# Indian Journal of Communicable Diseases




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# Mucormycosis and Covid: Why in India?

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**Abstract**

***Background*:** CAM (COVID-19 associated invasive Mucormycosis) has been increasingly documented in patients with coronavirus disease 2019 (COVID-19). Predisposing factors include diabetes, steroid use, neutropenia, malignancies, and immunocompromised individuals. The etiology and the exact route of entry for CAM in COVID patients are poorly understood. In India, the incidence of CAM in COVID patients is on the rise. Repeated use of steam inhalation with herbal medicines might cause nasal mucosal trauma which leads to CAM

***Patients and Methods*:** Analytical cross-sectional study was conducted to determine the cause for CAM. COVID positive patients with and without Mucormycosis admitted to our hospital were included in the study. A detailed history about the practice of steam inhalation, comorbid illnesses like Diabetes Mellitus (DM), and the use of steroids were assessed and analyzed.

***Results*:** 63 CAM patients and 154 Non-Mucormycosis COVID positive patients were taken for the study and analyzed. Injudicious use of steam inhalation (84.1% vs 40.9%) multiple times per day (> 3 times) are strongly associated with CAM among COVID-positive patients (P value 0.0001). Uncontrolled DM (P-value 0.011) and prolonged duration of steroids > 8 days (P-value <0.001) were significantly associated with CAM when compared to control groups. Early diagnosis and treatment improved the outcome of CAM patients.

***Conclusion*:** Injudicious use of steam inhalation can cause nasal mucosal trauma which can result in Invasive Mucormycosis in already immune depleted COVID positive patients

**Keywords:** CAM COVID-19 associated invasivemucormycosis); Coronavirus disease 2019 (COVID-19); Steam inhalation.

## Introduction:

CAM (COVID-19 associated invasive mucormycosis) is a rare life threatening opportunistic infection with high morbidity and mortality.[1] It commonly affects immune depleted individuals like uncontrolled Diabetes Mellitus (DM), malignancy, patients on long term steroids, and immunosuppressive medications.[2] The global pandemic of coronavirus disease 2019 (COVID 19) and its management leads to an immunocompromised state which invites opportunistic infections like CAM. Worldwide, the prevalence of Mucormycosis varied from 0.005 to 1.7 per million population.[3] In India, its prevalence is nearly 80 times higher (0.14 per 1,000), as per recent

estimate from 2019-2020.[4,5] CAM is characterized by devitalization of host tissues that results from thrombosis of vasculature by fungal hyphae.[6] The exact etiology and route of entry of CAM are poorly understood.

The fungus causing mucormycosis is commonly present in the environment. We hypothesize that damage/breach in nasal mucosa facilitates entry of Mucormycosis in COVID 19 patients. We believe that the indiscriminate use of steam inhalation in the COVID 19 pandemic cause's mucosal trauma thereby increases the incidence of CAM infection especially among Covid positive patients in India.

This study aims to evaluate the possible causes and risk factors for the high incidence of CAM in India during this global COVID pandemic.

***Patients and Methods***: This study is an analytical cross-sectional studyconducted in Government Stanley Medical College Hospital from April 2021 to June 2021 for 3 months. COVID positive patients with and without CAM admitted to our hospital were included in the study. A detailed history about the risk factors and practice of steam inhalation, comorbid illness like Diabetes Mellitus (DM), and duration and use of steroids were evaluated and analyzed. Data about demographics, clinical features, co-morbidities, laboratory investigations, histopathology, management, and outcomes were collected after obtaining informed consent from all patients. The study was approved by our institutional ethics committee.

The diagnosis of COVID 19 was based on a real-time polymerase chain reaction (RT-PCR) test from nasopharyngeal and/or oropharyngeal swabs. In clinically suspected patients, the presence of fungal hyphae was detected by direct examination in 10% Potassium Hydroxide (KOH) from scrapping and was subsequently proved based on microbiological culture. Apart from establishing COVID 19 status and ascertaining CAM, imaging like computed tomography (CT) and/or magnetic resonance imaging (MRI) of the orbit, brain, and/or paranasal sinuses were performed for all cases to assess the extent of involvement due to CAM.

**Statistical analysis:**

Data were entered in the excel spreadsheet and variables were coded accordingly. The statistical analyses were performed using SPSS version 20 software. All continuous variables were expressed as mean and Standard deviation and categorical variables were expressed as proportion and percentages. Chi-square test/Fisher's exact test and unpaired t test were used as tests of significance. p value <0.05 was considered statistically significant.

*Sample size:* n=63 (CAM group); n=154 (control groups)

*Sample calculation:* from study done by Moorthy *et al*, Banglore

Formula

$$n = \frac{z^2 pq}{d^2}$$

Where n=sample size

z=1.96 (statistical significant constant for 95% CI)

p=83% (proportion of covid 19 mucormycosis patients who are having DM as a risk factors))

q= (100-p) 17%

d=13% relative precision (i.e., 13% of 83=10.79 appr 11)

**Results:**

Sixty-three CAM patients (case n=63) and 154 Non-MucormycosisCOVID positive patients (control n=154) were taken for the study and analyzed. The baseline characteristics like age and sex between the two groups were comparable.

**Table 1:** Comparison of baseline characteristics between the groups

| Parameter | Case group (n=63) | Control group (n=154) | P value |
|---|---|---|---|
| Age in years (mean ±SD) | 54.57±10.8 | 50.1±17.1 | 0.124 |
| **Sex distribution** | | | |
| Male (n,%) | 32 (50.8) | 81 (52.6) | 0.881 |
| Female (n,%) | 31 (49.2) | 73 (47.4) | |

The COVID 19 patients with Mucormycosis are case group and without Mucormycosis are control group. Unpaired't' test was used to compare the mean age between the groups (t=1.55; df=215). Chi square test was used to compare the gender distribution between the groups (X2=0.451; df=2).

**Table 2:** Description of various parameters of COVID 19 patients with Mucormycosis observed in the study.

| Parameter | n | % |
|---|---|---|
| Steam inhalation | | |
| Present | 53 | 84.1 |
| Absent | 10 | 15.9 |
| **Use of native medication while steam inhalation*** | | |
| Amurtanjan | 5 | 9.4 |
| Herbal products (without scientific evidences) | 25 | 47.2 |
| Plain water only | 23 | 43.4 |
| Use of corticosteroids | | |
| Present | 44 | 69.8 |
| Absent | 19 | 30.2 |
| **Presence of diabetes** | | |
| Present | 38 | 60.3 |
| Absent | 25 | 39.7 |
| ENT mucormycosis infection present | 50 | 79.4 |
| Eye mucormycosis infection present | 40 | 63.5 |
| **Type of antifungal therapy given** | | |
| Amphotericin-B alone | 49 | 77.8 |
| Amphotericin-B + Posaconazole | 2 | 3.2 |
| Amphotericin-B + FESS | 2 | 3.2 |
| Amphotericin-B + Meropenem | 3 | 4.8 |
| Posaconazole alone | 7 | 11.1 |
| Positive fungal culture present | 46 | 73 |
| **Outcome observed** | | |
| Recovered | 55 | 87.3 |
| Died | 8 | 12.7 |

The total N = 63 except * where the = 53 (as only patients who took steam inhalation was included

Based on imaging, nose and paranasal involvement.

Were about 50 patients (79.4%), orbital involvement of about 40 patients (63.5%). Positive fungal cultures were in 46 patients (73%) among CAM.

The various sites of nasal and paranasal sinuses involved based on imaging were shown in Table-3.

**Table 3:** Description of types of sites of ENT Mucormycosis observed in the study (N=63).

| Site of ENT Mucormycosis involvement | n | % |
|---|---|---|
| All sinuses | 6 | 9.5 |
| Bilateral ethmoid, sphenoid frontal sinusitis | 3 | 4.8 |
| Bilateral maxillary sinusitis | 1 | 1.6 |
| Bilateral maxillary sinusitis, ethmoid, sphenoid sinusitis | 1 | 1.6 |
| Black turbinate sign in inferior turbinate left side | 1 | 1.6 |
| Ear crust, hyperemia, nasal turbinate hypertrophy | 1 | 1.6 |
| Edematous and hyperemic laryngeal mucosa | 1 | 1.6 |
| Edematous turbinate | 3 | 4.8 |
| Epistaxis, black discoloration of nasal bridge | 1 | 1.6 |
| Epistaxis, nasal discharge, edematous mucosa | 1 | 1.6 |
| Erythema of nasal mucosa ,hypertrophied turbinates | 1 | 1.6 |
| Erythema of nasal skin, foul smelling discharge. Mucosal edema | 1 | 1.6 |
| Foul smelling nasal discharge, epistaxis, Bilateral facial edema, black discoloration of nasal bridge | 1 | 1.6 |
| Invasive Rhino cerebral and Ocular Mucormycosis | 1 | 1.6 |
| Mild fungal sinusitis in right maxillary and ethmoid sinus | 1 | 1.6 |
| Nasal crusting, turbinate hypertrophy | 1 | 1.6 |
| Nasal foul smelling discharge, nasal bridge black discoloration+ | 8 | 12.7 |
| Nasal mucosal edema, turbinate hypertrophy | 1 | 1.6 |
| Normal | 13 | 20.6 |
| Oral mucosal hyperemia, turbinate hypertrophy | 1 | 1.6 |
| Palate black discoloration | 1 | 1.6 |

Similarly, orbital involvement was described in Table 4 of CAM patients. The duration of COVID related symptoms between the groups (7.27 ± 2.8days in case Vs 6.58 ± 1.98 in control) were significant (P-value 0.044)

**Table 5**: Comparison of parameters between the case and control groups.

| Parameter | Case group (n=63) | Control group (n=154) | Test used | Statistic value | df | P value |
|---|---|---|---|---|---|---|
| Duration of Covid symptoms in days (mean ±SD) | 7.27 ± 2.8 | 6.58 ± 1.98 | Unpaired t test | t=2.02 | 215 | 0.044* |
| Presence of steam inhalation, n(%) | 53 (84.1) | 62 (40.9) | Fisher's exact test | X2=33.5 | 1 | <0.0001* |
| Number of times steam inhalation done per day (median ± IQR) | 3 (2 – 4) | 2 (1 – 2) | Mann Whitney U test | U=414.5 | -- | <0.0001* |
| **Use of native medication during steam inhalation** | | | | | | |
| Amurtanjan, n(%) | 5 (7.9) | 4 (2.6) | | | | |
| Herbal, n(%) | 25 (39.7) | 28 (18.2) | Fisher's exact test | X2=0.504 | 2 | 0.7772 (NS) |
| Plain water only, n(%) | 23 (52.4) | 30 (19.5) | | | | |
| Use of steroid, n(%) | 44 (69.8) | 110 (71.4) | Chi square test | X2=0.055 | 1 | 0.871 (NS) |
| Duration of use of steroid in days (mean ±SD) | 8.43 ± 2.67 | 7 ± 0.1 | Unpaired t test | t=5.65 | 152 | <0.001 |
| Presence of diabetes, n(%) | 38 (60.3) | 63 (40.9) | Fisher's exact test | X2=6.79 | 1 | 0.011* |

*Indicates p<0.05 and considered statistically significant. The 'n' for row 4 was 53 and 62 for case group and control group respectively. The 'n' for row 6 was 44 and 110 for case group and control group respectively.

**Table 4:** Description of types of sites of ophthalmucormycosis observed in the study (N=63)

| Site of ophthalmucormycosis involvement | n | % |
|---|---|---|
| Bilateralsevere NPDR, CSME | 1 | 1.6 |
| Bony erosion medial wall of orbit/proptosis | 1 | 1.6 |
| Diplopia, restricted movements | 3 | 4.8 |
| Left orbit edema | 1 | 1.6 |
| Left eye peri orbital edema | 1 | 1.6 |
| Left ophthamoplegia | 1 | 1.6 |
| Left orbit exentration done | 1 | 1.6 |
| Left orbital cellulitus | 4 | 6.3 |
| Normal | 23 | 36.5 |
| Orbital cellilitis | 2 | 3.2 |
| Periorbital edema | 3 | 4.8 |
| Ptosis+proptosis | 1 | 1.6 |
| Right orbit exentration done | 1 | 1.6 |
| Right orbital cellulitis | 2 | 3.2 |

The practice of steam inhalation includes the use of native medications (medications without scientific evidences) like amurtanjan, other herbal products, or with plain water and the number of times per day used were compared between two groups (Table 5).

It was found that steam inhalation and its usage of more than 3 times/day was found to be significant 84.1% in the case group and 40.9% in the control group) between two groups (P-value 0.0001).

The impact of usage of steroids for moderate and severe COVID illness on CAM (Table 5) were analyzed and it was found that intravenous steroids use was not positively correlated with CAM, however, the prolonged duration of steroid use for more than one week (8.43 ± 2.67 days in case Vs 7 ± 0.1 days in control) was found to give a significant differencebetween the two groups (P-value 0.0001).

The presence of comorbid illness especially Diabetes Mellitus (DM) (Table 5) were compared between the two groups as a predisposing factor for opportunistic CAM. It showed that 38 patients (60.3%) in the CAM group had DM as compared to 63 patients (40.9%) in the control group and the results were statistically significant (P-value 0.011).

**Table 6:** Calculation of odd ratio for various risk factors identified in the study.

| Risk factor for mucormycosis | Mucor developed group (n=63) | No mucor group (n=154) | Odd's ratio | 95% confidence interval | P value |
|---|---|---|---|---|---|
| Presence of diabetes | 38 (60.3) | 63 (40.9) | 1.74 | 1.14 to 2.68 | 0.011* |
| Use of steam inhalation | 53 (84.1) | 62 (40.3) | 7.86 | 3.7 to 15.8 | <0.001* |
| Presence of both diabetes and steam inhalation | 33 (52.4) | 28 (18.2) | 4.95 | 2.6 to 9.1 | <0.001* |

Data are expressed as n (%). *indicates p<0.05 and considered statistically significant

The odds ratio for various risk factors like the presence of diabetes, use of steam inhalation, and both (DM and steam inhalation) identified in the study were calculated and found that presence of Diabetes Mellitus 38 (60.3%) among CAM versus 63 (40.9%) among non CAM, their odds ratio of 1.74 (CI 1.14 to 2.68), use of steam inhalation 53 (84.1%) among CAM versus 62 (40.3%) in control groups, their odds ratio was 7.86 (CI 3.7 to 15.8) produced significant association among CAM patients. The presence of both diabetes and steam inhalation was also produced significant results (odds ratio 4.95, CI between 2.6 to 9.1 with P-value <0.001).

Data about the outcome (table 2) were also analyzed and 55 patients (87.3%) were recovered and about 8 patients (12.7%) succumbed to illness which showed that appropriate diagnosis and intervention improved the outcome of CAM.

**Discussion:**

CAM is a rare superinfection in immunocompromised individuals caused by invasion of fungal hyphae resulting in ischemic necrosis of host tissues.[6] The most common clinical presentation of Invasive Mucormycosis (CAM) is a rhino orbital cerebral infection, due to invasion of spores into the paranasal sinuses of immune depletedind ividuals.[7] Cytokine storm, uncontrolled DM and prolonged steroids amidst Covid 19 infection causes immunocompromised states which lead to CAM.[8]

**Table 7:** Criteria for Proven Invasive Fungal Disease (Donnelly *et al*. Clinical Infectious Diseases 2020)

| Microscopic Analysis: Sterile Material | Culture: Sterile Material | Blood | Serology | Tissue Nucleic Acid Diagnosis |
|---|---|---|---|---|
| Histopathologic, cytopathologic, or direct microscopic examination of a specimen obtained by needle aspiration or biopsy in which hyphae or melanized yeast-like forms are seen accompanied by evidence of associated tissue damage | Recovery of a hyaline or pigmented mold by culture of a specimen obtained by a sterile procedure from a normally sterile and clinically or radiologically abnormal site consistent with an infectious disease process, excluding BAL fluid, a paranasal or mastoid sinus cavity specimen, and urine | Blood culture that yields a moldc (eg, Fusarium species) in the context of a compatible infectious disease process | Not applicable | Amplification of fungal DNA by PCR combined with DNA sequencing when molds are seen in formalin-fixed paraffin-embedded tissue |

Infection usually begins with flu-like symptoms, spreads to all the sinuses and then invade contiguous structures like the palate, orbit, and brain results in worsening of clinical symptoms.[9] Early recognition of warning symptoms and timely interventions are vital to avoid morbidity and mortality in this lethal condition. The diagnosis of CAM (Table-7) was made as per Criteria for Proven Invasive Fungal Diseasemade in "Revision and Update of the Consensus Definitions of Invasive Fungal Disease from the European Organization for Research and Treatment of Cancer and the Mycoses Study Group Education and Research Consortium".[10]

In the multicentric study by Moorthy et al, the incidence of mucormycosis is not age or gender-dependent, and the significantly higher number of males might be a reflection of the higher COVID 19 prevalence of males in India. In India till 25 May 2020, approximately 66.8% of COVID-19cases were identified to be males.[11] In the present study mean age affected was 54.57±10.8 years, gender distribution was 32 (50.8%) were males as against 31 (49.2%) were females in CAM group. The mean duration between the diagnosis of COVID 19 and the appearance of Mucormycosis in our study was 7.27 ± 2.8 days, which is consistent with a previous study.[12]

Our study included patients with Rhino-orbito Cerebral Mucormycosis as case group (n=63) compared to Non Mucormycosiscovid positive patients as the control group (n=154).

Computed tomography (CT) is the first diagnostic imaging of choice used to assess the status of sinuses, although the extent of extra-sinus spread is best judged with magnetic resonance imaging (MRI).[13] In our study, all suspected CAM patients had undergone CT paranasal sinuses and MRI (Fig. 1, 2, 3) which showed significant findings in 50 patients (79.4%), orbital involvement in 40 (63.5%) patients, both paranasal sinuses, and orbital involvement in 19 (30.1%) patients.

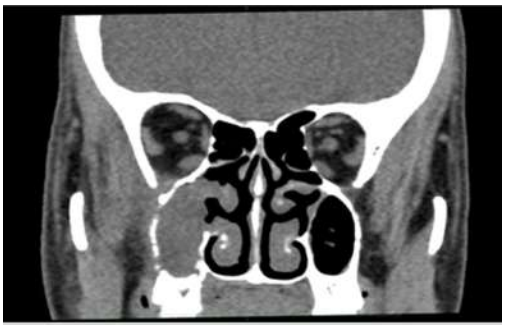

**Fig. 1:** Computed Tomography Para Nasal Sinuses (PNS) (reformatted coronal view) shows soft tissue opacification in right maxillary sinus with erosion of lateral wall of sinus and extension to right pterygopalatine fossa.

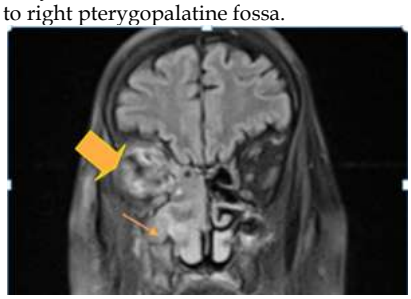

**Fig. 2:** MRI brain (FLAIR coronal section) shows soft tissue thickening in the right maxillary sinus with extension to the right nasal cavity (Arrow) and right orbit (Bold Arrow). Intraconal and extraconal fat stranding in the right orbit with premaxillary edema.

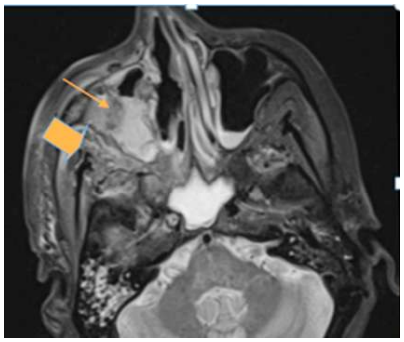

**Fig. 3:** Magnetic Resonance Imaging brain (axial section) shows mucosal thickening with air fluid levels noted in bilateral maxillary sinus (Arrow) (right more than left). Mucosal thickening in sphenoid sinus (Bold Arrow). Edema noted in right premaxillary and retro maxillary region

A definitive diagnosis of CAM as the causative fungal species is achieved by histologic examination of the biopsy specimen and culture as per criteria for Proven Invasive Fungal Disease.[10] KOH examination may be used only as a screening tool to identify the presence of mucormycosis.[14] All suspected CAM patients were subjected to biopsy as well as culture for fungal hyphae. It showed that 46 patients (73%) had a positive culture for fungal hyphae.

We have postulated this sudden increase in CAM infection with COVID 19 contributing in more than one way. Firstly, this fungus usually resides as a commensal of the nasal mucosa, for the fungus to cause invasion into sinuses, there can be a breach in nasal mucosa like trivial trauma. Overenthusiastic use of steam inhalation to get rid of COVID 19 infections, multiple times per day might cause nasal mucosal trauma, which causes invasion of fungus into sinuses. Traditionally steam inhalation is used to practice once or twice a day at a temperature of 40-420 C. Injudicious use of steam inhalation with high temperature and multiple times per day will cause nasal trauma and conjunctival congestion which may lead to fungal invasion into sinuses.

Secondly, uncontrolled DM favors the spread of opportunistic fungal infection. People with type 2 diabetes are increasing in every country, but more than 80% live in developing countries such as India, Bangladesh, Bhutan, Pakistan, Sri Lanka, the Philippines, and Indonesia.[15] In our study 38 patients (60.3%) in the CAM group had DM as compared to 63 patients (40.9%) in the control group, which favored the spread of opportunistic fungal infection.

Thirdly, intravenous steroids have been used considerably to reduce hospital stays and mortality related to Covid 19. Systemic steroids like dexamethasone and methylprednisolone are major part of COVID 19 management guidelines especially in moderate to severe cases. Owing to its immunosuppressive nature, Covid-19 patients are vulnerable to opportunistic infections like CAM.[16,17] In our hospital we found the use of that intravenous steroid was not positively correlated with CAM, however, the prolonged duration of steroid use for more than one week (8.43 ± 2.67 days in case Vs 7 ± 0.1 days in control) was found to give significant results for CAM (P-value 0.0001).

The first line antifungal agents for CAM are Amphotericin B (liposomal) or posaconazole. Isavuconazole is regarded as salvage therapy for refractory cases.[18,19] Combination therapy can also be given for recalcitrant cases. Surgical debridement of devitalized tissues and FESS (Functional Endoscopic Sinus Surgery) associated lavage helps to contain the spread and allows better pharmacokinetics of intravenous drugs.[20] In our study, we started Amphotericin B (liposomal) and posaconazole as a second-line drug for all suspected CAM and confirmed by following the Criteria for Proven Invasive Fungal Disease.

The prognosis of the infection is poor with the overall mortality ranging between 33.3 and 80%.[21,22] In the present study total of 8 (12.7%) out of 63 patients died due to CAM.

*The Strength of our Study:*

Our study is one of the unique study about CAM in this part of our country. The fact that this study was done in comparison with the control group (1:3) added weightage to the results of the study.

*Limitation:*

Though the sample size was taken for the study was sufficient statistically, to establish a finer causal relationship between various risk factors, future study should be done with a higher sample size covering various strata's of the general population.

## Conclusion

Injudicious use of steam inhalation amidst the COVID pandemic causes nasal mucosal trauma which resulted in CAM in already immune depleted covid positive patients. Early diagnosis and timely intervention improved the outcome of CAM.

Caution needs to be exercised injudicious use of steam inhalation. Stringent glycemic control, avoidance of inadvertent use of steroids can reduce the incidence of CAM.

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## Declaration Section:

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***Conflicts of interest***: The authors declare that they have no conflict of interest.

***Availability of data and material* (*data transparency*):** The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

***Ethical approval*:** The study was approved by the institutional ethical committee No: ECR/131/Inst/TN/2013/RR19, EC/NEW/INST/2020/461

***Authors' contributions*:** "All authors have contributed equally to the work".

***Consent to participate*:** Informed consent was obtained from all individual participants included in the study. (consent form included)

***Consent for publication*:** Written informed consent for publication of their clinical details and/or clinical images was obtained from the patient/ parent/guardian/ relative of the patient.

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*Original Article*

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# Rhino-cerebral Mucormycosis Presenting with Multiple Cranial Nerve Palsy and Cerebral Infarcts in a Patient with Uncontrolled Diabetes Mellitus

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**Abstract**

Multiple cranial nerve palsy is a syndrome resulting from damage to 2 or more cranial nerves, usually caused by granulomatous inflammation or an infectious process in the superior orbital fissure or lateral wall of cavernous sinus, or retrosphenoid space with involvement of cranial nerves 2, 3, 4, 5, or 6 in combination. Mucormycosis is a potentially lethal opportunistic fungal infection occurring in immunocompromised person.

We depict a patient with uncontrolled diabetes mellitus complicated by opportunistic fungal infection in the nose, palate and paranasal sinus progressively invading the cranial nerves 2,3,4,5 - sensory (oph and max), 6 and also the 7 ipsilaterally.

The patient also had multiple embolic infarcts of brain with involvement of intracranial ICA territory.

Mucormycosis is a serious opportunistic fungal sepsis of the soft tissue around face and mouth, including nose and paranasal sinus in immunocompromised person progressing rapidly to involve multiple cranial nerves and the cerebral vasculature.

Risk factors associated with such infection are uncontrolled diabetes mellitus, hyperlipidemia and atherosclerosis.

Early suspicion and diagnosis is mandatory to treat this dreadful infection and patient survival.

**Keywords:** Mucorales; Fungal sepsis; Cranial neuropathy; Embolic infarcts; Diabetes mellitus.

## Introduction:

Multiple cranial nerve palsy is a syndrome resulting from damage to 2 or more cranial nerves, usually caused by granulomatous inflammation or an infectious process in the superior orbital fissure or lateral wall of cavernous sinus, or retrosphenoid space with involvement of cranial nerves II, III, IV, V or VI in combination. Mucormycosis is a potentially lethal opportunistic fungal infection occurring in immunocompromised persons. Mucormycosis is caused by fungi of the order mucorales, class Zygomycetes. These fungal infections are not common and most frequently occur in people with another form of debilitating illness including poorly controlled diabetes, decreased immune function due to any cause, and burns or severe skin

or mucosal wounds. Treatments for mucormycosis need to be fast and aggressive. The need for speed is because by the time even the presumptive diagnosis is made, often the patient has suffered significant tissue damage that cannot be reversed.

We depict a patient with uncontrolled diabetes mellitus complicated by opportunistic fungal infection in the nose, palate and paranasal sinus progressively invading the cranial nerves 1, II, III, IV, V, VI and also the VII. She was diagnosed mucormycosis by tissue biopsy and was treated with liposomal Amphotericin B and surgical debridement and concomitant insulin therapy to control her diabetes and antibiotic therapy for cavernous sinus infection.

*Presentation of the case:*

A 35 year old obese woman admitted to this hospital with sudden onset visual loss in her left eye with ptosis, dysarthria and facial asymmetry.

One week before admission, she developed fever and diarrhea, was admitted in a local nursing home and treated with IV fluids & antibiotics and intravenous fluids.

Three days after coming home, she developed fever & weakness in her right upper limb and with slurring of speech and left sided facial weakness. On the day of admission, she developed sudden loss of vision in her left eye and was admitted in our hospital. She also had left hemicranial headache, with inability to move her left eye. She didn't have any trauma, loss of consciousness, or convulsion.

She was a known diabetic on irregular medication & also took OCP regularly. There was no history of hypertension or any chronic infection.

On Examination, she was conscious, oriented with normal vitals. She looked anxious, higher mental function normal. Speech was dysarthric with normal fluency, comprehension and repetition.

*Cranial Nerves:*

***Olfactory:*** anosmia in left nose.

***Optic***: Only perception of light in left eye & normal visual acuity & colour vision in right eye.

*III, IV, VI Nerve*: Left pupil dilated, not reacting to light, left ptosis, left extra-ocular movements absent.

*V Nerve*:

***Motor***: jaw movement & chewing was normal, without any deviation.

Sensory loss along left maxillary division.

***VII***: angle of mouth deviated towards right, unable to blow with left cheek. There was absence of wrinkles in left forehead.

Her palatal movements were normal bilaterally with painful swallowing. There were sores in her mouth, gum and nose.

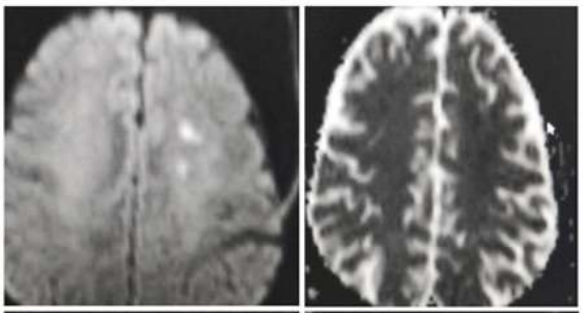
***Motor system*** : Power in right upper & lower limbs - 4/5 and right sided pronator drift was present. Power in left upper & lower limbs was also reduced with hyporeflexia in both lower limbs. Plantar response was extensor (right).

Kernig's, Brudzinsky sign negative. Remainder of the neurological and other system examination including sensory and cerebellar system was within normal limit.

Provisionally diagnosed with stroke and sepsis, she was treated conservatively with antibiotics, antiplatelets, statin and physiotherapy.

**Fig. 1:** Images showing absence of all extra-ocular movements in left eye with facial deviation to rightand absence of wrinkles in left forehead due to left 3rd, 4th, 6th and 7th nerve palsies.

***Investigations***: blood leukocytosis with raised CRP, ESR, hyperglycemia (FBS -180mg/dl; PPBS-350mg/dl, hyperlipidemia, and MRI (Fig. 2)



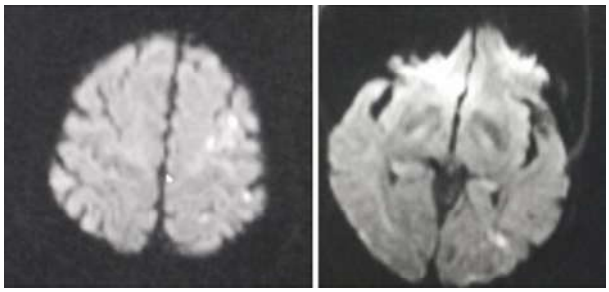


**Fig. 2:** Diffusion restricted lesions (embolic infarcts) in frontal, parietal and temporal lobes with corresponding ADC mapping

revealed acute infarcts in left parietal, temporal & frontal region with diffusion restricted lesions; There was absent flow void in left intracavernous internal carotid artery. MRAngio

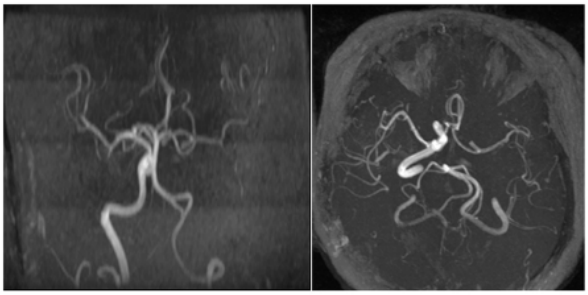


**Fig. 3:** MR Angiogram revealed no signal in left ICA and non visualisation of M1 part of left MCA; M2 & M3 segment of left MCA and left ACA appears unremarkable possibly through ACOM collaterals

showed non-visualization of left ICA & middle cerebral artery (MCA). Echocardiogram was normal.

Clopidogrel was added. But her neurological condition didn't improve; the patient complained of increasing pain within oral cavity. On next examination of oral cavity, one penetrating ulcer with fungating mass was noted

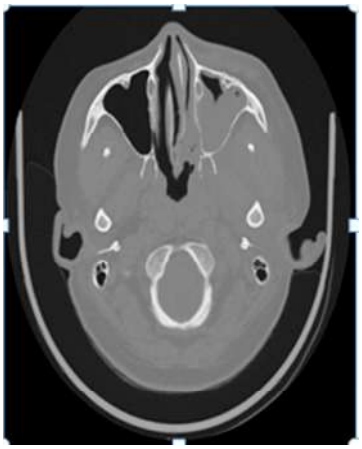


**Fig. 4A:** CT PNS-showing nodular thickening of mucous membranes of left nasal cavity, left ethmoidal, sphenoidal & maxillary sinus with gross dilatation and sclerosis of wall.

which perforated the hard palate; scrapping from ulcer base obtained for microbiological culture/ biopsy; CT PNS & NCV of all four limbs were done. NCV revealed bifacial axonal neuropathy (left worse than right) with mild distal axonal polyneuropathy. RNST did not show decrementing response and excluded Myasthenia gravis.

Clinically, a diagnosis of rhinocerebral Mucormycosis with multiple cranial nerve palsy with multiple embolic infarcts with ipsilateral ICA occlusion was made and patient was administered Liposomal Amphotericin B with monitoring of renal function. Anticoagulant LMWH was added and antibiotics upgraded to Meropenem and Piperacillin-tazobactum. CT PNS (Fig. 4 A & B)

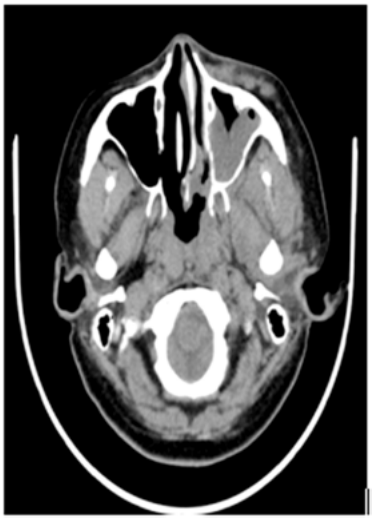


**Fig. 4B:** CT PNS-showing nodular thickening of mucous membra -nes of left nasal cavity, left ethmoidal, sphenoidal & maxillary sinus with gross dilatation and sclerosis of wall

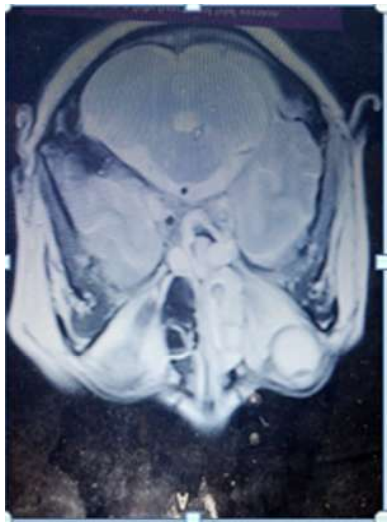


**Fig. 4C:** MRI brain showing absence of flow void in left ICA and mucosal thickening in left nose and paranasal sinus.

showed mucosal thickening of left sphenoidal, ethmoidal & maxillary sinus, dilatation & sclerosis of wall without destruction. Microscopy and tissue biopsy of oro nasal scrapings showed hyphae with branching. DSA revealed complete occlusion of left internal carotid artery, no flow in M1 segment of left middle cerebral artery with good collaterals from right ICA .

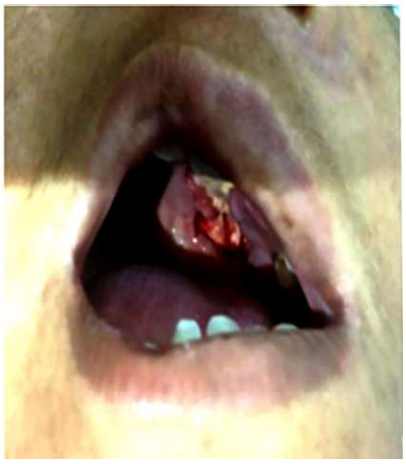


**Fig. 4D:** Fungating ulcer eroding hard palate.

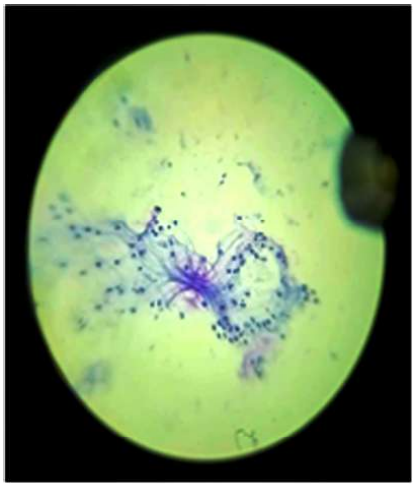


**Fig. 4E:** Microscopy & biopsy from nasal tissue through eroded hard palate revealing PAS+ fungal structure having broad non septate hyphae & irregular branching s/o mucormycosis.

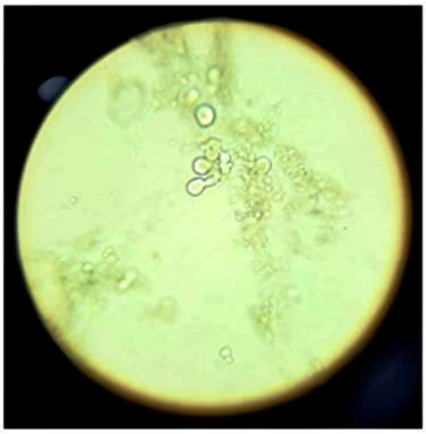


**Fig. 4F:** Microscopy & biopsy from nasal tissue through eroded hard palate revealing PAS+ fungal structure having broad non septate hyphae & irregular branching s/o mucormycosis.

After initial period of treatment with liposomal Amphotericin B, the patient was clinically better and there was no further deterioration of neurodeficit. Her left eye movement and vision did not improve. Biopsy report from palatal scrape confirmed diagnosis of Mucormycosis. Add on therapy with intravenous immunoglobulin (IVIG) 25 gms daily for 3 days was also administered for her polycranial neuritis with distal symmetric polyneuropathy and bifacial axonopathy.

Further, as the patient got symptomatically better, in consultation with the neurologist and the ENT surgeon, the case was referred to maxilla facial surgeon for surgical debridement.

| Nerve : Site | L1 mS | L2 mS | A p-p mVpp | Dist mm | CV M/S |
|---|---|---|---|---|---|
| Rt Oculi Orbicularis | 3.50 | 5.25 | 0.1 | – | – |
| Rt NASALIS | 3.62 | 7.00 | 0.1 | – | – |
| Rt ORBICULARI ORIS | 3.12 | 4.00 | 0.1 | – | – |
| Lt Oculi Orbicularis | 1.25 | 1.25 | – | – | – |
| Lt NASALIS | 1.25 | 1.25 | – | – | – |
| Lt ORBICULARI ORIS | 1.25 | 1.25 | – | – | – |

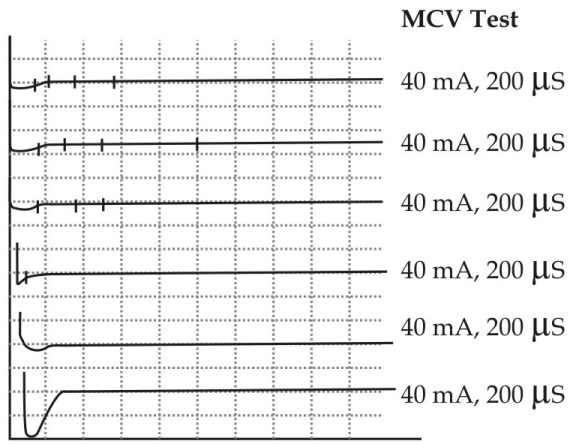



**Fig. 5a:** NCV study of facial nerves and upper limbs revealed bifacial axonlal neuropathy.

**Ref By: GM-UNIT-1 Set2 mcv Tech:**

| Nerve : Site | L1 mS | L2 mS | A p-p mVpp | Dist mm | CV M/S |
|---|---|---|---|---|---|
| Rt Median Wrist | 3.87 | 5.50 | 3.3 | 0 | |
| Rt Median Eibow | 7.25 | 9.00 | 2.6 | 230 | 68.2 |
| Rt Uinar Wrist | 2.25 | 3.87 | 5.3 | 0 | |
| Rt Uinar Eibow | 5.75 | 9.00 | 5.1 | 220 | 62.8 |
| Lt Median Wrist | 3.50 | 6.00 | 2.7 | 0 | |
| Lt Median Eibow | 7.12 | 9.87 | 2.5 | 230 | 63.5 |
| Lt Uinar Wrist | 2.62 | 5.75 | 4.9 | 0 | |
| Lt Uinar Eibow | 6.00 | 9.00 | 4.5 | 220 | 65.2 |

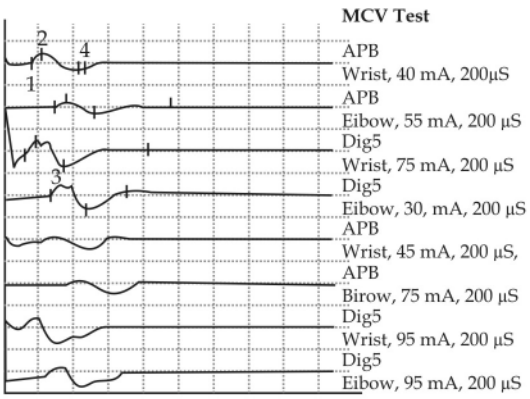



**Fig. 5b:** Distal symmetric motor axonal neuropathy of upper limbs.

## Discussion:

This patient was an obese uncontrolled diabetic presenting with left hemicranial headache and sudden visual loss, and ptosis of left eye and absent extraocular movement and pupillary dilatation, with infraorbital sensory loss consistent with polycranial neuropathy involving II, III, IV, V2 & VI.[1]

This was preceded by acute gastroenteritis and sepsis for which she was treated elsewhere. She also had ipsilateral infranuclear facial nerve palsy, which was axonal neuropathy.[2,3] The corrosive lesions in her palate, mouth, nose and paranasal sinus was proven to be Mucormycosis on tissue biopsy.The fungus eventually invaded the left internal carotid artery causing embolic infarcts in 3 different lobes of the cerebrum.[3] Alternatively, the infarcts might have been the result of artery to artery embolic stroke arising from the atherothrombotic ICA, the risk factor being uncontrolled diabetes mellitus, obesity, hyperlipidemia and OCP.

She was treated conservatively with IVIG followed by Liposomal Amphotericin B.[4]

As her condition improved, she was eventually referred to ENT and Orodental surgeons for surgical debridement.

## Conclusion:

Mucormycosis is aserious opportunistic fungal sepsis of the soft tissue around face and mouth, including nose and paranasal sinus in immunocompromised person progressing rapidly to involve multiple cranial nerves and the cerebral vasculature.

Risk factors of such infection are uncontrolled diabetes mellitus, hyperlipidemia and atherosclerosis. Early suspicion and diagnosis is mandatory to treat this dreadful infection and patient survival.

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*Original Article*

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# Malaria Prevalence and Society Awareness Against Malaria Control Strategies in Assosa District, Western Ethiopia

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**Abstract**

Malaria remains leading causes of morbidity and mortality globally. In Ethiopia, malaria cause evidential public health and Socio-economic effect. This study targeted at assessing the current prevalence of malaria and society awareness against malaria control strategies in Assosa district western, Ethiopia. All malaria suspected individuals who have complains of febrile illness in selected health institutions in the study area from September 2020 to February 2021 was considered to determine the current malaria prevalence. Individuals who visited the health institutions for any kind of health care service and selected house holders were the study subjects. Highest rate of malaria positivity was recorded at health post with positivity rate of 9.1% followed by private clinic with positivity rate of 4.9% whereas Assosa hospital and health center has positivity rate of 3.2% and 3.1% respectively. More males (69%) were affected by malaria than females (31%). Malaria morbidity was more concentrated in the age of 15-25 (38%) followed by age from 5 to 14(25%). P. falciparum is the dominant Plasmodium species over P. vivax in the study site which is 89% and 10% respectively. Most of the respondents (97%) had heard about malaria and similar number of respondents believed that malaria is one of the serious diseases of the community, around 94% of participants have at least one ITN. Most of the respondent especially in Assosa town claimed that the type of ITN is not comfortable to use it in their home. The overall malaria prevalence of Assosa district is 3.4 % which implies very low infection prevalence. Also, this research indicated that the community in the study area have good awareness on malaria control strategies.

**Keywords:** Assosa; Blood smear; Malaria; Society awareness; Prevalence.

## Introduction:

Malaria remained to be one of the most sever public health problem worldwide, particularly, in poor tropical and subtropical areas. In 2016, an estimated 445,000 people died of malaria, most were young children in sub-Saharan Africa (WHO, 2018).

Malaria is an infectious disease that causes morbidity and mortality in children and adults in developing countries, including Ethiopia. In Ethiopia, malaria is a serious public health concern and has great impact on Socio-economy. Around 75% Ethiopian landmass is considered endemic for malaria, putting 68% of the total population more at risk of contracting the diseases (EPHI, 2016). The transmission of malaria is highly seasonal throughout the country that depends on altitude and climatic variations (WHO, 2019). *Plasmodium*

*falciparum* and *Plasmodium vivax* are the most dominant malaria parasites in Ethiopia accounting for 60% and 40% of malaria cases respectively (WHO, 2019). The major responsible vector for malaria transmission in Ethiopia is *Anopheles arabiensis* however in some other areas *A. pharoensis*, *A. funestus*, and *A. nili* are also responsible for the transmission of malaria (PMI, 2019).

Risk of malaria is high within the Benishangul-Gumuz Regional State, in which 98% of the landmass is prone to malaria transmission (CSA, 2017). For instance, three years malaria surveillance data from different districts of the region revealed that total prevalence of malaria and malaria specific deaths were 57.5% and 79 deaths, respectively (Yaregal, 2017). However limited studies have been carried out in Benishangul Gumuz regional state regarding malaria prevalence and control options. Therefore, the aim of the current study was to analyze malaria prevalence and society awareness against malaria control strategies in Assosa district, Western Ethiopia.

## Methods and Materials

### *Descriptions of the Study Area*

The study was carried out in selected urban and rural areas of Assosa district in Benishangul Gumuz Regional State, Western Ethiopia (Figure 1).

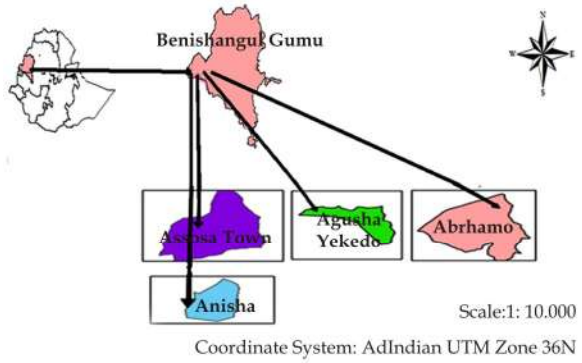


**Fig. 1:** Map of the study area.

Assosa town, the capital city of the region is located at 670 km toward west from Addis Ababa. The study area is located at latitude of 10°04'N and longitude of 34°31'E and an elevation of 1570 meters above sea level. The mean annual temperature and rainfall in the town and selected kebeles is about 21.6 °C and 1896.6 mill liters, respectively. The town is divided into 4 kebeles. The town has a total population of 20,226 of whom 10,929 were men and 9,297 women (CSA, 2004). Three public health institutions (one hospital and two health center) and more than 10 medium private clinics are found in the town that provides health care service to the society.

### Study design and population

The study used a health facility based cross sectional design. All malaria suspected individuals who have complains of febrile illness in the study health institutions from September 2020 to February 2021 was considered as study subjects to determine the current malaria prevalence. While individual permanently residing in the study area who visited the health institution and house holders in the study site kebele was the sample population to assess the knowledge of the society about malaria and its control strategies. The data was analyzed by using SPSS.

### *Sample Size and Sampling techniques*

All 11086 the malaria suspected patients registered in the study health center from Sep 2020 to Feb 2021 were the sample size to determine the current prevalence of malaria. And the sample size for determining the society awareness on malaria and its control practices strategies was calculated by n= N/1+N(e^)2 and simple random sampling method used to enroll the study participants.

### *Data collection*

### Malaria slides:

Blood film examination format was used; blood slide samples were taken from compliance of febrile patients at Assosa Hospital, Assosa health center, health post of each study Kebele, and 3 private clinics. The Socio-demographic data of patients was collected on patient separate sheet prepared for the study. Thick and thin blood smears were prepared to observe the presence of malaria parasite by direct microscopy techniques. The blood slides were read and then classified qualitatively as negative or positive, *P. falciparum* or *P. vivax or mixed* infection.

### Measurement of Society awareness against malaria control strategies

A structured questionnaire was designed to collect information regarding Socio-demographics and knowledge of the study participants about malaria and its control practices strategies. The questionnaire was first developed in English and translated into Amharic. Data were checked for completeness, and incomplete questionnaires returned to data collectors for correction by revisiting the concerned households.

### *Data analysis*

Data were checked for completeness and consistency and entered in to Microsoft Excel data sheets and exported in to Statistical Package for Social Science (SPSS) statistical data analysis. Descriptive statistics were carried out to measure percentages, averages, relative frequencies of the variables, mean, standard deviation and correlation of the response.

## Results and Discussion

### Results

***Socio***: Demographic characteristics of respondents

The socio demographic characteristics of the respondents are indicated in Table 1.

**Table 1:** Socio demographic characteristics of respondent in Assosa district selected kebeles.

| Variable | Category | Frequency | Percentage |
|---|---|---|---|
| Sex | Female | 283 | 67% |
| | Male | 137 | 33% |
| Age | 15-25 | 112 | 27% |
| | >=26 | 308 | 73% |
| Marital status | Single | 61 | 15% |
| | Married | 359 | 85% |
| Education | Illiterate | 85 | 20% |
| | Read and write | 178 | 42% |
| | Primary school | 90 | 21% |
| | > Secondary school | 67 | 16% |
| Occupation | Government employer | 97 | 23% |
| | Farmer | 164 | 39% |
| | Merchant | 89 | 21% |
| | Other | 70 | 17% |
| Mass media | Radio | 133 | 27% |
| | Television | 224 | 53% |
| | Internet | 56 | 13% |
| | No | 42 | 10% |
| Source of drinking water | Spring | 8 | 2% |
| | Dug well | 36 | 8% |
| | Surface water | 57 | 13% |
| | Public tab/stand pipe | 328 | 78% |
| | No toilet | 8 | 2% |
| Kind of toilet | Pit latrine (no cement) | 332 | 79% |
| | Have cement slab | 80 | 19% |

Knowledge and attitude of respondent towards malaria

Malaria related knowledge of the participants is summarized in Table 2.

**Table 2:** Knowledge of respondent in Assosa district.

| Variable | Cate-gory | Frequ-ency | Percen-tage | Mean | Std. Devi-ation |
|---|---|---|---|---|---|
| Ever heard about malaria | Yes | 409 | 97% | 1.00 | .049 |
| | No | 11 | 3% | | |
| Source of information | Health worker | 259 | 61% | 1.86 | .892 |
| | Mass media | 262 | 62% | | |
| | Religion institute | 3 | 0.7% | | |
| | Other | 3 | 0.7% | | |
| What is malaria | Diseases | 415 | 99% | 1.01 | .118 |
| | I don't know | 5 | 1% | | |
| Have you contracted malaria before | Yes | 285 | 68% | 1.33 | .474 |
| | No | 135 | 32% | | |
| Malaria transmitted by | Mosquito | 366 | 87% | 2.38 | .914 |
| | Dirty water | 225 | 53% | | |
| | I don't know | 19 | 4% | | |
| Sign / symptoms of malaria | Fever | 371 | 88% | 5.32 | 1.533 |
| | Chills shivers | 374 | 89% | | |
| | Headache | 314 | 74% | | |
| | Loss of appetite | 328 | 78% | | |
| | Vomiting | 302 | 72% | | |
| Mosquito breeding site | Stagnant water | 348 | 82% | 2.39 | .896 |
| | Waste material | 281 | 67% | | |
| | I don't know | 43 | 10% | | |
| Is there mosquito breeding site in your area | Yes | 159 | 38% | 1.62 | .485 |
| | No | 261 | 62% | | |

The majority of the respondents 409 (97%) had ever heard about malaria and almost all (99%) of the respondents believed that malaria is one of serious and life threatening diseases of the community. 285 (68%) of the respondents mentioned that they contracted malaria before the rest 32% did not.

Practices of respondents towards malaria prevention and control in Assosa district

Using mosquito bed nets and drain stagnant water are the best malaria prevention method by the majority of the respondents having 325 (77%),

134(32%) respectively. The majority 395(94%) interviewees reported that they possessed at least one insecticide treated mosquito net in their houses as described in Table 3.

Monthly Malaria prevalence at different health institutions in Assosa district, Western Ethiopia.

The number of malaria suspected patients who visited the health institution showed fluctuating trend each month. Accordingly, as indicated in the table below higher rates of confirmed malaria cases was reported during spring (September-November) and dry season of the year from December to February had lower case (Table 4).

**Table 3:** Practices of respondents towards malaria prevention and control in Assosa district.

| Variable | Category | Frequency | Percentage | Mean | Std. Deviation |
|---|---|---|---|---|---|
| Malaria prevention methods | Use mosquito net | 325 | 77% | 1.89 | 1.504 |
| | IRS | 101 | 24% | | |
| | Cleaning home and surrounding | 89 | 21% | | |
| | Drain stagnant water | 134 | 32% | | |
| Is ITN in your home | Yes | 395 | 94% | 1.05 | .217 |
| | No | 25 | 6% | | |
| Did you use it currently | Yes | 327 | 78% | 1.06 | .374 |
| | No | 93 | 22% | | |
| ITN used last night | Yes | 278 | 66% | 1.13 | .447 |
| | No | 117 | 44% | | |
| ITN per family | One | 58 | 15% | 2.30 | .868 |
| | Two | 141 | 36% | | |
| | >= 3 | 196 | 50% | | |
| Reason for don't use ITN | I don't have | 25 | 26% | .44 | 1.053 |
| | Do not prevent malaria | 6 | 6% | | |
| | Afraid of its toxicity | 13 | 13% | | |
| | Throw it away/damage/ | 0 | 0% | | |
| | Not comfortable to the home | 53 | 55% | | |
| Who use ITN | Children | 15 | 4% | 4.86 | 1.753 |
| | Mother | 8 | 2% | | |
| | Father | 3 | 1% | | |
| | Mother and Father | 27 | 7% | | |
| | Mother and Children | 141 | 36% | | |
| | All of the family | 201 | 51% | | |
| Seasonal use of ITN | All of the year | 210 | 53% | 1.23 | .670 |
| | Some time | 59 | 15% | | |
| | During malaria season | 126 | 32% | | |
| | In a week | 0 | 0% | | |
| ITN condition | Good no hole | 329 | 83% | 1.04 | .504 |
| | Have small hole | 48 | 12% | | |
| | Not good have more than 4 holes | 18 | 5% | | |
| When did you get ITN | Before month | 230 | 55% | 1.96 | 1.163 |
| | In a month | 19 | 5% | | |
| | Before 3 years | 122 | 29% | | |
| | I don't know | 49 | 12% | | |
| Your house spray with insecticide | Yes | 303 | 72% | 1.33 | .473 |
| | No | 117 | 28% | | |
| | 6 month ago | 196 | 65% | | |
| | Before two years | 28 | 9% | | |

**Table 4:** Monthly profile of malaria prevalence at Health institutions from (September 2020-February 2021

| Health institutions | Month | Examined number | Malaria positive | Percent of prevalence |
|---|---|---|---|---|
| Assosa hospital | September | 464 | 15 | 3.2% |
| | October | 734 | 36 | 4.9% |
| | November | 542 | 25 | 4.6% |
| | December | 310 | 8 | 2.6% |
| | January | 557 | 10 | 1.8% |
| | February | 847 | 16 | 1.9% |
| | **Total** | **3454** | **110** | **3.2%** |
| Assosa Health center | September | 1428 | 19 | 1.3% |
| | October | 1081 | 58 | 5.4% |
| | November | 766 | 42 | 5.5% |
| | December | 1060 | 37 | 3.5% |
| | January | 968 | 26 | 2.7% |
| | February | 1123 | 16 | 1.4% |
| | **Total** | **6426** | **198** | **3.1%** |
| Health post | September | 41 | 4 | 9.8% |
| | October | 24 | 2 | 8.3% |
| | November | 31 | 4 | 12.1% |
| | December | 23 | 4 | 17.4% |
| | January | 46 | 3 | 6.5% |
| | February | 54 | 3 | 5.6% |
| | **Total** | **219** | **20** | **9.1%** |
| Private clinics | September | 132 | 7 | 5.3% |
| | October | 166 | 9 | 5.4% |
| | November | 169 | 11 | 6.5% |
| | December | 156 | 9 | 5.8% |
| | January | 171 | 7 | 4.1% |
| | February | 193 | 5 | 2.6% |
| | **Total** | **987** | **48** | **4.9%** |
| Total | September | 2065 | 45 | 2.2% |
| | October | 2005 | 105 | 5.2% |
| | November | 1508 | 82 | 5.4% |
| | December | 1549 | 58 | 3.7% |
| | January | 1742 | 46 | 2.6% |
| | February | 2217 | 40 | 1.8% |
| | **Total** | **11086** | **376** | **3.4%** |

Prevalence of malaria cases by sex

In the present study, more males 69% were affected by malaria than females 31%. Distribution of malaria cases by sex is described in table 5.

**Table 5:** Distribution of malaria cases by sex Assosa district from September 2020-Feburary 2021.

| Sex | Total case examined | Slide positive, n (%) | P- value |
|---|---|---|---|
| Male | 5504 (49%) | 260 (69%) | |
| Female | 5592 (51%) | 116 (31%) | 1.12 |
| Total | 11086 (100%) | 376 (100%) | |

### *Prevalence of malaria cases by age group*

Regarding the age groups, the burden of malaria morbidity was more concentrated in the young of age 15-24 and 5-14 as described in the Table 6.

**Table 6:** Malaria prevalence in Assosa districts in association with age structures.

| Age group | Total case examined | Slide positive n. (%) | P-value |
|---|---|---|---|
| 0-4 | 4142 | 63(1.4%) | 1.67 |
| 5-14 | 1340 | 57(4.2%) | |
| 15-25 | 3057 | 173(5.7%) | |
| ≥ 26 | 2546 | 83(3%) | |
| Total | 11085 | 376(3.4%) | |

Distribution of malaria cases by Age group at Assosa district from September 2020-Feburary 2021.

Prevalence of malaria cases by medication history

Malaria prevalence varied by medication history, as described in the Table 7.

**Table 7:** Distribution of malaria cases by medication history at Assosa district from September 2020-Feburary 2021.

| Medication history | Total case examined | Slide positive n (%) |
|---|---|---|
| No malaria before | 6769 | 123(2%) |
| Yes there is malaria before | 4317 | 253(6%) |
| Total | 11086 | 376(3%) |

### *Prevalence of malaria cases by Occupation*

Malaria prevalence varied among different occupation, as indicated in the table below the higher cumulative result of positivity 33(8%) was seen for Daily worker followed by 137(7%) of Farmer others like Merchant, civil servant and Others were 26(5%), 25(3%) and 155(2%) respectively which indicates Daily worker and farmers are the most affected occupational group.

**Table 8:** Distribution of malaria cases by Occupation at Assosa district from September 2020-Feburary 2021.

| Occupation | Total case examined | Slide positive n(%) |
|---|---|---|
| Civil servant | 865 | 25(3%) |
| Farmer | 1925 | 137(7%) |
| Merchant | 484 | 26(5%) |
| Daily worker | 428 | 33(8%) |
| Other | 7384 | 155(2%) |
| Total | 11086 | 376(3.4%) |

### *Species composition of malaria parasites*

The predominant Plasmodium species detected among the current study participants was *P. falciparum.*

**Table 9:** Species composition malaria parasite in Assosa district.

| Slide positive (%) | *P. falciparum* n (%) | *P. vivax* n (%) | Mixed infection n(%) |
|---|---|---|---|
| 376 (100%) | 336 (89%) | 35 (10%) | 5 (1%) |

## Discustion

An overall malaria positivity rate of 3.4% was recorded in the current study area which is health post with positivity rate of 9.1% followed by private clinic with positivity rate of 4.9% whereas Assosa hospital and health center has positivity rate of 3.2% and 3.1% respectively. This figure is more or less in agreement with the result of the study done in Jiga area Northwest Ethiopia in which the prevalence is 2.8%, (Seble,2014). the result is very high as compared to 0.93% in Butajira area, south-central Ethiopia (Adugna 2012). The finding of this study contradicts with previous studies from southern and northern Ethiopia, reported overall malaria positivity rates between 11.5% and 28.1% among patients visited health facilities (Belete and Roro,2016 & Woday et al,2016) Possible factors for observed variations might be differences in the time of studies, microclimate, altitude, community awareness about malaria bed net application, its transmission, and health seeking behavior, and malaria intervention practices.

Higher rates of confirmed malaria cases was reported during spring (September-November) that indicates Transmission of malaria was higher, whilst the dry season of the year from December to February had lower case this finding Is in agreement with the study done chagni health center northwest Ethiopia (Bogale et al, 2018)

In this study, more males (69%) were affected by malaria than females (31%). This finding is coincident with studies from several localities in Ethiopia that reported higher malaria burden among males than females (Bogale et al, 2018 and shiferaw et al, 2018). Prevalence rate in males is high might be due to the fact that male's activity is usually far from home. In addition, males travel to different malarious part of region to perform mining and agricultural activities and these expose them to the higher risk of contracting malaria infection. Conversely, this was not similar with a study conducted in jiga area north west Ethiopia where the prevalence of malaria was relatively higher among female than males (Seble, 2014).

In this study *P. falciparum* is higher than *P. vivax* in which 89% and 10% respectively.This finding is congruent with national figures and other similar studies in parts of Ethiopia that reported preponderance of *P. falciparum* than *P. vivax* (Alemu *et al*, 2012 & Shiferaw *et al*, 2018). However; this is in disagreement with the previous report from jiga north west area which reported a higher prevalence of *P. vivax* than *P. falciparum* (Seble,2014). The reason why *P. falciparum* dominated over *P. vivax* in the study area could be due to the severity of disease, drug resistance, and gap of program performance.

The results revealed that most of the respondents (97%) had heard about malaria and similar number of respondents believed that malaria is one of the serious diseases of the community affecting both sex and all age groups, which is in line with previous reports on Ethiopia and elsewhere (Tesfaye *et al*, 2017 and Amusan *et al*, 2017). Fever, headache, chills and shivering, loss of appetite and vomiting were mentioned as sign and symptoms of malaria. Similar results were found from different KAP studies in other regions of Ethiopia (Abate *et al*, 2013).

## Concluion

Malaria is preventable and curable. The most commonly preventive strategies like Using mosquito bed nets,drain stagnant water and cleaning the household surrounding would employed. Accordingly, majority of the respondents slept under bed net especially mother and children which given priority to sleep under bed net. An

overall malaria positivity rate of 3.4% was recorded in the current study area. The number of malaria suspected patients who visited the health institution showed higher rates of confirmed malaria cases was reported during spring (September-November) that indicate the Transmission of malaria was higher at this time. Highest rate of malaria positivity was recorded at health post.

**Availability of data and materials:**

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

***Competing interests:***

The authors declare that they have no competing interests.

***Funding:***

The funding for this work was obtained from Assosa University.

***Authors' contributions***

SH conducted the laboratory work and interpreted the data and wrote the first draft of the manuscript. DE designed the field collection protocols and oversaw the collection and provided a critical revision of the manuscript. Both authors have read and approve the content of the submitted manuscript.

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***Authors' information***

All authors are from Assosa University, Assosa, Ethiopia.

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# Subject Index

# Author Index

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**Standard journal article**

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

**Article in supplement or special issue**

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

**Corporate (collective) author**

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

**Unpublished article**

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

**Personal author(s)**

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

**Chapter in book**

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O,

Kidd EAM, editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

**No author given**

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

**Reference from electronic media**

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

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