some authors have suggested that females may be more affected by olfactory disorders (Balungwe et al., 2020), the mechanism behind the onset of these disorders does not appear to be significantly influenced by sex (Rombaux et al., 2016). In contrast, patient age was significantly associated with olfactory disorders in this study, with individuals over 55 years old being the most affected. This finding aligns with observations made by Rombaux et al. (2016), Dalton et al. (2004), Balungwe et al. (2020), and several other researchers. Thus, the aging process, which also impacts olfactory sensory cells, is linked to olfactory disorders in older adults (Attems et al., 2015).

Strengths and limitations of the study

This study is the first to assess OD in Kinshasa, especially in patients with CRS with and without nasal polyps. However, due to its hospital-based and cross-sectional nature, along with a non-exhaustive sample size, we cannot generalize our findings to the broader population.

We also used the original extended version of the SST, which may explain some bias due to some unknown odors that may not be adapted to our cultural and environmental context.

CONCLUSION

Olfactory disorders are common in patients with sinonasal diseases, affecting approximately two out of three patients, particularly in older individuals. Olfactory assessment is essential for improving the diagnosis and treatment of rhinological conditions. Therefore, a large-scale study will be planned to determine the prevalence of olfactory disorders in the general population.

Authors' Contributions: Conceptualization: TKY and NTD; Data collection: TKY, NMA, and BLE; Data processing: TKY, MS, and NTD; Statistical analyses: SMNP and NTD; Manuscript writing contributions: MS, KKE, and OOA; Original version: TKY, MS, and NTD; Supervision: NTD. All authors have reviewed and approved the final version of the manuscript.

Acknowledgments: We would like to sincerely thank all the authors and managers of the healthcare establishments who made this study possible. We express our heartfelt gratitude to all the authors and managers of the healthcare facilities who contributed to the completion of this study.

Ethical Approval: This research was conducted under a protocol that has received ethical clearance from the National Health Ethics Committee (No. 536/CNES/BN/PMMF/202 of 20/05/2024), adhering to the principles outlined in the Declaration of Helsinki. Patients' names were not recorded on the survey documents.

Conflicts of Interest: None declared.

ORCID iDs:

Tshingamb, K. Y.[1]:	Nil identified
Mpiana, S. J.[1,2]:	Nil identified
Sekele, M. N. P.[3]:	https://orcid.org/0000-0001-5144-4654
Kayembe, K. E.[1,2]:	Nil identified
Banza, L. E.[1]:	Nil identified
Ntumba, M. A.[1]:	https://orcid.org/0009-0005-3772-1324
Omadjela, O. A.[4,5]:	Nil identified
Nyembue, T. D.[1]:	Nil identified

REFERENCES

Attems, J., Walker, L., & Jellinger, K. A. (2015). Olfaction and aging: A mini-review. *Gerontology, 61*(6), 485–490. https://doi.org/10.1159/000381619

Balungwe, P., Huart, C., Bisimwa, G., Matanda, R., Mouraux, A., & Rombaux, P. (2020). Assessing olfactory function in patients with smell disorders in the South Kivu province of the Democratic Republic of the Congo. *B-ENT, 16*(2), 115–119. https://doi.org/10.5152/b-ent.2020.19021

Balungwe, P., Huart, C., Matanda, R., Bisimwa, G., Mouraux, A., & Rombaux, P. (2020). Adaptation of the Sniffin' Sticks Test in South-Kivu. *European Annals of Otorhinolaryngology, Head and Neck Diseases, 137*(6), 467–471. https://doi.org/10.1016/j.anorl.2020.01.012

Dalton, P. (2004). Olfaction and anosmia in rhinosinusitis. *Current Allergy and Asthma Reports, 4*(3), 230–236. https://doi.org/10.1007/s11882-004-0031-3

De Araújo Neto, S. A., Baracat, E. C. E., & Felipe, L. F. (2010). Um novo escore para opacificação tomográfica dos seios paranasais em crianças. *Brazilian Journal of Otorhinolaryngology, 76*(4), 491–498. https://doi.org/10.1590/s1808-86942010000400014

De Loos, D. D., Lourijsen, E. S., Wildeman, M. A., Freling, N. J., Wolvers, M. D., Reitsma, S., & Fokkens, W. J. (2018). Prevalence of chronic rhinosinusitis in the general population based on sinus radiology and symptomatology. *Journal of Allergy and Clinical Immunology, 143*(3), 1207–1214. https://doi.org/10.1016/j.jaci.2018.12.986

Dekeyser, A., Huart, C., Hummel, T., & Hox, V. (2024). Olfactory loss in rhinosinusitis: Mechanisms of loss and recovery. *International Journal of Molecular Sciences, 25*(8), 4460. https://doi.org/10.3390/ijms25084460

Fokkens, W., Lund, V., & Mullol, J. (2020). European position paper on rhinosinusitis and nasal polyps 2020. *Rhinology Journal, 0*(0), 1–464. https://doi.org/10.4193/rhin20.600

Giacomelli, A., Pezzati, L., Conti, F., Bernacchia, D., Siano, M., Oreni, L., Rusconi, S., Gervasoni, C., Ridolfo, A. L., Rizzardini, G., Antinori, S., & Galli, M. (2020). Self-reported olfactory and taste disorders in patients with severe acute respiratory coronavirus 2 infection: A cross-sectional study. *Clinical Infectious Diseases, 71*(15), 889–890. https://doi.org/10.1093/cid/ciaa330

Hummel, T., Whitcroft, K., Andrews, P., Altundag, A., Cinghi, C., Costanzo, R., Damm, M., Frasnelli, J., Gudziol, H., Gupta, N., Haehne, A., Holbrook, E., Hong, S., Hornung, D., Huttenbrink, K., Kamel, R., Kobayashi, M., Konstantinidis, I., Landis, B.,. . . Welge-Luessen, A. (2017). Position paper on olfactory dysfunction. *Rhinology Journal, 54*(26), 1–30. https://doi.org/10.4193/rhino16.248

Kalala, H. K., Kakobo, P. K., Yalombe, H. N., Mvita, L. K., Muamba, L. N., & Nyembue, D. T. (2024). Evaluation of the quality of life of patients suffering from chronic rhinosinusitis in a hospital setting in Kinshasa. *International Journal of Otolaryngology and Head & Neck Surgery, 13*(01), 41–52. https://doi.org/10.4236/ijohns.2024.131005

Kim, J., Kim, H. S., Kim, M., Kim, S. H., Cho, S., & Kim, J. Y. (2021). Validation of olfactory questionnaire in Koreans: An alternative for conventional psychophysical olfactory tests. *Journal of Korean Medical Science, 36*(6). https://doi.org/10.3346/jkms.2021.36.e34

Kohli, P., Naik, A. N., Harruff, E. E., Nguyen, S. A., Schlosser, R. J., & Soler, Z. M. (2016). The prevalence of olfactory dysfunction in chronic rhinosinusitis. *The Laryngoscope, 127*(2), 309–320. https://doi.org/10.1002/lary.26316

Lim, M., Lew-Gor, S., Darby, Y., Brookes, N., Scadding, G., & Lund, V. J. (2007). The relationship between subjective assessment instruments in chronic rhinosinusitis. *PubMed, 45*(2), 144–147. https://pubmed.ncbi.nlm.nih.gov/17708462

Loftus, C., Schlosser, R. J., Smith, T. L., Alt, J. A., Ramakrishnan, V. R., Mattos, J. L., Mappus, E., Storck, K., Yoo, F., & Soler, Z. M. (2019). Olfactory cleft and sinus opacification differentially impact olfaction in chronic rhinosinusitis. *The Laryngoscope, 130*(10), 2311–2318. https://doi.org/10.1002/lary.28332

Mattos, J. L., Schlosser, R. J., Storck, K. A., & Soler, Z. M. (2017). Understanding the relationship between olfactory-specific quality of life, objective olfactory loss, and patient factors in chronic rhinosinusitis. *International Forum of Allergy & Rhinology, 7*(7), 734–740. https://doi.org/10.1002/alr.21940

Peters, A. T., & Patel, G. (Updated 2021). Rhinosinusitis - synopsis - World Allergy Organization. https://www.worldallergy.org/component/content/article/rhinosinusitis-synopsis-peters-at-patel-g-updated-2021?catid=16&Itemid=101

Pusswald, G., Auff, E., & Lehrner, J. (2012). Development of a brief self-report inventory to measure olfactory dysfunction and quality of life in patients with problems with the sense of smell. *Chemosensory Perception, 5*(3–4), 292–299. https://doi.org/10.1007/s12078-012-9127-7

Rombaux, P., Huart, C., Levie, P., Cingi, C., & Hummel, T. (2016). Olfaction in chronic rhinosinusitis. *Current Allergy and Asthma Reports, 16*(5). https://doi.org/10.1007/s11882-016-0617-6

Schlosser, R. J., Desiato, V. M., Storck, K. A., Nguyen, S. A., Hill, J. B., Washington, B. J., Noonan, T. E., Lamira, J., Mulligan, J. K., Rowan, N. R., Yoo, F., Matthews, L. J., Dubno, J. R., & Soler, Z. M. (2020). A community-based study on the prevalence of olfactory dysfunction. *American Journal of Rhinology and Allergy, 34*(5), 661–670. https://doi.org/10.1177/1945892420922771

Soler, Z. M., Kohli, P., Storck, K. A., & Schlosser, R. J. (2016). Olfactory impairment in chronic rhinosinusitis using threshold, discrimination, and identification scores. *Chemical Senses, 41*(9), 713–719. https://doi.org/10.1093/chemse/bjw080

Yuan, F., Wu, D., & Wei, Y. (2022). Predictive significance of the questionnaire of olfactory disorders-negative statements for olfactory loss in patients with chronic rhinosinusitis. *European Archives of Oto-Rhino-Laryngology, 279*(11), 5253–5262. https://doi.org/10.1007/s00405-022-07438-z

Zhang, L., Wang, T., Wang, Z., Li, H., Wu, Y., Guo, S., Li, W., You, J., & Chao, C. (2023). Analysis of risk factors affecting olfactory dysfunction in patients with chronic rhinosinusitis: Highlighting the role of metabolic syndrome. *Laryngoscope Investigative Otolaryngology, 8*(3), 615–620. https://doi.org/10.1002/lio2.1061