



# Clinical and Mycological Profile of Fungal Rhinosinusitis: A Cross-Sectional Study

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## KEYWORDS

Fungal rhinosinusitis, Aspergillus

## ABSTRACT:

**Introduction:** Fungal rhinosinusitis (FRS) is an important subtype of chronic rhinosinusitis, particularly in immunocompromised patients. It presents with varied clinical features and requires accurate diagnosis for effective management.

**Aim:** To evaluate the clinical and mycological profile of fungal rhinosinusitis in patients presenting to a tertiary care hospital.

**Materials and Methods:** This cross-sectional prospective study was conducted from January 2024 to December 2025, enrolling 83 patients with suspected FRS. Clinical evaluation, specimen collection (nasal exudates, swabs, biopsies, sinus pus), direct microscopy (KOH mount), and culture on Sabouraud Dextrose Agar were performed. Fungal isolates were identified using standard mycological techniques. Data were analyzed using descriptive statistics.

**Results:** The majority of patients were 41–50 years old (36.14%), with male predominance (60.24%). The most common symptoms were nasal discharge (69.88%) and nasal blockage (54.22%). Diabetes mellitus was the leading predisposing factor (55%). Culture positivity was 69.88%, compared to KOH positivity in 55.42% of culture-positive cases. *Aspergillus niger* was the most frequent isolate (26%), followed by *Mucor* (17%) and *Candida albicans* (13%). Biopsy and sinus pus samples yielded the highest positivity (88–100%).

**Conclusion:** FRS is most prevalent in middle-aged males with diabetes. Nasal discharge and obstruction are hallmark symptoms, while orbital involvement indicates invasive disease. Culture remains the gold standard for diagnosis, with *Aspergillus* species predominating. Deep tissue specimens provide superior diagnostic yield, emphasizing their importance in clinical practice.

## Introduction

Chronic rhinosinusitis (CRS) is a globally prevalent condition that significantly impacts patient quality of life and healthcare systems. Among its various subtypes, fungal rhinosinusitis (FRS) has emerged as a distinct clinical entity requiring special attention due to its varied presentations and potential severity. Fungal spores are ubiquitous in the environment and are constantly inhaled into the upper airways, making colonization of the paranasal sinuses a common occurrence. However, in

susceptible individuals, particularly those with impaired immunity, this colonization can progress to invasive disease with serious outcomes<sup>1,2,3</sup>.

The prevalence of FRS has been reported to vary across geographic regions, influenced by climatic conditions, host factors, and diagnostic practices. Studies from India and other tropical countries highlight a relatively higher burden of FRS compared to temperate regions, likely due to warm and humid environments that favor fungal growth<sup>1</sup>. Clinical manifestations often overlap with



bacterial rhinosinusitis, including nasal discharge, obstruction, headache, and orbital symptoms, which can delay diagnosis if fungal etiology is not suspected<sup>2</sup>.

Several risk factors predispose patients to FRS, with diabetes mellitus being the most significant, followed by allergic conditions, structural abnormalities of the nasal cavity, and dental infections. The disease spectrum ranges from non-invasive forms, such as allergic fungal rhinosinusitis, to invasive and potentially life-threatening forms like mucormycosis<sup>3</sup>. Accurate diagnosis relies on a combination of direct microscopy (KOH mount), culture, and histopathological examination, with culture being indispensable for species identification and guiding antifungal therapy<sup>1</sup>.

Given the rising incidence of FRS and its clinical importance, this study was undertaken to evaluate the clinical and mycological profile of fungal rhinosinusitis in patients presenting to a tertiary care hospital. By correlating demographic data, clinical features, predisposing factors, and laboratory findings, the study aims to provide insights into the burden of FRS and highlight the importance of early detection and species-level identification for effective management.

## Aim and Objectives

### Aim

To evaluate the clinical and mycological profile of fungal rhinosinusitis in patients presenting to a tertiary care hospital

### Objectives

1. To analyze the demographic profile, clinical presentations, predisposing factors of patients diagnosed with fungal rhinosinusitis.
2. To compare the diagnostic yield of direct microscopy (KOH mount) with fungal culture.
3. To determine the spectrum of fungal species isolated from clinical specimens of rhinosinusitis patients.

## Material and Methods

The present study was designed as a cross-sectional prospective study conducted in the Department of Microbiology, MGM Medical College and Hospital, Chhatrapati Sambhajnagar, from January 2024 to December 2025. Written informed consent was taken

from all participants after explaining the nature and purpose of the study.

### Study Population

A total of 83 patients fulfilling the inclusion and exclusion criteria were enrolled.

### Inclusion Criteria

1. Patients of all age groups presenting with clinical suspicion of fungal rhinosinusitis.
2. Willingness to provide informed consent.

### Exclusion Criteria

1. Patients already on antifungal treatment.
2. Inadequate or contaminated specimens.

### Procedure

1. **Clinical Evaluation:** Each patient underwent detailed clinical examination by ENT specialists. Symptoms such as nasal discharge, nasal blockage, headache, difficulty in breathing, and orbital involvement were documented. Predisposing factors including diabetes mellitus, nasal allergy, deviated nasal septum, and dental infections were recorded.
2. **Specimen Collection:**
  - **Exudates/crusts from nasal cavity** were collected using sterile forceps.
  - **Nasal swabs** were obtained under aseptic precautions.
  - **Biopsy specimens** from nasal cavity or maxillary sinus were collected during surgical procedures.
  - **Pus samples** from maxillary sinus were aspirated when indicated. All specimens were transported immediately to the microbiology laboratory in sterile containers.
3. **Direct Microscopy (KOH Mount):** A portion of each specimen was subjected to 10% potassium hydroxide (KOH) mount for rapid detection of fungal elements. The presence of septate or aseptate hyphae, yeast cells, or spores was noted.



#### 4. Culture:

- Specimens were inoculated onto two Sabouraud Dextrose Agar (SDA) with antibiotics (chloramphenicol).
- Slopes of SDA were incubated at 25°C and 37°C and observed daily for up to 4 weeks.
- Growth was identified based on colony morphology, pigmentation, and texture.

#### 5. Identification of Fungal Isolates:

- Microscopic examination was performed using Lactophenol Cotton Blue (LPCB) mount.
- Identification was based on characteristic structures such as conidiophores, sporangia, vesicles, and yeast morphology.
- Standard mycological techniques and reference manuals were used for confirmation.

#### Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using descriptive statistics. Results were expressed as frequency, percentages, and proportions. Comparative analysis between KOH positivity and culture results was performed to assess diagnostic yield.

#### Observation and Result

**Table 1: Demographic Profile**

Sr No	Variables	Number of cases n	Percentage %
<b>1</b>	<b>Age (Years)</b>		
	a. 0–10	0	0 %
	b. 11–20	0	0 %
	c. 21–30	8	9.64 %
	d. 31–40	21	25.30 %
	e. 41–50	30	36.14 %
	f. 51–60	13	15.66 %
	g. 61–70		
	h. 71–80		

		6	7.23 %
		5	6.03 %
<b>2</b>	<b>Gender</b>		
	a. Male	50	60.24 %
	b. Female	33	39.76 %
<b>Total N (%)</b>		<b>83</b>	<b>100 %</b>

The study enrolled 83 participants, with the majority falling in the age group of 41–50 years (36.14%), followed by 31–40 years (25.30%). Younger age groups (below 20 years) had no representation, while elderly patients above 70 years accounted for 6.03%. This indicates that fungal rhinosinusitis predominantly affects middle-aged individuals. Gender distribution showed a male predominance, with 60.24% males compared to 39.76% females, suggesting a possible higher susceptibility or exposure among men.

**Table 2: Clinical Presentation**

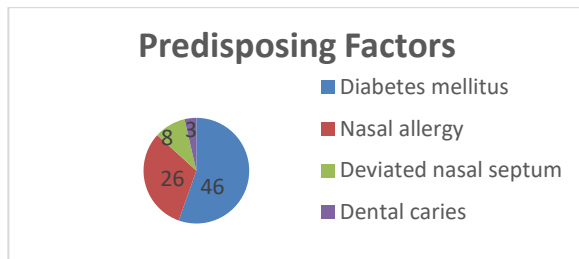
Sr No	Variables	Number of cases n=83	Percentage %
<b>1</b>	Nasal discharge	58	69.88 %
<b>2</b>	Nasal blockage	45	54.22 %
<b>3</b>	Difficulty in breathing	30	36.14 %
<b>4</b>	Headache	22	26.51 %
<b>5</b>	Orbital swelling / ocular symptoms	18	21.69 %

The most common clinical symptom observed was nasal discharge, present in nearly 70% of cases, followed by nasal blockage in 54.22%. Difficulty in breathing was reported in over one-third of patients (36.14%), while headache was seen in 26.51%. Orbital swelling and ocular symptoms were noted in 21.69% of cases, highlighting the potential for invasive disease with



orbital involvement. These findings emphasize that nasal discharge and obstruction are the hallmark presentations, whereas orbital symptoms, though less frequent, may indicate severe disease progression.

**Fig 1: Predisposing Factors**



**Table 3: KOH vs. Culture Results**

Sr No	Culture status	KOH positive	KOH negative	Total
1	Culture positive	46 (55.42%)	12 (14.46%)	58 (69.88%)
2	Culture negative	12 (14.46%)	13 (15.66%)	25 (30.12%)
Total N (%)		58 (69.88%)	25 (30.12%)	83 (100.00%)

Out of 83 specimens, culture positivity was achieved in 69.88% of cases, while 30.12% were culture negative. Among culture-positive cases, 55.42% were also KOH positive, whereas 14.46% were KOH negative but still yielded growth on culture. Interestingly, 14.46% of culture-negative cases were KOH positive, suggesting possible non-viable fungal elements or sampling issues. This comparison demonstrates that while KOH mount is a rapid diagnostic tool, culture remains essential for species identification and confirmation.

**Table 4: Fungal Species Distribution**

Sr No	Isolated fungal species	Number of isolates n=58	Percentage %
1	<i>Aspergillus niger</i>	15	26 %

2	<i>Mucor species</i>	9	17 %
3	<i>Candida albicans</i>	8	13 %
4	<i>Aspergillus flavus</i>	7	13 %
5	<i>Non-albicans Candida</i>	5	8 %
6	<i>Rhizopus species</i>	5	8 %
7	<i>Aspergillus fumigatus</i>	5	8 %
8	<i>Fusarium species</i>	4	7 %
Total N (%)		58	100 %

Among the 58 culture-positive isolates, *Aspergillus niger* was the most frequently isolated species (26%), followed by *Mucor* (17%) and *Candida albicans* (13%). Other notable isolates included *Aspergillus flavus* (13%), *Non-albicans Candida* (8%), *Rhizopus* (8%), *Aspergillus fumigatus* (8%), and *Fusarium* (7%). This distribution highlights the predominance of *Aspergillus* species in fungal rhinosinusitis, while mucormycosis and candidiasis also contribute significantly, particularly in immunocompromised patients.

**Table 5: Specimen-wise Distribution of Fungal isolates**

Sr No	Specimen	Total specimens n=83	Fungal isolates N=58	Percentage %
1	Exudates/crusts from nose	46	32	70 %
2	Nasal swabs	22	12	56 %
3	Biopsy from nasal cavity	8	7	88 %
4	Biopsy/pus from maxillary sinus	7	7	100 %
Total N (%)		83	58	70 %



Out of 83 specimens, exudates and nasal crusts were the most common samples received (46 cases), yielding fungal isolates in 70% of them. Nasal swabs accounted for 22 cases, with a 56% positivity rate. Biopsy specimens from the nasal cavity showed a higher yield, with 88% positivity, while biopsy or pus samples from the maxillary sinus had the highest diagnostic yield, with 100% positivity. These findings suggest that deeper tissue samples, particularly sinus biopsies, provide superior diagnostic accuracy compared to superficial swabs or exudates.

## Discussion

Fungal rhinosinusitis has been increasingly recognized as a significant subtype of chronic rhinosinusitis, particularly in regions with warm and humid climates. It commonly affects middle-aged individuals and often presents with nasal discharge, obstruction, headache, and in severe cases, orbital involvement. Diabetes mellitus and allergic conditions are among the most important predisposing factors, making certain populations more vulnerable. Diagnosis typically relies on direct microscopy and culture, with culture being essential for species identification. *Aspergillus* species are the most frequently isolated fungi, while biopsy specimens consistently provide the highest diagnostic yield compared to superficial samples.

In the present study, fungal rhinosinusitis was most common in the 41–50 year age group (36.14%), followed by 31–40 years (25.30%), with a clear male predominance (60.24%). Similar age-related trends have been reported in South Indian studies, where middle-aged adults were most affected<sup>1</sup>. Banday et al. also observed higher prevalence in the 30–50 year age group, supporting the notion that middle age is a vulnerable period<sup>2</sup>. A retrospective study from Ludhiana reported comparable findings, with peak incidence between 30–50 years and male predominance<sup>3</sup>. Another institutional study highlighted that occupational exposure to dust and unhygienic environments predisposed men above 40 years to allergic fungal rhinosinusitis<sup>4</sup>. Jitendra Kumar's study on invasive fungal sinusitis also confirmed male predominance and middle-age clustering<sup>5</sup>. These findings collectively suggest that gender-linked exposure and immunological factors may explain the higher burden in men.

The most frequent symptom in our study was nasal discharge (69.88%), followed by nasal blockage (54.22%), difficulty in breathing (36.14%), headache (26.51%), and orbital symptoms (21.69%). Menon et al. reported nasal obstruction and discharge as the most common complaints in South Indian patients<sup>1</sup>. Banday et al. similarly found nasal blockage and discharge as hallmark symptoms<sup>2</sup>. A Bangalore study noted headache and nasal obstruction as frequent presentations, with orbital involvement in advanced cases<sup>6</sup>. A study on unilateral allergic fungal rhinosinusitis emphasized nasal obstruction and discharge as universal features, while orbital symptoms were less frequent<sup>7</sup>. Another tertiary care study highlighted that orbital swelling and ocular symptoms are late manifestations, often indicating invasive disease<sup>8</sup>. Thus, our findings align with global evidence that nasal discharge and obstruction are primary symptoms, while orbital involvement signals severity.

In our cohort, diabetes mellitus (55%) was the most significant predisposing factor, followed by nasal allergy (31%), deviated nasal septum (10%), and dental caries (4%). This is consistent with Banday et al., who found diabetes as the leading risk factor<sup>2</sup>. Menon et al. also reported diabetes and allergy as major contributors<sup>1</sup>. A systematic review on invasive fungal rhinosinusitis in diabetics confirmed diabetes as the strongest predictor of poor outcomes<sup>4,5</sup>. Dykewicz et al. emphasized allergic predisposition as a major factor in non-invasive fungal rhinosinusitis<sup>6</sup>. A Western India study also highlighted diabetes and immunocompromised states as critical risk factors<sup>9</sup>. Collectively, these findings reinforce that systemic immunocompromise (especially diabetes) and allergic states are the most important predisposing factors.

Our study showed culture positivity in 69.88% of cases, with KOH positivity in 55.42% of culture-positive samples. Menon et al. reported similar findings, with culture being more sensitive than KOH mount<sup>1</sup>. Banday et al. also emphasized the importance of culture for species identification<sup>2</sup>. A Taiwanese study comparing fungal vs. non-fungal rhinosinusitis confirmed that culture-based analysis provided higher diagnostic yield than microscopy<sup>7,8</sup>. Another comparative study highlighted that while KOH is rapid, culture remains indispensable for species-level identification<sup>10</sup>. A North Indian study further demonstrated that culture



consistently outperformed direct microscopy in diagnostic accuracy<sup>11</sup>. Patel et al. also noted that microscopy alone often missed low-burden infections, reinforcing the need for culture<sup>12</sup>. Thomas et al. reported that culture-based diagnosis was crucial in invasive fungal sinusitis, especially in immunocompromised patients<sup>13</sup>. Thus, our findings support the consensus that KOH is useful for screening, but culture remains the gold standard.

In our study, *Aspergillus niger* (26%) was the most common isolate, followed by *Mucor* (17%) and *Candida albicans* (13%). Menon et al. also reported *Aspergillus* species as predominant<sup>1</sup>. Banday et al. found *Aspergillus flavus* and *niger* as leading isolates<sup>2</sup>. A global systematic review confirmed *Aspergillus fumigatus* predominance in temperate zones, while *A. flavus* was common in tropical climates<sup>14,15</sup>. A MedCrave study reported allergic fungal rhinosinusitis dominated by *Aspergillus* and mucormycosis in diabetics<sup>10</sup>. Our findings thus align with global evidence that *Aspergillus* species dominate, with mucorales and *Candida* contributing significantly in immunocompromised hosts.

In our study, biopsy/pus from maxillary sinus had 100% positivity, followed by nasal cavity biopsy (88%), exudates (70%), and nasal swabs (56%). Menon et al. reported higher diagnostic yield from biopsy specimens compared to swabs<sup>1</sup>. Banday et al. also emphasized biopsy samples for accurate diagnosis<sup>2</sup>. A Western India histopathological study confirmed biopsy as the most reliable specimen type<sup>9</sup>. A Delhi study using MALDI-TOF also found biopsy samples superior in diagnostic yield<sup>16</sup>. Another tertiary care study highlighted that superficial swabs often miss deeper fungal invasion, making biopsy essential<sup>17</sup>. Thus, our findings reinforce that deep tissue specimens provide the highest diagnostic accuracy.

The predominance of fungal rhinosinusitis in middle-aged males may be attributed to greater occupational exposure to dust and allergens, combined with lifestyle-related comorbidities such as diabetes and smoking, which weaken host defenses<sup>1,2</sup>. The high frequency of nasal discharge and obstruction reflects mucosal inflammation and blockage of sinus ostia caused by fungal colonization, while orbital involvement in some patients suggests invasive disease, where hyphae

penetrate thin sinus walls and invade vascular structures<sup>3,4</sup>.

The strong association with diabetes mellitus is explained by impaired neutrophil function, reduced phagocytosis, and hyperglycemia that favors fungal proliferation<sup>2,5</sup>. Allergic predisposition contributes through exaggerated immune responses to fungal antigens, leading to chronic inflammation and polyp formation<sup>6</sup>. Structural abnormalities such as deviated nasal septum further impair sinus drainage, creating a stagnant environment conducive to fungal growth<sup>7</sup>.

The higher diagnostic yield of culture compared to KOH mount is due to culture's ability to detect viable organisms and allow species-level identification, whereas KOH may miss cases with low fungal burden or non-viable elements<sup>1,2,8</sup>. The predominance of *Aspergillus* species reflects their ubiquitous presence in soil and air, with small conidia that easily colonize paranasal sinuses. In immunocompromised hosts, mucorales such as *Mucor* and *Rhizopus* gain prominence due to their angioinvasive properties, while *Candida* acts as an opportunistic pathogen in patients with altered local immunity<sup>9,10</sup>.

Finally, the superior diagnostic yield from biopsy and sinus pus samples compared to swabs or exudates is explained by deeper tissue involvement of fungi. Superficial swabs may capture colonizing organisms, whereas biopsy specimens reflect true invasive disease, making them more reliable for confirmation<sup>1,2,11</sup>.

## Conclusion

The present study highlights that fungal rhinosinusitis predominantly affects middle-aged individuals, with a clear male predominance and strong association with diabetes mellitus and allergic conditions. The most common clinical features were nasal discharge and obstruction, while orbital involvement indicated severe disease progression. Culture proved superior to KOH mount for diagnosis, emphasizing its role in species-level identification. *Aspergillus* species were the most frequently isolated fungi, followed by mucorales and *Candida*, underscoring their clinical relevance in immunocompromised patients. Specimen-wise analysis demonstrated that biopsy and sinus pus samples provided the highest diagnostic yield, reinforcing the importance of deep tissue sampling for accurate diagnosis. Overall,



early detection, species identification, and recognition of predisposing factors are crucial for effective management and prevention of complications in fungal rhinosinusitis.

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