Original Article

# Prevalence of Incidental Sinonasal Diseases on Brain Imaging by Computed Tomography Scan

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**Objective:** The purpose of this study was to investigate the prevalence of incidental sinonasal diseases on CT scan in Pakistani population presenting with neurological signs and symptoms for brain imaging.

**Material & Methods:** This cross sectional study was conducted in Department of Radiology, Services Institute of Medical Sciences/ Services Hospital, Lahore, between August 2009 and June 2010. All the cases undergoing CT head referred by physicians and neurophysicians presenting with neurological symptoms and signs besides exclusion of the cases of head trauma were included. The study population consisted of 507 patients, including 311 men and 196 women, who were 2-75 years old (mean age, 42 years). Frontal, ethmoid, sphenoid, left and right maxillary sinuses were separately evaluated. The pathological processes included were mucosal thickening, opacification, air-fluid level, retention cysts and polyps.

**Results:** Out of 507, there were 199 patients (39.25%) in whom sinus pathology was documented. There were no significant gender differences amongst the study population. Most of the patients were adults; pediatric age group consisted 11%. The incidental sinonasal disease was more common in the patients above 30 years of age, with slight predilection toward females (56%). Mucosal thickening was the most common pathology (71.8%); categorization including normal (no mucosal thickening), mucosal thickness of 1 mm (34.6%), 2 mm (24.6%), 3 mm (27.7%), and 4 mm or above (13.1%) was done accordingly. Other abnormalities including sinus opacification (14%), air-fluid level (5.0%), retention cyst (5.5%) and polyp (3.5%) were found uncommon.

**Conclusion:** The high prevalence of sinonasal disease in general population emphasizes the necessity of clinical correlation, if picked incidentally on cross-sectional brain imaging. Subtle mucosal thickening, in particular to ethmoidal air cells, is a normal variant, most likely due to the physiologic nasal cycle. Incidental findings of paranasal sinus disease without clinical signs and symptoms do not define a diagnosis of sinusitis or a sinonasal disease; adequate clinical information is mandatory prior to starting the treatment. The possible reason of high prevalence of sinonasal disease in Pakistani population could be dust allergy and pollution besides respiratory tract infections and smoking. Future studies are recommended to a larger population to evaluate the significance of these incidental findings.

**Key Words:** Prevalence, incidental, sinonasal disease, CT scan, brain imaging.

## Introduction

Sinonasal disease is a common clinical problem in general practice. Diagnosis of sinusitis is complicated, especially in children because of fewer specific signs and symptoms.[1] Patients who do not respond to medication or are planning surgical treatment need a radiographic examination to confirm the diagnosis.

Plain films are still the most commonly used diagnostic preliminary tool for the investigation of sinusitis. However, CT and MRI are more sensitive modalities. CT scan has the advantage of demonstrating bony abnormalities. MRI is best at revealing the soft tissue changes. Studies previously done on CT and MRI[2] demonstrating changes in the paranasal sinuses of asymptomatic patients were given abnormalities in symptomatic group.

The purpose of this study was to investigate the prevalence of incidental sinonasal disease in Pakistani population presenting with neurological signs and symptoms for brain imaging and its clinical significance.

## Material & Methods

This cross sectional study was conducted in Department of Radiology, Services Institute of Medical Sciences/ Services Hospital, Lahore, between August 2009 and June 2010. CT scan was

performed in the patients with neurological symptoms and signs who were referred from the indoors, outpatient department and accidents/ emergency department of Services Hospital Lahore by physicians and neurophysicians. We consecutively included the cases undergoing CT head besides exclusion of all the cases of head trauma from our study, so that any abnormality picked would be purely sinonasal in origin. The patients' medical records were reviewed. The study population consisted of 507 patients, including 311 men and 196 women, who were 2-75 years old (mean, 42 years). CT scanning was done on multidetector Aquilion Multi-Slice CT (Toshiba Medical Co. Ltd, Tokyo, Japan). Axial slices of 2-3 mm thickness were reformatted on 2000-2500 HU window width & 200-350 window level, as to provide bone & soft tissue details in a single set of films. Bony algorithm was utilized. The CT scan covered the skull region from the anterior margins of the frontal sinus to the posterior margins of the sphenoid sinus. The radiation dose was kept minimum by the use of low mA with peak KV around 120. The CT scanning was performed in the supine position. The gantry was angled perpendicular to the hard palate. All CT scans were acquired without intravenous contrast. An experienced radiologist read all non-enhanced CT head images for sinonasal disease. Frontal, ethmoid, sphenoid, left and right maxillary sinuses were separately evaluated. If the sinus was not developed, it was regarded as clear. The pathological processes included in our study were mucosal thickening, opacification, air-fluid level, retention cysts and polyps.

## Results

Out of 507, there were 199 patients (39.25%) in whom sinus pathology was documented. There were no significant gender differences amongst the study population undergoing CT head. Most of the patients were adults; pediatric age group consisted 11% in our sample population. **Table-1** shows the prevalence of sinus pathology in different age groups and genders. The incidental sinonasal disease was more common in the patients above 30 years of age, with slight predilection toward females (56%). **Table-2** shows the sinus abnormalities of different paranasal sinus groups. As the major bulk of patients in our study

**Table-1:** Prevalence of incidental sinus pathology on NECT head in different age groups and genders.

| Sinus Morphorlogy (n=507) | Age Groups (Year) | | | | | Gender | |
|---|---|---|---|---|---|---|---|
| | 2-15 | 16-30 | 31-45 | 46-60 | >60 | Male | Female |
| Clear / Normal (n=308) | 36 | 48 | 57 | 79 | 88 | 168 | 140 |
| Pathological /diseased (n=199) | 21 | 39 | 58 | 51 | 30 | 87 | 112 |
| Total | 57 | 87 | 115 | 130 | 118 | 255 | 252 |

**Table-2:** Percentages of sinus abnormalities of different paranasal sinus groups.

| Pathological Changes | Sinuses (n=507) | | | | Total (n=199) |
|---|---|---|---|---|---|
| | Frontal (n=15) | Ethmoid (n=68) | Maxillary (n=103) | Sphenoid (n=13) | |
| Mucosal thickening | 13 | 58 | 63 | 9 | 143(71.9%) |
| Opacification | 2 | 8 | 17 | 1 | 28 (14%) |
| Air-fluid level | 0 | 0 | 8 | 2 | 10 (5.0%) |
| Retention cyst | 0 | 0 | 11 | 0 | 11 (5.5%) |
| Polyp | 0 | 2 | 4 | 1 | 7 (3.5%) |

**Table-3:** Categories of the mucosal thickening of various groups of paranasal sinuses and their percentages.

| Mucosal Thickening | Sinuses | | | | Total (n=143) |
|---|---|---|---|---|---|
| | Frontal (n=13) | Ethmoid (n=58) | Maxillary (n=63) | Sphenoid (n=9) | |
| Minimal (1mm) | 0 | 11 | 10 | 0 | 80 (34.6%) |
| Mild (2mm) | 3 | 15 | 17 | 1 | 57 (24.6%) |
| Moderate (3mm) | 6 | 23 | 12 | 3 | 64 (27.7%) |
| Gross (4mm or above) | 4 | 9 | 24 | 5 | 30 (13.1%) |

Categorized the patients according to the maximal mucosal thickening present in any of paranasal sinuses. **Table-3** shows the categories of the mucosal thickening of various groups of paranasal sinuses and their percentages.

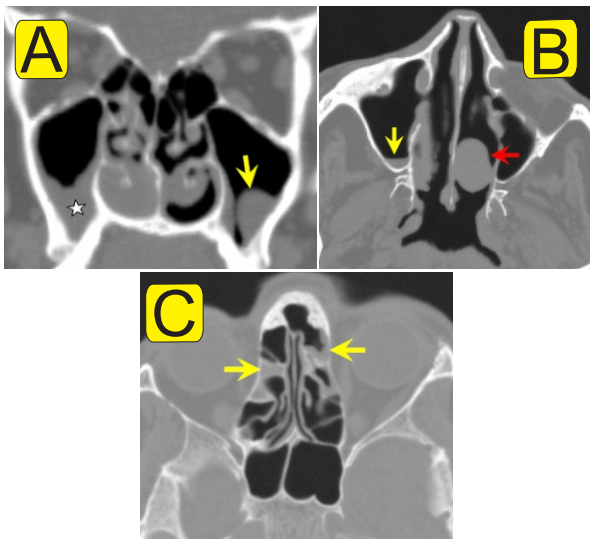


**Fig-1:** (a). Coronal reformatted NECT head with right maxillary sinus mucosal thickening (star) and left maxillary sinus retention cyst (yellow arrow). (b). Axial NECT section through maxillary sinuses revealing air-fluid level in the right maxillary sinus (yellow arrow) with a left sided nasal polyp (red arrow). (c). Axial NECT section through the ethmoidal cells shows mucosal thickening of these cells (yellow arrows).

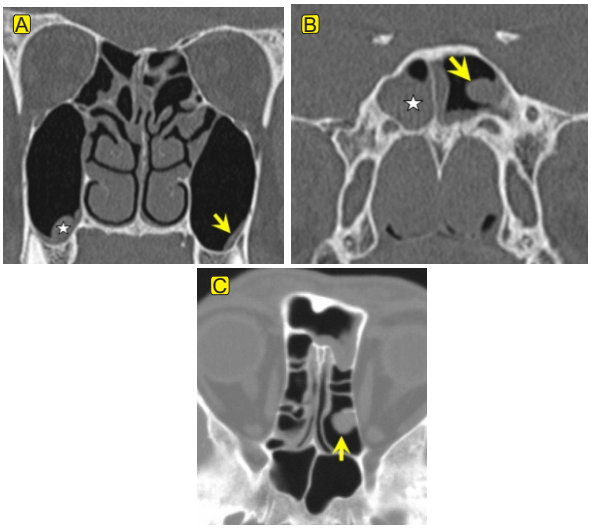


**Fig-2:** (a) Coronal reformatted NECT head with right maxillary sinus retention cyst (star) and left maxillary sinus mucosal thickening (yellow arrow). (b). Coronal reformatted NECT head through sphenoid sinus revealing mucosal thickening (star) in right sphenoid sinus and a left sided polyp (yellow arrow). (c). Axial NECT section through the ethmoidal cells shows left sided polyp (yellow arrow).

## Discussion

It has previously been reported with CT that abnormalities in one or more pananasal sinuses are seen in 42% of asymptomatic adults.[3] Similarly, various degrees of mucosal thickening in the paranasal sinuses are commonly seen during routine MR of the brain. Goal of our study was to investigate the prevalence of incidental sinonasal disease and to delineate the significance of mucosal abnormalities. Such a finding would be of certain clinical value regarding further medical workup and therapy. Glasier et al.[4] examined the cranial CT scans of 101 children and identified paranasal sinus abnormalities in 31% of the upper respiratory inflammation (URI)-positive group and in 26% of the URI-negative group. Diament et al.[5] prospectively studied 137 consecutive paediatric patients referred for a CT of the brain and orbit, and presented that an overall 45% of the patients had incidental sinusitis, with similar findings with Lesserson et al.[6] Choi et al.[7] analyzed CT scans of 162 children who had no signs or symptoms of paranasal sinusitis, and reported that one or more sinus opacifications were found in 47% of the patients. Stankiewicz et al.[8] reported that more than 50% of the patients who met the criteria of a symptom-based definition of rhinosinusitis had a negative CT scan and were treated unnecessarily with antibiotics. They recommended the use of the CT in addition to clinical evaluation to increase the accuracy of the clinical diagnosis. Wald et al.[9] pointed out that sinusitis is a clinical diagnosis which can be ruled out by negative image findings. CT is the most useful imaging tool to diagnose sinusitis.[10,11] However, the main disadvantages of cost and high radiation dosage limit its application.[12, 13] The concept of normal nasal cycle is essential for interpreting our study data. Zinneich et al.[14] report that, in a normal adult, changes in the nasal mucosal volume occurs cyclically, alternating from side to side. Mucosal volume changes are observed in the mucosa of the turbinates, the nasal septum, lateral wall and cavity floor, nasolacrimal ducts, and ethmoidal sinuses. The frontal, maxillary, and sphenoidal sinuses are not affected. Mucosal volume changes are observed in the mucosa of the turbinates, the nasal septum, lateral wall and cavity floor, nasobacnimal ducts, and ethmoidal sinuses. The frontal, maxillary, and sphenoidal sinuses are not affected.

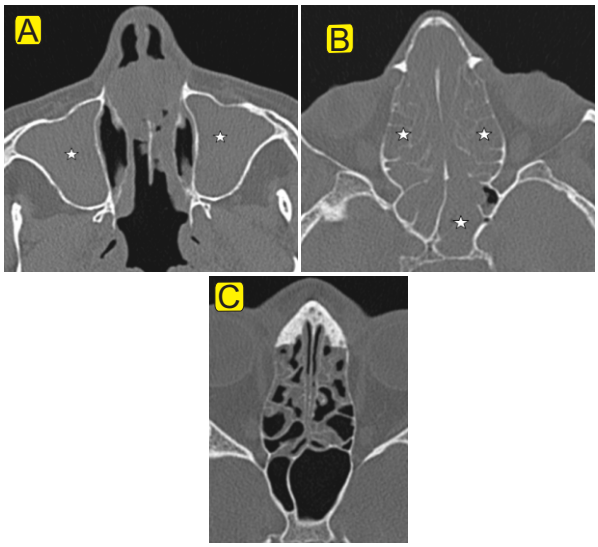


**Fig.3:** Axial NECT sections through maxillary sinuses (a), ethmoidal cells and sphenoid sinuses (b) show complete opacification of the sinuses. (c). Axial NECT section through the ethmoidal cells shows mucosal thickening of all the cells.

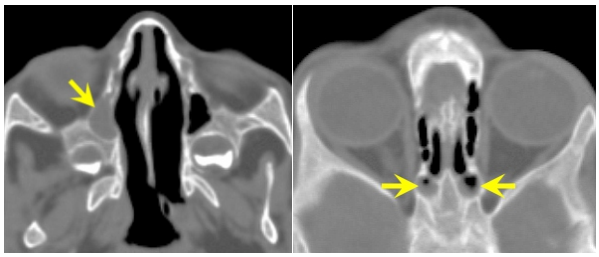

**Fig-4:** Axial NECT sections of pediatric age through maxillary sinuses (a), ethmoidal cells and sphenoid sinuses (b) show complete opacification of the right maxillary sinus and mucosal thickening of partially pneumatized sphenoid sinuses.

Ethmoidal sinuses are the only pananasal sinuses to undergo cyclical mucosal volume changes. Minimal 1 to 2 mm mucosal thickening in the ethmoidal sinuses are a physiologically normal variant, a function of mucosal volume changes occurring in the nasal cycle. The physiologic ethmoidal mucosal edema may be diffuse or focal. It is commonly bilateral, suggesting that in the nasal cycle, the resolution of mucosal edema may be somewhat delayed, such that edema may persist on one side while the contralateral mucosa has already become edematous.

Sinusitis is a nebulous disease, with subjective symptoms that are commonly vague on nonspecific. Clinical history is essential in the assessment of sinus disease [15], but symptoms may not reflect the true

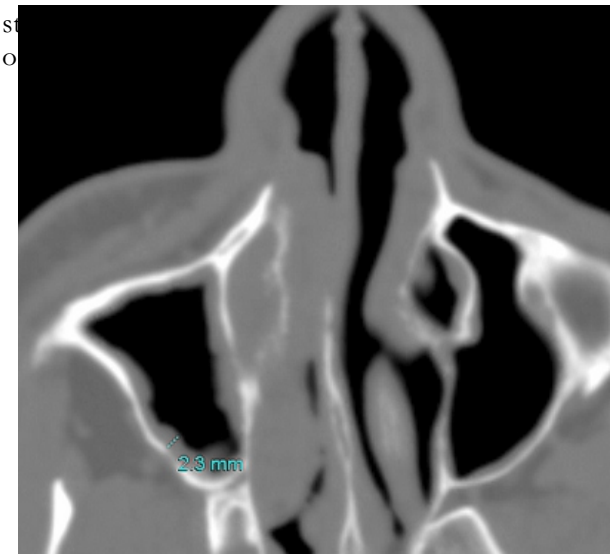


**Fig-5:** Axial NECT section through maxillary sinuses shows subtle mucosal thickening of the right maxillary sinus walls (measuring 2.3mm in thickness).

Our study was that we relied strictly upon radiological findings and not on clinical history to categorize patients as either symptomatic or asymptomatic. We are not suggesting that mucosal disease of 3 mm or less is not clinically significant; however, the results of previous studies show that up to 3 mm of mucosal thickening may commonly be seen in asymptomatic patients. As such, radiological findings on imaging may not match clinical symptoms. Thus, clinical correlation is required. Retention cysts are due to obstruction and dilatation of a duct of a minor seromucinous gland. They are typically asymptomatic.[15]

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Inhalant allergic conditions such as seasonal and perennial allergic rhinitis and sinusitis are becoming quite common. The effect of allergy on an individual's quality of life and the extent to which it may restrict daily activities is often overlooked. The triggers that have a large effect on the health of the population sample for allergic rhinitis are respiratory infections, tyre burning and war gases, house dust, strong odours, auto exhaust, smoke and weather changes. According to one survey, allergic rhinitis

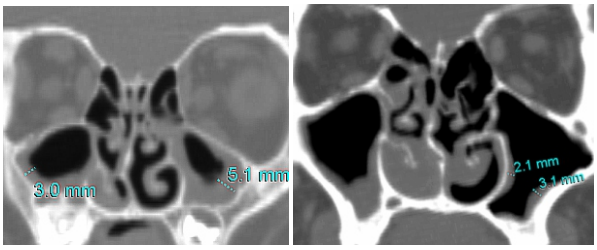


**Fig.5:** Coronal reformatted NECT section through maxillary sinuses shows subtle to variably gross mucosal thickening of maxillary sinus walls.

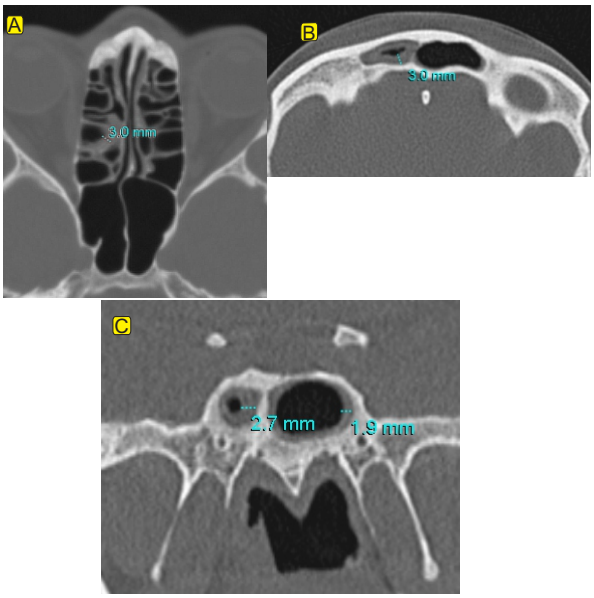


**Fig.6:** Axial NECT sections through ethmoidal cells and sphenoid sinuses (a) and frontal sinus (b) show subtle mucosal thickening of these sinuses (measuring 3mm each). (c). Coronal reformatted NECT section through sphenoid sinus shows subtle mucosal thickening of sinus walls (measuring 1.9-2.7mm).

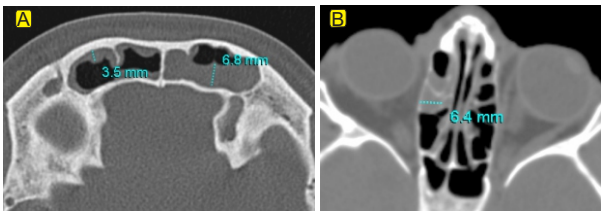


**Fig.7:** Axial NECT sections through frontal sinuses (a), ethmoidal cells and sphenoid sinuses (b) show subtle to variably gross mucosal thickening of sinus walls (measuring 3.5-6.8mm).

possible reason we concluded from our study of this much high prevalence of sinonasal disease in our population could be dust allergy and pollution besides respiratory tract infections and smoking.

## Conclusion

Sinonasal disease is prevalent in general population. This high prevalence emphasizes the necessity of clinical correlation, if picked incidentally on cross-sectional brain imaging. Subtle mucosal thickening, in particular, if only present in ethmoidal air cells, may be normal variant, most likely due to the physiologic nasal cycle. Incidental findings of paranasal sinus disease without clinical signs and symptoms do not define a diagnosis of sinusitis or a sinonasal disease, adequate clinical information is mandatory prior starting the treatment. The possible reason of high prevalence of sinonasal disease could be dust allergy and pollution besides respiratory tract infections and smoking. Future studies are recommended to a larger population to evaluate the significance of these incidental findings.

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