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Radiology

Assessment of Paranasal Sinus Diseases Using Computed Tomography in Sudanese Population: A Study in Kassala and Shandi States

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Abstract	Original Research Article

Background: Paranasal sinus diseases are a significant health concern globally, and their prevalence and characteristics can vary based on geographical and environmental factors. In Sudan, limited data exist on the spectrum of these diseases. This study aimed to assess the patterns of paranasal sinus diseases using computed tomography (CT) in the Sudanese population in Kassala and Shandi States. **Methods:** A descriptive, cross-sectional study was conducted from November to December 2024. A total of 70 patients from Kassala and Shandi States presenting with symptoms of sinus disease and referred for CT sinus evaluation were included. Data on demographics, clinical presentation, CT findings, treatment, and outcomes were collected and analyzed. **Results:** The study included 34 (48.6%) males and 36 (51.4%) females, with a mean age of 32.44 years. The most common diagnosis was sinusitis, affecting 62.9% of patients, followed by polyps (27.1%). Headache was a universal symptom (100%), followed by nasal congestion (82.9%). The maxillary sinus was the most frequently affected (77.1%). A significant proportion of patients (82.9%) experienced vision problems as a complication. The majority of patients were treated with decongestants (82.9%) and allergy medicine (62.9%). Recovery within 2-3 weeks was reported by 62.9% of patients. **Conclusion:** Sinusitis is the most prevalent paranasal sinus disease in the studied Sudanese population, with a high burden of symptoms and complications. CT imaging is a crucial tool for accurate diagnosis and management. These findings highlight the need for enhanced public awareness, improved healthcare access, and further research into the specific etiological factors in this region.
Keywords: Paranasal Sinus Diseases, Computed Tomography, Sinusitis, Sudanese Population, Kassala, Shandi.

INTRODUCTION

Paranasal sinus diseases encompass a range of inflammatory and infectious conditions affecting the four paired, air-filled cavities surrounding the nasal cavity: the maxillary, ethmoidal, frontal, and sphenoid sinuses. These conditions, most commonly manifesting as rhinosinusitis, represent a significant and growing global health problem, imposing a substantial financial burden on individuals and healthcare systems [1] While often not life-threatening, the chronic nature of these diseases can significantly impair quality of life, leading to decreased productivity, missed workdays, and impaired sleep [2]

The epidemiology of paranasal sinus diseases, particularly chronic rhinosinusitis (CRS), exhibits considerable geographical variation. In Western countries, the prevalence of CRS is estimated to be between 5% and 15% of the population [1,2] In Africa, while data is more limited, studies suggest a high prevalence of sinonasal pathologies. For instance, a study in Nigeria reported rhinosinusitis as one of the most frequent otorhinolaryngology diseases encountered in daily practice [3] Similarly, research in South Africa has highlighted the increasing health problem and financial burden of sinusitis [1]

In Sudan, a vast and diverse country, environmental and socioeconomic factors likely play a significant role in the pattern of paranasal sinus diseases. Exposure to dust, allergens, and specific climatic conditions may influence the prevalence and severity of these conditions. Fungal rhinosinusitis, in particular, has been identified as a common and often extensive disease in Sudan, with Aspergillus flavus being a predominant causative agent [4] Furthermore, studies on bacterial pathogens in Sudanese patients with sinusitis have

identified a range of organisms, with a high prevalence of Staphylococcus aureus [5,6]

Computed tomography (CT) has become the gold standard for the radiological evaluation of paranasal sinus diseases [7] It provides detailed anatomical information, allowing for the accurate assessment of the extent of mucosal disease, the identification of underlying anatomical variations that may predispose to sinusitis, and the detection of complications. For preoperative planning in functional endoscopic sinus surgery (FESS), CT is considered an indispensable tool [7]

Despite the high burden of sinonasal symptoms in the Sudanese population, there is a paucity of comprehensive studies that utilize CT imaging to characterize the spectrum of paranasal sinus diseases in different regions of the country. This study was therefore undertaken to assess the demographic patterns, clinical presentations, and CT findings of paranasal sinus diseases in patients from Kassala and Shandi States, two areas with distinct geographical and environmental characteristics. The findings of this research are intended to provide valuable data for clinicians, public health professionals, and policymakers to better understand and manage these conditions in the Sudanese context.

MATERIALS AND METHODS
Study Design and Setting
This was a descriptive, cross-sectional hospital-based study conducted during the period of November to December 2024. The study was carried out in Kassala and Shandi States in Sudan. The target population included patients presenting with symptoms suggestive of paranasal sinus disease who were referred for a CT scan of the paranasal sinuses.

Study Population and Sampling
A total of 70 patients were enrolled in the study. The inclusion criteria were patients of any age and gender residing in Kassala or Shandi State, presenting with clinical symptoms of paranasal sinus disease, and who underwent a CT scan of the paranasal sinuses. Patients with a history of recent facial trauma or those who had undergone previous sinus surgery that could alter the anatomy were excluded.

Data Collection
Data was collected using a structured questionnaire and by reviewing the patients' medical records and CT scan reports. The collected data included:
- Demographic data: Age and gender.
- Clinical data: Presenting signs and symptoms and any reported complications
- CT scan findings: The diagnosed pathology and the specific sinuses affected
- Treatment and Outcome: The type of treatment received, the time to recovery, and any post-treatment deformities or persistent symptoms.

Data Analysis
SPSS 25.V. was used to analyze data using descriptive statistics. Frequencies and percentages were calculated for categorical variables. The data is presented in tables and a descriptive plot.

Ethical approval
Ethical approval for this study was obtained from the research ethics committee of the Faculty of Radiologic Imaging Science at AlzaiemAlazhari University. The study was conducted in accordance with the ethical standards of the institution and the Helsinki Declaration.

RESULTS
Demographic Characteristics
A total of 70 patients were included in this study, with 34 (48.6%) being male and 36 (51.4%) female (Figure 1). The age of the patients ranged from 12 to 87 years, with a mean age of 32.44 years (Standard Deviation ±14.476). The mean age for males was 34.23 years, and for females, it was 30.75 years. The age group with the highest number of patients was 19–29 years, constituting 34.3% of the total, followed by the 30–39 years age group (25.7%). The distribution of patients across different age groups is detailed in Table 1.
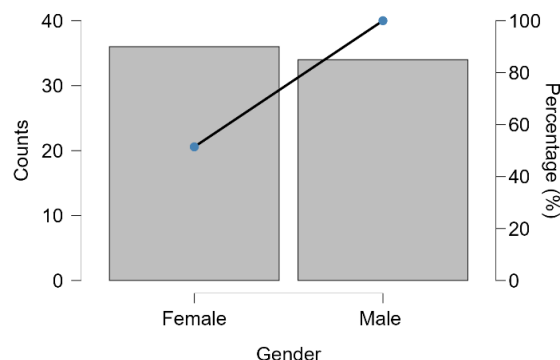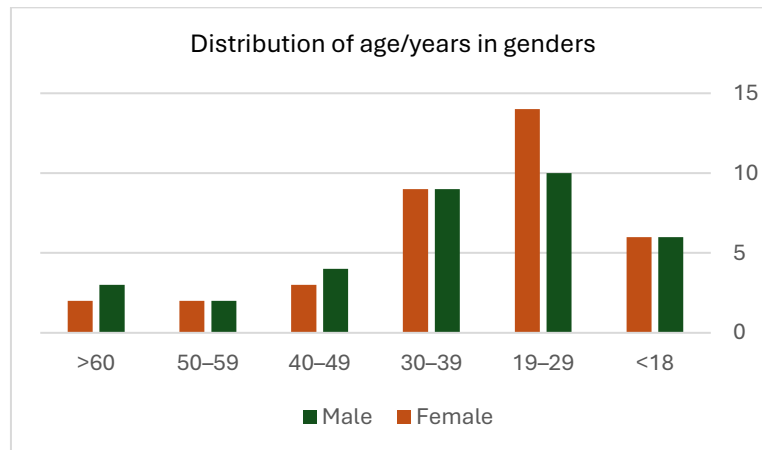

Figure 1. Gender distribution

Table 1. Descriptive Statistics of Age and according to gender

Age	Minimum	Maximum	Mean	Std. Deviation
Male	15	87	34.23	15.74
Female	12	68	30.75	13.16
All	12	87	32.44	14.476

According to age group distribution among genders, the highest age group in the study was 19–29 years, comprising 34.3% of the total participants (29.4% males and 38.9% females). In contrast, the lowest represented age group was 50–59 years, accounting for only 5.7% of the total sample (5.9% males and 5.6% females) (Figure 2).

Figure 1: Distribution of age/years in genders

Clinical Diagnoses and Affected Sinuses

The most common diagnosis based on CT findings was sinusitis, which was observed in 44 patients (62.9%). Polyps were the second most frequent finding, present in 19 patients (27.1%). A combination of polyps and sinusitis was found in 3 patients (4.3%), and a mass was diagnosed in 4 patients (5.7%). A descriptive plot of these diagnoses is shown in Figure 2.
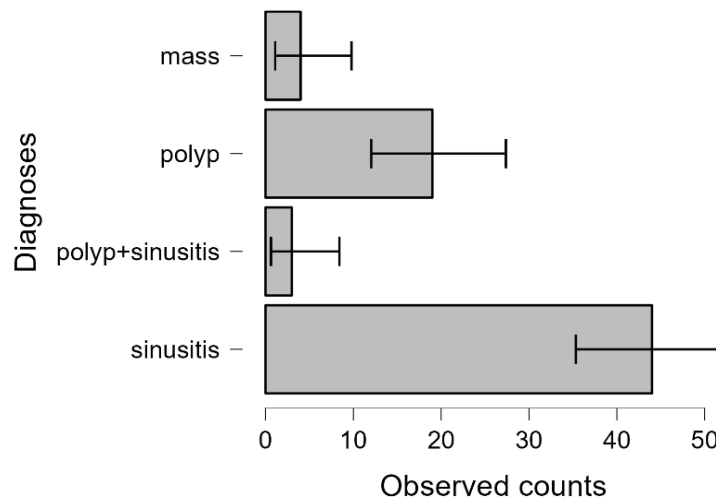
**Figure 3: Descriptive Plot of pathology diagnosis**

Table 3: Descriptive Statistics PNS variables and distribution across genders

Category	Variables	Total	Male	Female
Diagnosis	Mass	4 (5.7%)	3 (8.8%)	1 (2.8%)
	Polyp	19 (27.1%)	9 (26.5%)	10 (27.8%)
	Polyp+ sinusitis	3 (4.3%)	0 (0%)	3 (8.3%)
	sinusitis	44 (62.9%)	22 (64.7%)	22 (61.1%)

Category	Variables	Total	Male	Female
Affected sinuses	Maxillary	54 (77.1%)	28 (82.4%)	26 (72.2%)
	Ethmoidal	38 (54.3%)	17 (50.0%)	21 (58.3%)
	Frontal	36 (51.4%)	17 (50.0%)	19 (52.8%)
	sphenoid	31 (44.3%)	15 (44.1%)	16 (44.4%)
Signs and Symptoms	Nasal congestion	58 (82.9%)	29 (85.3%)	29 (80.6%)
	Reduce sense of smell	39 (55.7%)	24 (70.6%)	15 (41.7%)
	Headache	70 (100%)	34 (100%)	36 (100%)
Complications	Vision problems	58 (82.9)	29 (85.3%)	29 (80.6%)
	Cystic fibrosis	26 (37.1%)	12 (35.3%)	14 (38.9%)
Treatment	Nasal spray	32(45.7%)	16 (47.1%)	16 (44.4%)
	Decongestions	58 (82.9%)	30 (88.2%)	28 (77.8%)
	Allergy medicine	44 (62.9%)	23 (67.6%)	21 (58.3%)
	Surgery	22 (31.4%)	9 (26.5%)	13 (36.1%)
How long did it take until recovery?	2-3weeks	44 (62.9%)	3 (8.8%)	1 (2.8%)
	1-2 months	19 (27.1%)	9 (26.5%)	10 (27.8%)
	6-12 months	4 (4.7%)	0 (0%)	3 (8.3%)
deformities affected organ after treatment	Structural changes	9 (12.9%)	22 (64.7%)	22 (61.1%)
	Reduce smell or taste	7 (10%)	28 (82.4%)	26 (72.2%)
	Chronic symptoms	19 (27.1%)	17 (50.0%)	21 (58.3%)
	Nasal distress	65 (92.9 %)	17 (50.0%)	19 (52.8%)
	bleedings	17 (24.3%)	15 (44.1%)	16 (44.4%)

The distribution of affected sinuses revealed that the maxillary sinus was the most commonly involved, seen in 54 patients (77.1%). This was followed by the ethmoidal sinus (54.3%), frontal sinus (51.4%), and sphenoid sinus (44.3%). The detailed distribution across genders was provided in (Table 4 & Fig. 3)
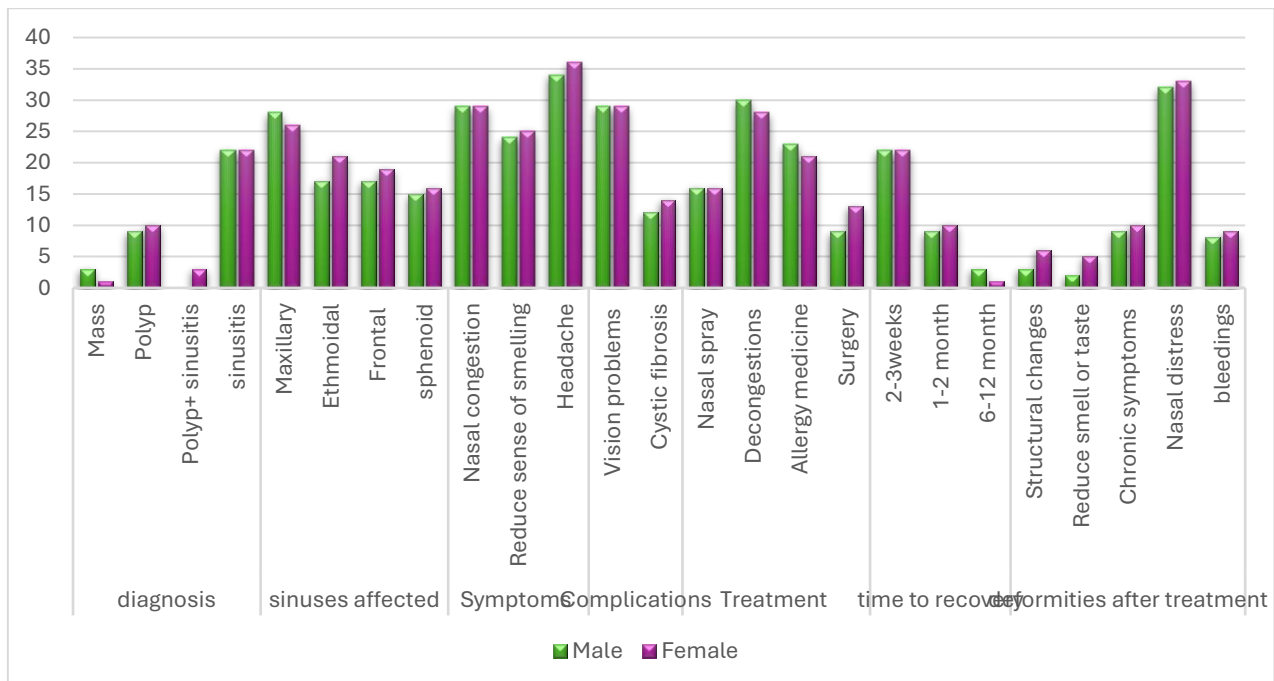
Fig 3: Descriptive Statistics PNS variables and distribution across genders

Signs, Symptoms, and Complications
Headache was a universal symptom, reported by all 70 patients (100%). Nasal congestion was also highly prevalent, affecting 58 patients (82.9%). A reduced sense of smell was reported by 39 patients (55.7%). A significant number of patients, 58 (82.9%), reported vision problems as a complication.

Furthermore, 26 patients (37.1%) had a concurrent diagnosis of cystic fibrosis.Table 4

Treatment and Outcomes
The most common treatment was the use of decongestants, prescribed to 58 patients (82.9%). Allergy medicine was used by 44 patients (62.9%), and

nasal sprays by 32 patients (45.7%). Surgical intervention was undertaken in 22 patients (31.4%). Regarding recovery, 44 patients (62.9%) reported recovery within 2-3 weeks, while 19 (27.1%) took 1-2 months to recover. Post-treatment, a variety of issues were reported. Nasal distress was the most common complaint, affecting 65 patients (92.9%). Chronic symptoms were reported by 19 patients (27.1%), structural changes by 9 patients (12.9%), reduced smell or taste by 7 patients (10%), and bleeding by 17 patients (24.3%). A comprehensive summary of these findings is presented in Table 4.

Sinus Pathology Across Age Groups

The distribution of affected sinuses was analyzed across different age groups. The 19-29 age group showed the highest involvement of the frontal sinus (38.9%), while the 30-39 age group had the highest involvement of the ethmoidal (31.6%) and sphenoid (32.3%) sinuses. No statistically significant association was found between the specific sinus affected and the age group (P-values > 0.05 for all sinuses), as shown in Table 5.

Table 5: Distribution of sinus pathology across age groups

Sinuses	age groups						Total	
	<18	19-29	30-39	40-49	50-59	>60		P value
Maxillary	9 (16.7%)	17 (31.5%)	15 (27.8%)	6 (11.1%)	3 (5.6%)	4 (7.4%)	54	.936
Ethmoidal	7 (18.4%)	11 (28.9%)	12 (31.6%)	4 (10.5%)	2 (5.3%)	2 (5.3%)	38	.800
Frontal	6 (16.7%)	14 (38.9%)	9 (25.0%)	5 (13.9%)	1 (2.8%)	1 (2.8%)	36	.454
Sphenoid	6 (19.4%)	9 (29.0%)	10 (32.3%)	4 (12.9%)	1 (3.2%)	1 (3.2%)	31	.578
Total	**28 (17.6%)**	**51 (32.1%)**	**46 (28.9%)**	**19 (11.9%)**	**7 (4.4%)**	**8 (5.0%)**	70(100%)	

DISCUSSION

This study provided valuable insight into the CT-assessed characteristics of paranasal sinus diseases in a Sudanese population from Kassala and Shandi States. The findings reveal a high burden of inflammatory sinus disease, universal presentation with headaches, and a significant rate of associated complications.

The predominance of sinusitis (62.9%) in our cohort aligns with the global understanding of sinonasal pathology, where rhinosinusitis was the most common manifestation. However, the prevalence in our study appears robust more age-affected sinus being the maxillary affecting younger adults 19-29 years old and males more than females in all sinus pathologies. For comparison, a large-scale study in the United States based on self-reported symptoms found a prevalence of chronic sinusitis to be around 12% (8). While methodologies differ, our findings, based on symptomatic patients referred for CT, suggest a high burden of severe or persistent disease in this Sudanese population. This could be attributed to various factors prevalent in the region, including environmental exposures like dust and specific allergens, as well as potential genetic predispositions and socioeconomic factors that may delay diagnosis and treatment.

The maxillary sinus was the most frequently affected sinus (77.1%), followed by the ethmoidal, frontal, and sphenoid sinuses. This pattern is consistent with findings from numerous international studies. A study from India, for example, also reported the maxillary sinus as the most commonly involved sinus in patients with chronic rhinosinusitis (9). This is anatomically logical, as the maxillary sinus is the largest of the paranasal sinuses and its ostium is located superiorly, which can impede drainage and predispose it to fluid collection and inflammation.

A striking finding in our study was the universal reporting of headache (100%) among patients. While headache is a well-recognized symptom of sinusitis, a 100% prevalence is exceptionally high compared to other populations. For instance, a study in Turkey found headache in 75% of patients with chronic rhinosinusitis (10). This universal prevalence in our cohort may indicate a tendency for patients in this region to seek medical attention only when symptoms become severe, with headache being a particularly debilitating symptom. It may also reflect specific patterns sinus inflammation or referral bias.

Another alarming finding is the high rate of reported vision problems (82.9%). Orbital complications of sinusitis, while known, are generally considered less common. A study found Among these patients, 75 experienced complications, which translates to an incidence rate of approximately 3.3% for complications in the overall population of sinusitis patients(11) The exceedingly high rate in our study is a major concern and could suggest a high prevalence of aggressive, untreated, or late-stage disease that extends beyond the sinus cavities. It warrants urgent investigation into the specific nature of these vision problems (e.g., orbital cellulitis, optic neuritis) and the underlying pathology. This finding may also be linked to the prevalence of fungal sinusitis in Sudan, which is known for its aggressive and invasive nature (4).

The reported association with cystic fibrosis (37.1%) is also noteworthy and unusually high. Cystic fibrosis is a genetic disorder that is typically considered rare in African populations. The reported prevalence in our study is orders of magnitude higher than expected

and may be due to misinterpretation of the data, a specific genetic cluster, or a misunderstanding of the term in the data collection phase. This finding requires careful verification.

The treatment patterns reflect standard medical management, with decongestants and allergy medications being the mainstay. However, the high rate of persistent post-treatment symptoms, particularly nasal distress (92.9%), suggests that current treatment strategies may be suboptimal or that the underlying disease is particularly recalcitrant in this population.

LIMITATIONS

This study has several limitations. The sample size is relatively small, which limits the generalizability of the findings to the entire Sudanese population. The data on complications and post-treatment outcomes were based on patient reports and could be subject to recall bias.

CONCLUSION

This study, conducted in the Sudanese regions of Kassala and Shandi, shows that sinusitis—mainly affecting the maxillary sinus—is the most frequently diagnosed paranasal sinus disorder based on CT imaging. The patient group experienced a high symptom burden, with headache reported universally and vision-related issues occurring at a very high rate. These findings highlight the significant clinical impact of paranasal sinus diseases in the region and underline the crucial role of CT imaging in their accurate diagnosis and assessment. The prevalence of complications and ongoing post-treatment symptoms indicates the need for further research into region-specific causes, including environmental factors and microbial patterns. Additionally, a thorough review of current treatment protocols is necessary. Enhanced public health measures promoting early detection and intervention are essential to reduce the morbidity associated with these common and often disabling conditions in Sudan.

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