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# Magnitude of Incidental Paranasal Sinus Abnormalities and Associated factors on Brain Mri Done For Patients With Other Cns Problems In Nisir and Nolot Diagnostic Centers In Bahir Dar, Ethiopia.

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BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE  
AND HEALTH SCIENCES SCHOOL OF MEDICINE  
DEPARTMENT OF CLINICAL RADIOLOGY

MAGNITUDE OF INCIDENTAL PARANASAL  
SINUS ABNORMALITIES AND ASSOCIATED FACTORS ON  
BRAIN MRI DONE FOR PATIENTS WITH OTHER CNS  
PROBLEMS IN NISIR AND NOLOT DIAGNOSTIC CENTERS IN  
BAHIR DAR, ETHIOPIA.

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BAHIR DAR, ETHIOPIA

BAHIR DAR UNIVERSITY COLLEGE OF MEDICINE AND  
HEALTH SCIENCES DEPARTMENT OF CLINICAL  
RADIOLOGY.

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FROM FEBRUARY 2022 TO MAY 2022 GC, BAHIR DAR,  
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## Abstract

**Background:** Diagnostic imaging of the head is used with increasing frequency, and often includes the paranasal sinuses, where incidental findings are found. Evaluating the clinical relevance of such findings is challenging, and for the patient such incidental findings can give rise to concern if they are reported. Studies of incidental findings in the paranasal sinuses have been conducted mostly in patients referred for diagnostic imaging, hence the prevalence in the general population is not known. There is little study in Ethiopia, so this study will contribute to strong evidence in the field.

**Objective:** To assess the magnitude of incidental paranasal sinus abnormalities and factors associated with the magnitude of incidental paranasal sinus abnormalities on brain MRI done for patients with other CNS problems in NISIR and Nolot diagnostic centers in Bahir Dar

**Method:** An institutional-based cross-sectional study was conducted and systematic random sampling technique was used to select study participants.

To collect necessary data structured questionnaire was administered. MRI soft copy images were assessed by Radiologist. Data was entered using EpiData version 4.6 software and exported to SPSS software version 26. The association between the incidental paranasal sinus abnormalities on brain MRI and independent variables was assessed using simple binary and multivariable logistic regression analysis. In simple binary logistic regression variables with a p-value, of less than 0.25 were selected for multivariable analysis and in multiple binary logistic regression analysis variables with a P-Value, of less than 0.05 was considered statistically significant. Finally, the analyzed data were described using tables, figures accordingly

**Result:** of two hundred twenty-eight patients, 132 (57.9%) had one or more than one incidental paranasal sinus finding seen. the maxillary sinus was the most commonly affected sinus group followed by the ethmoid sinus. frontal sinus was the least to have incidental abnormalities. Significant Mucosal thickening was the most common type of abnormality seen followed by retention cyst/polyp. The prevalence

of incidental paranasal sinus abnormalities was significantly associated with Retroviral infection (AOR:3.273, CI 95%:1.158-9.327, Pvalue of 0.026), diabetes mellitus (AOR:2.895, CI 95%:1.007-8.327, P value 0.049), and Allergy (AOR:2.932, 95% CI:1.018-8.435, P value 0.046). there was no significant relationship seen between age of the patient, gender, smoking history, place residency occupation, brain tumor, hypertension and seizure, meningitis with a P value of > 0.05.

Conclusion; Our findings revealed that the proportion of paranasal sinuses abnormalities in asymptomatic patients was that 57.9%. A significant correlation was observed between Diabetes Mellitus, Allergy history, and retroviral infection with incidental sinus findings. Our findings significantly contribute to the knowledge of incidental sinus findings in patients. It will help the radiologists determine the relevance of abnormal findings and consider the possibility of the development of unexpected abnormalities

Keywords; Magnetic resonance imaging, paranasal sinus, incidental abnormalities

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## Acronyms and abbreviations

CDC	Center for Disease Control and Prevention
CNS	Central Nervous System
CT	Computed Tomography
ENT	Ear, Nose, Throat
mm	Millimeter
MRI	Magnetic Resonance Imaging
MT	Mucosal thickness
PET	Positron Emission Tomography
PNS	Paranasal Sinus
SD	Standard Deviation
(0.5) T	(0.5) Tesla
T1W	T1-weighted imaging
T2W	T2-weighted imaging

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# 1. Introduction

## 1.1 Background

Paranasal sinuses are hollow-filled cavities in human facial bones, which play an essential role which includes reducing skull weight, humidifying and warming inhaled air, pressure control within the nasal cavity, also trapping dust particles. There are four combined Paranasal sinuses, these are maxillary, frontal, and sphenoid sinuses as well as ethmoid air cells by abundant inter and intra-individual similarities. Three essential components make up the paranasal sinus: thin natural mucus secretions, normally working hairlike cilia that exchange mucus out of sinuses, and an open sinus drainage opening known as the sinus ostium.

Diagnostic imaging of the head and neck are used with increasing frequency and often includes the paranasal sinuses where incidental abnormalities such as mucosal thickening, polyps, retention cysts, and fluid, are often found, but the clinical relevance of these findings often remains uncertain for radiologists and ear, nose and throat surgeons. For the patient, such findings can cause unnecessary concern, and for the health system, they can potentially lead to unnecessary costs.

Currently, Available imaging techniques include computed tomography (CT), magnetic resonance imaging (MRI), and positron emission tomography/computed tomography (PET/CT). Each of these modalities offers certain advantages, and each has disadvantages when compared with the other techniques. Notably, plain films are no longer considered to be a part of the primary imaging armamentarium. At best, they give only an overview of the anatomy and underlying pathology, as they are limited to displaying three-dimensional structures in a two-dimensional plane. CT and MR imaging have the advantage of being able to show fine anatomic detail in serial tomographic sections, thus eliminating the gross volume averaging inherent in plain films.

Contrast-enhanced CT is the current radiologic criterion standard for the evaluation of sinus disease. MRI is generally reserved only for complex cases. Soft tissue contrast is better with MRI so, neoplasms, orbital and intracranial complications, and fungal sinusitis can be better evaluated with both T1-weighted imaging (T1WI) and T2

weighted imaging (T2WI) are required because of the variability of signal intensity of Sino nasal secretions caused by protein concentration. Fat-suppressed contrast-enhanced T1WI are employed for the evaluation of complicated sinusitis or suspected neoplastic disease. Differentiating tumors from infections of the Sino nasal cavity may be best achieved with contrast-enhanced MR (4)

## 1.2 Statement of the problem

The primary concern to the radiologist evaluating the paranasal sinuses and nasal fossae is the identification of any osseous changes or variations, noting the presence of abnormal soft-tissue disease and its possible extension beyond the Sino nasal cavities, characterization of the disease (3).

Inflammatory disease is the most common pathology involving the paranasal sinuses and nasal cavities. Mild mucosal thickening, primarily within the maxillary and ethmoid sinuses, is common, even in asymptomatic individuals. In contrast, acute sinusitis is characterized by the presence of fluid levels or foamy appearing sinus secretions and is typically caused by a viral upper respiratory tract infection. In chronic sinusitis, changes include mucoperiosteal thickening as well as osseous thickenings of the walls. Soft tissue findings suggestive of sinusitis are best detected on T2WIs, as they are often high in signal intensity. An exception is chronic sinus secretions that have become so desiccated that they yield no signal on either T1 or T2WIs and mimic an aerated sinus (5).

Globally Many studies showed that incidental paranasal sinus abnormalities are common findings on brain MRI images done for other CNS problems. Among the commonly detected abnormalities, mucosal thickening involving the ethmoidal & maxillary sinuses are the highest. Up to 6mm thickness was seen in asymptomatic individuals. Hence, it is recommended that reporting such findings are unnecessary unless there are concomitant clinical symptoms (2-4, 6-11).

There is only one study done in Ethiopia so far on the prevalence of incidental paranasal sinus abnormalities on brain MRI for other CNS indications. But the study did not

include associated factors that affect the prevalence of incidental paranasal sinus abnormalities on brain MRI for Asymptomatic patients. This study will try to fill this gap.

There is no study done in Bahir Dar regarding the prevalence of incidental paranasal sinus abnormalities and associated factors on Brain MRI for patients with CNS indications. so this study can be used as a baseline for future studies.

### 1.3 Significance of the study.

The importance of knowing the magnitude of incidental paranasal abnormalities on brain MRI for asymptomatic patients in the general population is to avoid routine reports by Radiologists. Routine reporting of such findings prone the patient to unnecessary further investigations. Trying to manage such incidental findings surgically are commonly associated with a negative surgical result.

This study helps to find out factors that affect the magnitude of incidental paranasal sinus abnormalities on brain MRI for asymptomatic patients and will help the decision of radiologists and treating physicians for subsequent patient management.

Since there is no study done in this area regarding the prevalence of incidental paranasal sinus abnormalities and associated factors on Brain MRI for patients with other CNS indications, this study can be used as baseline information for the Ethiopian ministry of health, Amhara health bureau, Bahir Dar University, and nongovernmental organizations for future study and enable them to suggest appropriate interventions.

## 2. Literature review

### 2.1 Magnitude of paranasal sinus abnormalities on Brain MRI on Asymptomatic Patients

A retrospective study was carried out to determine the prevalence of abnormality in the paranasal sinuses in a British population using MRI scans for neurological signs and symptoms. The T2-weighted scans of 130 patients were read. Abnormalities included mucosal thickening, fluid levels, sinus opacification and retention cysts/polyps. Of the patients studied, 49.2 percent showed one or more abnormalities. Mucosal thickening was the most common abnormality noted and the ethmoid sinuses were the most commonly affected (9).

Another Korean study done to evaluate incidentally observed thickened mucosa of paranasal sinuses on brain MRI of patients without evidence of sinusitis showed that among 82 adults aged over 20, the mean mucosal thickness at the most thickened portion of PNS regardless of their location was 3.5mm with SD of 1.5mm. The mucosal thickening was observed more commonly in maxillary (79 patients) & ethmoid (80 patients) sinuses. It was concluded that mucosal thickening of up to 6.5mm was a common finding on brain MRI of patients without evidence of sinusitis with an accuracy of 95% (7).

A Cross-sectional survey of paranasal sinus MRIs was done on schoolchildren at the University of Oulu, Finland from April to May 1998 to determine the frequency of sinus abnormalities among otherwise healthy children attending school. Twenty-four children were studied aged 6-9 years, and abnormalities were seen in 50% of the children in the maxillary sinuses. From this study it was concluded that normal sinus MRI findings are common among otherwise healthy children. As incidental findings, these should be interpreted as normal and do not indicate any need for treatment in children imaged for purposes other than sinus disease (2).

According to a cross-sectional study done in Kuala Lumpur, Malaysia on 115 patients from 2007 to 2008 to investigate the prevalence of incidental sinus abnormalities on CT & MRI imaging of the head & identify if there is any correlation between patient

symptomatology & imaging findings, the prevalence of incidental sinus abnormalities was found to be between 29.5% & 85.2% for MRI, depending on the Lund-Mackay grading system. There was no significant difference between different age groups or gender (13).

Randomly and independent of medical history, 982 participants underwent MRI of the head as part of a large public health survey in Norway in the period between July 21, 2007, and December 10, 2009. Sinus Opacifications were found in 66% of the participants. Mucosal thickenings were found in 49%, commonly in the maxillary sinuses (29%). Other opacifications occurred in the anterior ethmoid (23%), anterior ethmoid (21%), frontal sinus (9%), and sphenoid (8%). Polyps and retention cysts were also found mainly in the maxillary sinuses in 32%. Fluid was observed in 6% of the MRIs. From this study, it was concluded that Knowledge of incidental sinus opacification is important because it can affect clinical practice (14).

A cross-sectional hospital-based study of 118 patients was done in Bhairahawa, Nepal from April to September 2014. MRIs were evaluated for the presence of any abnormal findings in sinuses. Random probabilistic sampling was carried out. The sinuses were normal in 51 patients and abnormal in 67 patients. The most common abnormality was mucosal thickening followed by polyp, cyst, mass and fluid level respectively. 50 of 67 (74.6%) positive findings were observed as mucosal thickening while polyp was seen in 13 patients (28.4%). Similarly, both mass and fluid level was seen in 3 (4.5%)

A prospective hospital-based study was done in Japan between June 1, 1991, and April 30, 1992 on a total of 325 patients who underwent MRI for suspected intracranial disease to investigate the prevalence of abnormalities of paranasal sinus on brain MRI in asymptomatic subjects. Sinus abnormalities were seen on MRI in 153 (47.1%) of 325 patients. Subjects older than 50 years had a significantly higher frequency of sinus abnormalities on MRI (49.8%) vs those younger than 50 years (39.5%) ( $P < .05$ ). The maxillary sinus abnormality was observed in 99 patients (38.5%) and the ethmoid sinus abnormality was observed in 52 (20.2%) ( $P < .01$ ). The most common abnormality was mucosal thickening in the maxillary and ethmoid sinuses (16).



Similarly, a retrospective study was done on 115 patients in a private diagnostic center in Addis Ababa, Ethiopia to determine the prevalence of incidental abnormalities of PNS on T2W Brain MRI, 66 were males and 49 were females. Of all, 62.2% showed abnormalities in at least one of their sinuses. Significant paranasal mucosal thickening of more than 3mm was the commonest finding followed by the presence of polyps or retention cysts. The most involved sinus groups were the ethmoid and maxillary sinuses. This study concluded that PNS abnormalities are common findings in MRI scans done for other neurological problems (6).

## 2.2 Factors Associated with the magnitude of incidental paranasal abnormalities on brain MRI On asymptomatic patients.

A Prospective study on 404 patients was carried out at Aarhus University Hospital, Denmark from May 1996 to April 1997 to evaluate the significance of the findings by relating them to the presence of sinusitis symptoms, allergy, smoking, and seasonal variations. 128 cases (31.7%) of the 404 images showed abnormalities in one or more of the 8 paranasal sinuses. When the left and right sinuses were considered together, abnormalities were most commonly seen in the maxillary sinuses (33.7%) followed by the sphenoid (4.2%), the ethmoid (3.2%) and the frontal sinuses (2.3%). A significantly higher incidence was found in the winter period but there was no significant relationship between paranasal sinus abnormalities and sex, age, allergy, smoking habits, previous events of sinusitis or frequent events of colds (10).

A prospective study was conducted in the pediatric radiology department, among 147 children aged between 0.2 to 22.7 years in Stuttgart, Germany from January to April 2004. 61% of them had one or more salient findings in the paranasal sinuses while 48% had mucosal swelling in their paranasal cavities. The prevalence was higher among children below 10 years of age (50%). No correlation was seen with history of headache, snoring, asthma, allergies, gender or place of residence. From this study Mucosal swelling in paranasal sinuses is a frequent incidental finding in children. The initiation of treatment should be based on clinical symptoms and not on radiological abnormalities alone (11).

A prospective, cross-sectional study was carried out on 600 patients to assess the prevalence of nasal and paranasal sinus abnormalities in Jordanian patients at Akkarak hospital, Jordan from May 2018 to October 2018. Of the 600 patients (445 MRI, 145 CT scans), sinus pathology was observed in 170 patients (28.33%). The most common sinus abnormality was mucosal thickening (n=135, 79.41%), followed by complete opacification and cysts. A significant correlation was observed between sex, Sino nasal symptoms, facial pain, and asthma in both sinus pathology and nasal pathology (6).

An institutional-based retrospective study was carried out in Ankara, Turkey on 839 patients who had brain MRI for possible intracranial lesions to investigate the prevalence of incidental paranasal sinus abnormalities and associated factors. Of the 839 patients, 45.5% showed one or more sinus abnormalities. The prevalence of sinus abnormalities was significantly higher in winter (50.6%) than in summer (40.3%) ( $p=0.003$ ). While sphenoidal sinus lesions did not show significant seasonality ( $p>0.05$ ), maxillary and ethmoidal sinus lesions were significantly more common in winter than summer ( $p<0.05$ ). Paranasal sinus abnormality is a frequent incidental brain MRI finding which is more commonly detected in winter (17).

Similarly, an institutional-based cross-sectional study was done in Glasgow Scotland between January 1990 and May 1990 on 133 patients with a suspected intracranial lesion undergoing MRI. Abnormal sinuses were present in 45 percent of MR images compared on men compared to 34 percent of those on women but this difference was not statistically significant. There was no relationship between age group, type of neurological abnormality seen on MRI or smoking habit and the presence of sinus abnormalities (18).

A cross-sectional study was done on 1350 participants in Japan to investigate the association between diabetes and the presence of paranasal sinus disease. Of the 1350 participants (mean age,  $61.6 \pm 10.0$  years; 71.6% men), 220 diabetes cases were identified. Paranasal sinus disease was diagnosed in 151 adults. The adjusted odds ratio of having paranasal sinus disease was 1.74 (95% confidence interval [CI] 1.2-2.4) in those with diabetes. The odds of having paranasal sinus disease increased with HbA1c levels. (P for trend = 0.01) (19).

### 3. Conceptual Framework

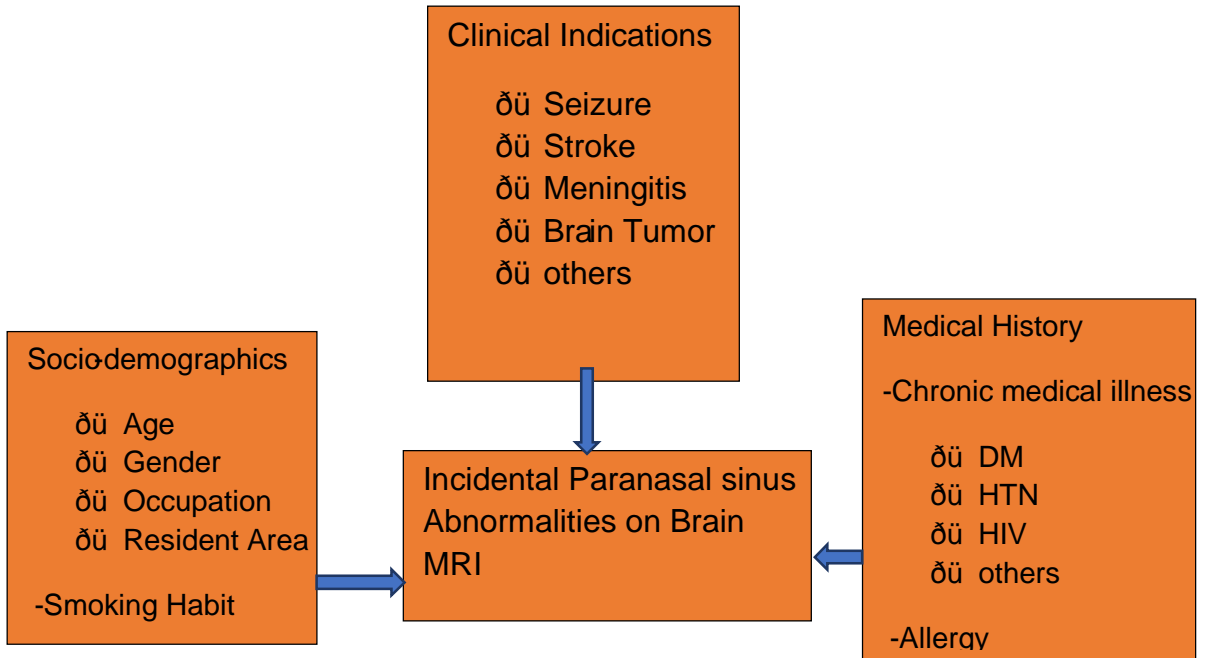


Figure1:Conceptual framework for the magnitude of incidental finding of paranasal sinus abnormalities and its associated factors on Brain MRI study.

## 4. Objectives of the study

### 4.1 General objectives

To assess the magnitude of incidental PNS abnormalities and associated factors on Brain MRI done for patients with other CNS problems in Nisir and Nolot Diagnostic centres.

### 4.2 Specific objectives

To determine the magnitude of incidental PNS MRI abnormalities in Nisir and Nolot Diagnostic centers.

To identify factors associated with incidental PNS abnormalities on brain MRI Nisir and Nolot Diagnostic centers.

## 5. Methods and materials

### 5.1 Study area and period

The study was conducted at Nisir and Nolot Private Diagnostic centers Bahir Dar, Ethiopia. Nisir and Nolot Private Diagnostic centers are the only Diagnostic centers that have MRI machines in Bahir Dar city. An average of 1440 patients had brain MRI at both diagnostic centers per year.

Bahir Dar is the capital city of the Amhara region in northern Ethiopia. It is a port on the south shore of the huge inland Lake Tana. It is 580km far from Addis Ababa, a population 318,429 (2016) (20).

Nisir and Nolot private diagnostic centers are two of the three diagnostic centers in Bahir dar, and they are the only diagnostic centers with MRI machines, which have 4 radiologists, 5 nurses, and 3 radiology technicians. They give radiologic medical services and undertake academic activities. The training of radiologists is in collaboration with Bahir Dar University. The study period was from February 2022 to May 2022.

### 5.2 Study design

The study design is an institutional based cross-sectional study.

### 5.3 Population

#### 5.3.1 Source population

All patients who had brain MRIs at Nisir and Nolot Diagnostic centers.

#### 5.3.2 Study population

All selected patients who had Brain MRI evaluation for an indication other than paranasal sinus disease in Nisir and Nolot Diagnostic centers in the period between February 2022 and May 2022 G.C.

### 5.4 Sample size determination

Sample size determination for the first objective

The sample size was calculated using single population proportion formula considering the prevalence of incidental PNS abnormalities is 0.6225, 95% level of confidence, 5% level of significance and 5% margin of error.

$n = z^2 pq / d^2$  where

z is CI of 95% which is 1.96

P is the proportion of patients who have incidental PNS abnormalities on brain MRI done for other CNS problems.

d is the margin of error which is 5%

$$n = 1.96^2 \times 0.6225 \times 0.3775 / 0.05^2 = 362$$

Using correction formula

$n_f = n / (1 + n/N)$  where N is the estimated total population, from the last 4 months report there were a total of 480 patients who had brain MRI in both diagnostic centers.

$$\text{So } n_f = 362 / (1 + 362/480) = 207$$

Then using a 10% nonrespondent rate

The final sample size will be 228

Sample size calculation for the second objective

From the previous study diabetes was associated with incidental paranasal sinus abnormality with having (AOR 1.74 95% CI 1.12 2.71, and P value of 0.019(21) .using power 80. Adding a non-respondent rate of 10%, and using a correction formula the sample size is 220

From the previous study, smoking history was associated with incidental paranasal sinus abnormality with having AOR 2.9; 95% CI, 0.918 to 9.009; value=0.0054(22). using power 80, Adding a nonresponse rate of 10%, and using a correction formula the sample size is 228.

The sample size calculation using a single population proportion is larger than the factor so the final sample size is 228.

## 5.5 Inclusion and exclusion criteria

### 5.5.1 Inclusion criteria

All patients who had Brain MRI evaluation for an indication other than paranasal sinus abnormalities in Nis and Nolot Diagnostic centers in the time between February 2022 and May 2022 G.C.

### 5.5.2 Exclusion criteria

Patients who had a concomitant clinical diagnosis of acute or chronic sinusitis.

Patients with severe head & facial trauma.

Patients who had facial or paranasal surgery

Patients with incompletely filed clinical data

## 5.6 Sampling procedures

A systemic random sampling technique was used to select the study participants. All the patients in each diagnostic center with brain MRI for an indication other than paranasal sinus disease in the study period were given a serial number. By using a constant interval  $k$ , which was calculated by dividing the total population size by the desired sample size it became  $k = 2$ . So the sample was taken in every other patient to obtain a total sample size of 228. The first sample was selected using the lottery method.

## 5.7 Variables

### 5.7.1 Independent variables:

Age, Gender, Occupation, Place resident, Smoking history, Allergy history, clinical indication, Chronic Medical Illness

### 5.7.2 Dependent variables:

Incidental Paranasal sinus abnormalities

## 5.8 Operational definitions

**PARANASAL SINUSES;** Four pairs of hollow, air-filled spaces located within the bones of the face that surround the nasal cavity and are connected to the nose by small openings. They are named the frontal, maxillary, ethmoid, and sphenoid sinuses. (23)

**PARANASAL SINUS ABNORMALITY;** when normally air-filled spaces are opacified or when there is thickened mucosa.

**INCIDENTAL FINDINGS:** An incidental finding, also known as an incidentaloma, may be defined as an incidentally discovered mass or lesion, detected by CT, MRI, or other imaging modality performed for an unrelated reason. (24)

**MUCOSAL THICKENING;** Mucosal thickening is an inflammatory reaction with hyperplasia of the mucous lining of the paranasal sinuses. This condition is caused by trauma, infections, chemical agents, foreign body reaction, neoplasms, airway conditions such as allergies, rhinitis, or asthma. It is considered normal mucosal thickening when it measures 3mm or less. (25)

**CIGARETTE SMOKER;** The definition of a cigarette smoker by the CDC is a person that has smoked 100 cigarettes in their lifetime and currently smokes either every day or some days. (26)

## 5.9 Data collection tools and procedures

A structured questionnaire was developed based on study objectives and available literature. After oral informed consent taken from patients, socio-demographic characteristics related to age, gender, occupation, place of residence, clinical indication,



Smoking history, Allergy history, and chronic medical illnesses were properly recorded for each subject

Brain MR Images were acquired using 0.3 T strength MR scanners with standard protocol. Images were acquired with an axial plane in T2 weighted with 5 mm slice thickness, slice gap of 1.5 mm and FOV of 140 mm x 140 mm. In T1 weighted sagittal plane, T2 weighted sagittal plane with 5 mm slice thickness, slice gap of 3.3 mm and FOV of 213 mm x 213 mm. Coronal plane acquisition Post intravenous gadolinium-based contrast images were also included. MRI soft copy was assessed by a Radiologist and the findings were properly recorded for each subject

#### 5.10 Data quality control

The completeness and consistency of the collected data were checked on daily bases during data collection by the principal investigator. Whenever there appears incompleteness and ambiguity recording, the filed information formats were cross checked with source data. Individual records with incomplete data were excluded from the study. Data entry have done by standardized and consistent procedures with clear instructions to ensure data quality

#### 5.11 Data processing and analysis

Data were entered using EpiData version 4.6 and sent for analysis using SPSS version 26. Simple tabulation and descriptive statistics using cross and frequency table were used to look for the magnitude of incidental paranasal sinus abnormalities on brain MRI. Ratio were used to look for the association of magnitude of Incidental paranasal abnormalities on brain MRI with other variables by using simple binary and multivariable logistic regression analysis. Variables having a p-value less than 0.05 in the simple binary logistic regression analysis were added to the final multivariable logistic regression analytic process. Independent variables having a p-value less than 0.05 in the analysis were considered a significant association. Multicollinearity was checked among independent variables through the variance inflation factor (VIF) and the observations in the dataset are independent of each other.

## 5.12 Ethical considerations

Before conducting the study, permission and approval letter from TGS management and research review committee of Bahir Dar University College of medicine and health science have been received. Informed consent was obtained from the participants of the study and they were told they can discontinue whenever they want. During the data collection procedure, patient privacy and confidentiality were kept to the maximum.

## 5.13 Dissemination of research findings

Based on the findings, after conclusion and recommendation, one soft copy and two hard copies of the research paper will be submitted to Bahir Dar University College of medicine and health science, the clinical Radiology Department, NISIR, and NOLOT Diagnostic center. The result will also be distributed to the library and department of otolaryngology. Subsequently, attempts will be made to present at scientific conferences and publish in scientific journals.

# 6. Result

## 6.1. Sociodemographic characteristics

A total of 228 patients were studied with a response rate of 100%. Among the total of 228 patients, 117 (51.3%) were male and 111 (48.7%) are female. The age of the patients ranged from 1 to 85 years. The highest number of patients was in the 15-64 years age group (77.6%) followed by the age group of 65 years and above (12.7%). The lowest numbers of patients were in the age group of 14 years of age comprising 9.6%. The mean age of the patients was  $39.7 \pm 19.2$  years. The majority of the patients 140 (61.4%) were live in the urban area (27.6%). The majority of 213 (93.4%) of the respondents were Amhara in ethnicity (Table 1)

Table 1: Sociodemographic characteristics of patients seen at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

Variables	Category	Frequency	Percent (%)
Sex	Male	117	51.3
	Female	111	48.7
Age range (years)	0-14	22	9.6
	15-64	177	77.6
	>=65	29	12.7
Residency	Urban	140	61.4
	Rural	88	38.6
Occupation	Employed	82	36
	Farmer	64	28.1
	Merchant	17	7.5
	Others (retired, have no work)	65	28.7
Ethnicity	Amhara	213	93.4
	Agew	14	6.1
	Others	1	0.4
Religion	Orthodox	206	90.6
	Muslim	17	7.5
	Protestant	4	1

Marital status	Single	63	27.6
	Married	159	69.7
	Divorced	1	0.4
	Widowed	5	2.2

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## 6.2, Patient's clinical indications

Among the 228 patients, the most common clinical indication for brain MRI was brain tumor which was seen in 73 patients (32%), followed by stroke in 36 patients (15.8%), meningitis in 35 patients (15.35%), seizure 28 (12.28). The Other indications included headache, encephalitis, post-traumatic brain injury, a neurodegenerative disorder, congenital anomalies, etc. in 56 patients (24.56).

Figure 2: Patient's clinical indications for brain MRI at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

### 6.3, Chronic medical illness

One hundred eight (47.4%) have a chronic medical illness, the most common chronic medical illness identified is hypertension 41 (37.96%), followed by retroviral infection 24 (22.22%) the rest were bronchial asthma 22 (20.37%) and diabetes mellitus 21 (19.44%).

Figure 3: Chronic medical illness identified from patients who had brain MRIs other than paranasal sinus disease indications at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC

### 6.4, Magnitude and Distribution of paranasal sinus findings

Among the 28 MRI scans, 13 (57.9%) patients showed one or more paranasal sinuses incidental abnormalities. The right, the left and bilateral considered together, the most commonly involved sinuses were the maxillary and ethmoidal groups as seen in 105 (52.76%) and 68 (34.17%) of the total patients respectively. The frontal sinus is the least to have incidental findings 4 (2.98%).

Table 2: Magnitude and distribution of abnormal paranasal sinus findings on brain MRI seen at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

Paranasal sinus	Frequency (n=132)	Percent (%)
Right Maxillary	25	18.9
Left Maxillary	25	18.9
Bilateral Maxillary	55	41.67
Right Frontal	3	2.27
Left Frontal	1	0.75
Anterior ethmoid	33	24.45
Posterior ethmoid	35	26.51
Right sphenoid	5	3.78
Left sphenoid	8	6.5
Bilateral sphenoid	9	6.8

### 6.5, Pattern of incidental paranasal abnormalities

The abnormal sinus findings were categorized into five groups, namely mucosal thickening, retention cyst/polyp, airfluid level, total opacification, and more than one finding.

The total number of abnormalities was more than a hundred percent because multiple answers were possible. From the total number of abnormal paranasal findings, 126 (63.64%) patients showed mucosal thickening, 31 (15.65%) patients showed retention cyst/polyp, 25 (12.62%) patients showed multiple abnormalities in their paranasal sinuses, 12 patients (6%) had total sinus opacification, and 4 patients (2%) demonstrated airfluid level.

Significant mucosal thickening of more than 3mm was the most common incidental finding, and both total sinus opacification and air-fluid levels were the least frequent.

Maxillary sinus was the most common sinus involved mucosal thickening, found in 60 out of the 126 (47.6%). Some of the patients had sinus involvement at multiple sites. Among the sixty patients with maxillary sinus involvement 36 (60%) had bilateral sinus mucosal thickening, 12 (1.6%) patients had left maxillary sinus mucosal thickening and 11 (18.34%) had right maxillary mucosal thickening.

There were 52 (41.2%) patients with mucosal thickening of ethmoid cells, of which, 28 (53.84%) had posterior and 24 (46.16%) had anterior ethmoid air cells. 18 (73%) patients had sphenoid sinus mucosal thickening. The frontal sinus was the least involved sinus found in only 3 of the 126 (2.38%).

The other commonly detected incidental abnormality was presence of a retention cyst or polyp which were grouped together. In the maxillary sinuses alone these were found in 16 (51.6%) of patients while the frontal sinuses were least involved as only 1 (3.2%) patient has this finding.

More than one type of abnormality was seen more in the maxillary, 20 (80%) and sphenoid 3 (12%) sinuses, the commonest combination being significant mucosal thickening and presence of retention cyst or polyp.

The highest incidence of total sinus opacification was 7 (58.3%) and air fluid level 3 (25%) was seen in the maxillary sinuses.

Table 3 Summary of the pattern of abnormalities seen in the PNS on brain MRI at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

Paranasal sinus	Mucosal thickening	Retention cyst/Polyp	Air-fluid level	Total opacification	More than one findings
Right maxillary	11	6	3	2	3
Left maxillary	13	7		3	2
Bilateral maxillary	36	3		1	15
Right frontal	3				
Left frontal		1			
Bilateral frontal					
Anterior ethmoid	24	5		3	1
Posterior ethmoid	28	5	1		1
Right sphenoid	2	2		1	
Left sphenoid	4	2		1	
Bilateral sphenoid	5			1	3
Total number of abnormalities	126	31	4	12	25



### 6.6, The Age distribution of paranasal abnormalities

The highest number of incidental paranasal sinus abnormalities seen in the age group of 15-64 years which was 103(78%) whereas the lowest incidence was shown in the group 0-14 years 11(8%).

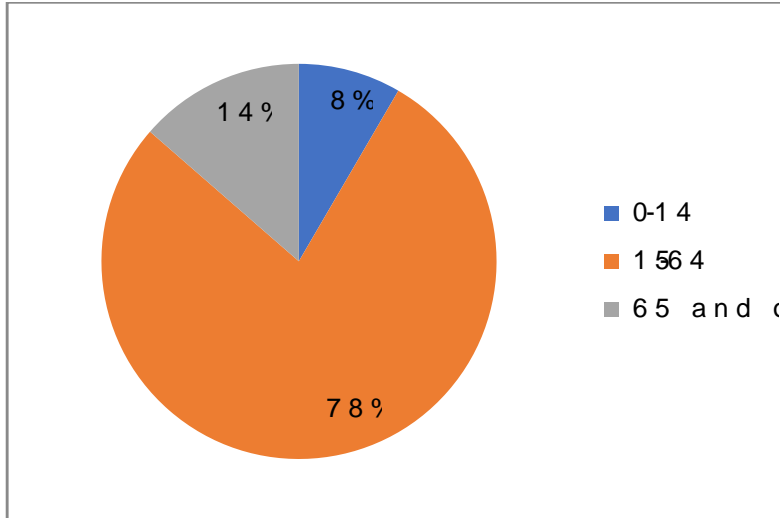


Figure 4 Percentage of Abnormal PNS MRI findings in different age groups seen at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

### 6.7, Factors associated with magnitude of incidental paranasal sinus abnormalities.

Table 4: Bivariate logistic regression showing the association of independent variables with incidental paranasal sinus abnormalities on brain MRI seen at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

Variable	Category	PNS abnormality		COR(95%,CI)	P-Value
		Yes	No		
Sex	Male	70	47	1	0.544
	Female	62	49	0.850(0.5021.438)	
The age range of patients	1-14	11	11	1	0.465
	15-64	103	74	1.392(0.5733.381)	

	>=65	18	11	1.636(0.5325.030)	0.390
Occupation	Employed	46	36	1	
	Farmer	39	25	1.221(0.6282.374)	0.556
	Merchant	9	8	0.880(0.3092.510)	0.812
	Other	38	27	1.101(0.5702.128)	0.774
Residency	Urban	79	61	1	
	Rural	53	35	1.169(0.6802.011)	0.572
Allergy	No	116	91	1	
	Yes	16	5	2.510(0.8867.110)	0.083
Seizure		12	16	0.985(0.4412.198)	0.970
Stroke		19	17	0.706 (0.2661.871)	0.484
Brain Tumor		43	30	1.015(0.4552.266)	0.97
Meningitis	No	106	87	1	
	Yes	26	9	2.371(1.0565.326)	0.037
HTN	No	105	82	1	
	Yes	27	14	1.506(0.7433.055)	0.256
DM	No	116	91	1	
	Yes	16	5	2.510(0.8868.51)	0.083
HIV	No	113	91	1	
	Yes	19	5	3.06(1.108.51)	0.032

Asthma	14	8	0.734(0.248-2.169)	0.576
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In binary logistic regression: Allergy, meningitis, Diabetes Mellitus, and human immunodeficiency virus infection were statistically significant at a p-value of 0.05 and CI of 95%

Significant variables in the bivariate logistic regression were entered into multivariate logistic regression. And in the multivariate logistic regression: Allergy history, Diabetes Mellitus, and human immunodeficiency virus infection were significantly associated with incidental paranasal abnormalities on brain MRI at a p-value of 0.05 and CI of 95% (Table 5).

Table 5: Multivariate logistic regression showing the association of independent variables with incidental paranasal sinus abnormalities on brain MRI seen at NISIR and NOLOT diagnostic centers from February 2022 to May 2022 GC.

Variable	category	PNS abnormality		COR(95%,CI)	AOR(95%,CI)	P-Value
		Yes	No			
Allergy	No	116	91	1		
	Yes	16	5	2.510(0.889-7.110)	2.932(1.019-8.435)	0.046
Meningitis	No	106	87	1		
	Yes	26	9	2.371(1.056-5.326)	2.140(0.934-4.917)	0.073
DM	No	116	91	1		
	Yes	16	5	2.510(0.886-7.51)	2.895(1.007-8.327)	0.049
HIV	No	113	91	1		
	Yes	19	5	3.06(1.108-8.51)	3.273(1.154-9.280)	0.026

Those patients with allergies were 2.93 times more likely to have incidental paranasal sinus abnormality on brain MRI than those patients with no Allergy. (AOR:2.93, 95% CI:1.0198.435, P value 0.046)

Those patients with diabetes mellitus were 2.90 times more likely to have incidental paranasal sinus abnormalities on brain MRI compared to those patients with no diabetes mellitus. (AOR:2.90, CI 95%:1.0078.327, P value 0.049)

HIV-positive patients were 3.27 times more likely to have incidental paranasal sinus abnormalities on brain MRI compared with HIV-negative patients. (AOR:3.27, CI 95%:1.1548.327, P value of 0.026)

## 7, Discussion

Among the cross-sectional brain imaging modalities MRI has superior soft tissue contrast. This together with its ability to take multiplanar images using different sequences makes it the preferred technique to demonstrate soft tissue abnormalities. Inflammatory changes in the PNS which are commonly seen even in asymptomatic individuals are easily detected on T2W MR images.

This study showed inflammatory changes in the PNS of patients scanned for other neurologic problems. Of these patients 57.9% showed abnormality in one or more sinus groups. Considering the right, left, and bilateral together, the most commonly involved sinuses were the maxillary and ethmoidal groups as seen in 105 (52.76%) & 83 (47.6%) of the total patients respectively. The least commonly affected sinus was the frontal sinus accounting for 1 (2.98%). The most common finding was mucosal thickening seen in 60 (47.6%) and the most commonly seen in the maxillary sinuses. Most of the air fluid levels & retention cysts/ polyps were found in the maxillary sinuses followed by the ethmoid sinuses. The prevalence is in line with that of previous studies as seen in 29.55% (6), 49.2% (10) & 64.3% (11)

Retention cysts/ polyps which accounted for 15% are the second most common incidental paranasal abnormality seen in our study and the prevalence is in line well with

the previous studies 25.4%(27),28.4%(21),15%(28).Polyps and retention cysts are common, asymptomatic, and incidental findings on imaging that cannot be distinguished from each other on MRI or any other imaging modality; hence, they are generally classified as one pathologic entity (29).

More than one type of abnormality was seen more in the maxillary, 20(80%) and sphenoid 3 (12%) sinuses, the commonest combination being significant mucosal thickening and presence of retention cyst or polyp

Air fluid level was an infrequent finding in our study 4 (6%),and the commonest location was seen in the maxillary sinus.the value comparable to other studies 6%(30)

Of the total patients included in this study, only 11(8%) patients were below the age of 15 years. Half of these had abnormalities at least in one of their sinuses, the commonest sinus involved being the maxillary followed by the ethmoid air cell. Again, from the incidental abnormalities, mucosal thickening and retention cysts/polyps were the highest in number. These values are comparable with that of the results found in previous studies 50%(8) 50%(31)& 61%(11)

There was no statistically significant association found between the pattern of PNS abnormalities and age,sex,hypertension, smoking habits,asthma, and place of residence of the study population. there is one study conducted in the pediatric radiology department among 147 children aged 0-22.7yrs which showed an increased prevalence of abnormalities in children below 10 years (11), another study was done on 600 patients in Jordan, a significant correlation was observed between seasonal asthma and paranasal abnormal findings (32). the disagreement with our study could be the difference in ethnicity, geographic area, and the study design used. of the other studies showed no significant correlation between the incidence of abnormalities and the sex or age of patients (11),(28).

In our study there was a statistically significant association found between incidental paranasal sinus abnormality and Allergy history a P value of 0.046 but most studies showed no statistically significant association between allergy and paranasal sinus

abnormalities (11), (28), (33). This variation could be due to different ethnicity and study designs used.

The study showed also a statically significant association between diabetes mellitus and HIV with incidental paranasal sinus findings on brain MRI. In 2015, GC there is one study took place in Japan on 1350 brain MRI to assess the association of incidental paranasal sinus abnormality and diabetes mellitus and there was a significant association seen between those variables (P value = 0.019) (19).

Similarly, there was a case-control study done in England on 150 patients with 104 patients with HIV/AIDS, significant mucosal thickening was seen in those who have HIV compared with those not have the disease (P value < 0.001) and there was also increased prevalence seen in patients with stage defining illness compared with those without stage defining illness (34).

There is an association seen between meningitis and incidental paranasal sinus opacification in our study but it is not significant.

## 8, Conclusion

Our findings revealed that the magnitude of paranasal sinus abnormalities in asymptomatic patients was high at 57.9%. The maxillary and ethmoid sinuses are commonly reported with incidental sinus pathology. Significant mucosal thickening of more than 3mm was the most common incidental finding followed by retention cyst/polyp in patients who presented for brain MRI for non-ENT indications. A significant correlation was observed between Diabetes Mellitus, Allergy history, and retroviral infection with incidental sinus findings. Our findings significantly contribute to the knowledge of incidental sinus findings in patients. It will help the radiologists determine the relevance of abnormal findings and consider the possibility of development of unexpected abnormalities.

## 9. Recommendation

To hospital staff and both clinical Radiology and ENT department

We recommend the clinical radiology departments since incidental paranasal sinus abnormalities are common findings on brain MRIs for asymptomatic patients it is unnecessary to routinely report such findings to the ENT department, treating incidental paranasal sinus abnormalities on routine brain imaging is unnecessary, treatment should depend on the patient's symptoms.

To regional and federal administrative

We recommend the regional health bureau and the ministry of health to consider the high prevalence of asymptomatic paranasal sinus abnormalities in brain imaging while preparing national treatment guidelines.

To the researchers

We recommend further research with a large population and a long study period. Since these paranasal sinus abnormalities detected could be the reasons for the indications of the brain MRI scans in patients who otherwise do not have pertinent neurological findings on MRI, a further comparative study between those having normal and abnormal brain MRI neurological findings is recommended.

## 10, limitations of this study

The limitation of this study is that the sample size is not representative of the general population as it was derived from private diagnostic centers. Hence, the actual prevalence of abnormalities in the general population cannot be extrapolated.

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# ANNEX

Annex I Consent form and information sheet

BAHIR DAR UNIVERSITY SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF CLINICAL RADIOLOGY

Information sheet and consent form

Introduction

My name is Dr. Sebsbie Adma (Radiology 3<sup>rd</sup> Year Resident). I am learning at Bahirdar University. I am doing this research as partial fulfillment for the requirement of a Radiology specialty in College of Medicine and Health sciences at Bahirdar University, Department of Clinical Radiology. I will do the magnitude of incidental paranasal sinus abnormalities and associated factors on brain MRI. Your name will not be written in this Form and the information you give are kept confidential. If you don't want to answer all of or some of the questions, you do have the right to do so. However your willingness would be appreciated.

Would you like to participate in this study and answer all of the questions asked by investigator?

Yes-----

No-----

Name of data collector who sought the consent-----

Signature-----

Date of data collection-----

Annex II Questionnaire

Part I Socio-Demographic Characteristics

- 1. MRN \_\_\_\_\_
- 2. Age \_\_\_\_\_
- 3. Sex     1. M       2. F
- 4. Religion     1. Orthodox Tewahido   2. Muslim   3. Protestant   4. Others
- 5. Education Status:     1. Grade 1   2. Grade 2
- 3. Grade 9/12   4. Diploma   5. Degree and above
- 6. Occupation: 1. Government employee   2. Non government employee.
- 3. Farmer           4. Merchant   5. Others
- 7. Resident   1. Urban   2. Rural
- 8. Ethnicity   1. Amhara   2. Agew
- 3. Tigre       4. Gumz     5. Others
- 9. Marital status

- 1. Single                   2. Married
- 3. Divorced                4. Widowed
- 5. Separated               6. Mention if other

Part II: clinical indication

- 1, seizure       2, stroke   3, meningitis   4, Brain Tumor
- 5, other

Part III :Smoking History

Have you ever smoke cigarette? 1, Yes       2, No

If yes,, how many packet you smoke per day for how long?.....

Part IV; Allergy History

Do you have any kinds of Allergy? 1, Yes       2, No

Part V; History of chronic medical illness

- 1,DM            2,HTN  
 3,Athsma      4,HIV      5,Others

Part VI; Brain MRI PNS findings

Paranasal sinus		Findings				
		Mucosal thickening	Retention cyst/Polyp	Air-Fluid level	Total opacification	More than one findings
Maxillary Sinus	Right					
	Left					
	Bilateral					
Frontal Sinus	Right					
	Left					
	Bilateral					
Ethmoidal Sinus	Anterior					
	Posterior					
Sphenoidal Sinus	Right					
	Left					
	Bilateral					