# Wax Prevalence and Related Factors among Primary School Learners in Lilongwe, Malawi

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**ABSTRACT**

The rate of hearing loss caused by wax impaction is most common in low- and middle-income countries, with the resulting hearing loss typically being of the conductive kind. This study focused on the prevalence of wax and related factors among primary school learners in Lilongwe, Malawi. The screening procedures was done using otoscope, tympanometer and audiometer. The study was analyzed using Statistical Package for Social Science (SPSS). The study used a random sample of one hundred and fifty learners from six public primary schools; three from rural and three from urban. The results showed that fifty-one learners had wax (34 %) of the total sample and ninety nine learners had no wax (66%), with a relatively small mean age (M=13.43, SD=2.15). It also showed that there is no significant difference of wax prevalence between urban and rural public schools but the use of cotton buds is the preferred method used in urban with 38.7%, while matchstick is commonly used in rural areas with 34.7%. Wax impaction is a common ear problem among primary school learners in Lilongwe. There is no significant difference of wax impaction between urban and rural public primary schools. The study recommended that awareness, screening programmes and routine otoscopy should be done in primary schools.

## INTRODUCTION

The World Health Organization (WHO) released its initial data on the prevalence of sensorineural hearing loss in 1985. At that time, it was believed that 42 million people, or about 1% of the world's population, had moderate to profound (or disabling) hearing impairment. The ability to hear is essential for learning spoken language, and it is crucial for children's cognitive development. Hearing loss is a barrier to both schooling and social integration in the absence of effective solutions.

Some 360 million individuals, or around 5% of the world's population, currently suffer from hearing loss that is incapacitating, and children make up roughly, 32 million of this population (World Health Organization, 2016). In addition, WHO (2018) estimates that 466 million people (or 6.1 percent of the world's population) may have had a hearing loss problem that make them unable to hear. Studies have also shown that the population with hearing loss increased from 1.2 billion (17.2 percent) in 2008, to 1.4 billion (18.7 percent) in 2017, that's according to the Global Burden of Disease research, which included mild and unilateral hearing loss (Cui & Yan, 2022).

By 2030, the number of people with hearing loss is expected to reach 630 million, and by 2050, it will reach over 900 million (Chadha et al., 2018). Ninety percent of those with moderate to severe hearing loss live in low- and middle-income countries (LMCs) including Malawi (Davis & Hoffman, 2019). These revelations have resulted into a significant public health concern that calls for proper and well-coordinated international action.

According to WHO estimates, 630 million individuals will have hearing loss that is disabling by 2030, and that figure is anticipated to rise to nearly 900 million

by 2050 if nothing is done (World Health Organization, 2018). Early diagnosis of hearing loss and provision of the right interventions is crucial to prevention of total hearing loss. However, it is also necessary to take action to avoid the preventable causes of hearing loss.

Despite not having enough of data, it has been estimated that 8 million ear operations and 12 million medical visits are made for earwax-related issues each year in the United States (Coppin et al., 2011). But, the rate of hearing loss caused by wax impaction is highest (51.23 per 10,000 individuals) in low- and middle-income countries, with the resulting hearing loss typically being of the moderate conductive kind (Kaspar, 2020).

In 1995, the World Health Assembly (WHA) passed a resolution on the prevention of preventable causes of hearing loss and on its early detection in vulnerable groups including neonates, toddlers, young people, and older populations. In Malawi it is hard to detect the problems early since the country, with a population of more than 20,000,000 people has only three Ear Nose and Throat (ENT), and Audiology clinics. In addition, there are a total of five ENT surgeons, forty-five ENT clinical officers who are responsible for the twenty-seven districts in Malawi (Mulwafu & Singano, 2022). Currently, two audiologist and five Audiology technicians are working in the two main government hospitals: Queens Elizabeth Central Hospital in Blantyre and at Kamuzu Central Hospital in Lilongwe. African Bible College hearing clinic which is part of a private hospital has nine audiologists. It is imperative to note that the northern region which has six districts

with the population of 2,286,960 people (Coutts et al., 2019) does not have a single clinic.

The Ministry of Health in Malawi is however dedicated to making sure that all Malawians have access to the Essential Health Package's services and universal coverage, including audiology services. Malawi, has however, a high prevalence of ear diseases and hearing loss, and this is a result of scarce resources and a lack of awareness among the populace to prevent diseases and total hearing loss.

Malawi fails to carry out relevant population-based surveys using established protocols and classification methodologies, which results in a paucity of data on earwax and hearing impairment (Bright et al., 2020). Therefore, the purpose of this study was to investigate the prevalence of wax among primary school students in Lilongwe.

## Literature Review

**Wax**

Wax shields the ear canal's epidermis, aids in cleansing and lubrication, and offers some defense against bacteria, fungi, insects, and water. As part of a self-cleaning mechanism, cerumen is often ejected from the ear canal on its own with the help of jaw movement. Wet type earwax has a thicker consistency than dry type because it contains more lipid and pigment granules (50% lipid) than (30% lipid) dry type (Shah et al., 2011.). However, in certain individuals this system fails, which has an effect on the wax. Wax impaction is defined as a buildup of cerumen that results in symptoms or prevents inspection of the ear canal and tympanic membrane (ear drum). The ear canal's natural and protective mechanism is the creation of wax. Wax should be removed, nevertheless, if it causes symptoms (such as hearing loss, itchiness, pain, or tinnitus) or the skin of the outer ear canal is thin, without dermal papillae, and weakly attached to bone and cartilage. It is also thought to be the root of 60 to 80 percent of hearing aid malfunctions (Shah et al., 2011).

Impacted earwax occurs because of some of the following reasons: when the ear produces wax more quickly than the body can eliminate it, some ear diseases, that is, infectious conditions such as swimmer's ear (external otitis), skin conditions (such as eczema), a receding ear canal (from birth, chronic inflammation, or injury), overproduction of earwax brought on by trauma. Some of these ailments result in a physical obstruction. Others increase the production of earwax. It is not always possible to determine what causes impacted earwax. Additionally, placing objects in the ears repeatedly might cause impacted earwax. This is more likely to occur in kids and teenagers who do not have any other ear canal issues. When using cotton buds to remove earwax, for instance, children are at risk of pushing the wax deeper into the ear canal. Approximately 9% reported injuries to their ears as a result of cleaning, including skin abrasions, eardrum perforation, and cerumen impaction (Schwartz et al., 2017).

Blockage in the external ear canal, typically brought on by occluding wax or impacted wax, is one of the most frequent causes of conductive hearing loss (Hydri & Siddiqui, 2016). According to estimates, more than 60% of such preventative interventions could be used to prevent hearing loss. Additionally, youngsters who have early detection and the right interventions can help hearing loss a lot.

Cerumen impaction affects 10% of children, 5% of healthy adults, up to 57% of elderly residents in nursing homes, and a third of patients with

intellectual disability (Michaudet & Malaty, 2018). It is a common reason for primary care doctors to see patients. Medicare expenditures for Medicare Cerumen-related procedures totaled about $50 million in 2012 (Michaudet & Malaty, 2018). It protects the ear canal's epidermis, aids in lubrication and cleansing it also contains antimicrobial peptides that stop germs and fungus from infecting the external auditory canal (Schwaab et al., 2011).

According to a review of impacted ear wax, 2.3 million persons in the UK experience wax problems that require treatment each year, and it estimated that 4 million ears are syringed on average each year (Guest et al., 2004). Middle ear infections are the most frequent cause of hearing loss in mainstream schools and the general population (36%) followed by unexplained reasons (35%) and cerumen impaction (24%) (Bright et al., 2020).

People at risk of wax impaction include those using of hearing aids especially in older person, frequent insertion of the objects in the ears, some medical and ear condition like eczema and otitis externa. Unless it accumulates enough, the earwax frequently causes no symptoms. The most typical signs of wax impaction include: feeling of fullness or blocked, ear ache, ringing in the ear, dizziness and hearing loss.

By reviewing the medical history and performing a physical examination the doctor can determine whether a person has impacted earwax by inspecting the ear with an otoscope the doctor can be able to clearly detect the wax even if there is no symptoms.

**Treatment**

Ear curettes, probes, hooks, forceps, and micro suction are among tools that can be used for manual removal. When the ear canal is just partially blocked and the material is not sticking to the ear canal's skin, otolaryngologists are more likely to employ the curette approach. Contrarily, cotton swabs merely remove a little piece of the top layer of wax that happens to stick to the swab's fibers and push the majority of earwax deeper into the ear canal. The American Academy of Otolaryngology published new recommendations in 2008 that discouraged removing extra earwax unless it was harming persons health. Although normally secure and efficient, this approach can abrade the ear canal (Schwartz et al., 2017). Irrigation includes flushing the wax out with a spray of warm water also known as ear syringing is ideally at body temperature, warm water, normal saline, sodium bicarbonate solution, or water and vinegar are frequently used to irrigate the ear canal in order to assist avoid subsequent infection (Shah et al., 2011.).

According to Nair on access the efficacy of cerumenolytic agents, which helps removing and softening the impacted wax revealed that post-ceruminolytic use and appearance. The most effective cerumenolytic was found to be 2% paradichlorobenzene, closely followed by 10% sodium bicarbonate. Normal saline underperformed, but 2.5% acetic acid performed satisfactorily (Nair et al., 2009). Similar research by Carr and Singer demonstrated that cerumenolytic medicines can help children with impacted wax, but that adults should be treated in other methods. This is especially recommended for children.

In order to spread the cerumen and lessen the necessity for syringing or manual removal of the

impaction cerumenolytic agents, are utilized. This can be combined with irrigation or physical removal. Total wax removal became possible due to the use of olive oil dripped into the ears before the removing the wax (Rodgers, 2013).

Once confirmed, warm water is softly squirted into the ear canal using an electric pump or connection of canal and syringe that has the right water pressure to flush the ear wax out. The wax is loosened by this process and eventually flows out with the water. Any symptoms will often go away after the earwax is gone over the course of a day or two. The most common side effects of aural irrigation include discomfort, ear canal damage with or without bleeding, and acute otitis externa. Vertigo (0.2%) and tympanic membrane perforation (0.2%) are frequently reported serious consequences (Schwartz et al., 2017). Although generally safe and effective, there is a tiny chance that the eardrum could perforate (Schwartz et al., 2017). Therefore, despite the removal of such impacted cerumen, children with a history of impacted cerumen are more likely than those without to experience eventual hearing issues of a more severe nature (Olusanya, 2003). According to (Thomas et al., 2012) another side effect of syringing is facial nerve palsy, which highlights the condition's dramatic appearance and emphasizes the need for extreme caution when syringing the ears.

Since dizziness is a common adverse effect of syringing with fluids that are either cooler or warmer than body temperature, patients typically prefer the irrigation solution to be warmed to body temperature. According to (Blake et al., 1998), it is recommended to use water at 38°C, one degree above body temperature, Sharp et al. (1990) propose 37°C and emphasize that this should be verified using a thermometer. Vertigo could be caused by any other temperature, exactly like when testing the caloric reflex.

A common treatment to remove extra ear wax or foreign things (such as food or insects) from the ear is ear syringing. This painless method is frequently used to remove wax that has become wet or extremely soft and accumulated on the eardrum. Skilled health personnel examine the ear before beginning any ear syringing procedures to be sure the symptoms are not due to something more serious and are instead being brought on by an excessive accumulation of wax or foreign objects. The practice of syringing or ear irrigation is fairly widespread among general practitioners (GPs). It is typically efficient and safe, and it is frequently chosen as the treatment of choice for cerumen (Poulton et al., 2015).

In children, cerumen plugs are typical. May obstruct the tympanic membrane, making it difficult to examine youngsters who may have acute or chronic middle ear illness, and they also induce localized skin reactions. A study done in UK by Baxter showed that 37% of the children had wax; of these, 90% had their ears cleaned with a cotton swab. Overall, 71% had their ears cleaned with cotton tipped swabs, and 47% of them had plugs, as opposed to four 13% of the other 32 kids who had their ears cleaned using other techniques for example flannel, finger, etc. (Baxter, 1983).

The prevalence of wax impaction was 46.7% and mostly bilateral (Eziyi et al., 2011). Earwax impaction was identified in 437 patients overall, with an incidence of 20.1% study done in Nigeria which concluded that incorrect perception and avoidable self-ear cleaning with different objects, such as cotton buds, were common predisposing factors of

this high rate of recurrent earwax impaction (Adegbiji et al., 2014). Since the large majority of the instances were asymptomatic, the participants lacked any reason to seek medical attention. Impacted wax in the external canal is a harmless issue that a person may not have any symptoms for.

According to a study conducted in Tanzania on prevalence of cerumen and its associated factors among primary children in Mwanza, prevalence of wax (23.4%) had cerumen impacted in their ears and had symptoms that were present like; tinnitus, hearing loss, otalgia, and itching in the ears (Chalya et al., 2019). So this study only focused on the symptoms but there was a need of a similar study to be conducted to focus on what the learners use to remove wax if it is present in their ears.

The prevalence of otitis media, hearing loss and cerumen impaction among primary school children in rural and urban. Cerumen impaction was discovered in 20.45% of school children in rural areas and 14.8 of school children in urban areas among schools in Dar es Salaam, Tanzania. This disparity between the two groups' prevalence levels was not statistically significant (Minja & Machemba, 1996). So there was a need for a study to be conducted on wax prevalence and the related factors among schools in rural and urban.

According to studies by Maharjan et al. (2021) on ear and hearing impairment at schools in the Kathmandu Valley, ear wax was present in 34.64% of cases, and ear wax was related to a hearing impairment in 0.88% of case. These school children share the same age range as the participants in this study. Investigations in Africa, however, found that children of older age groups than those in this study had reduced prevalence rates of impacted wax. 8.6% to 28.2% of people experienced these rates (Eziyi et al., 2011).

The most frequent reason given for attending an ENT clinic was other reasons (60.1%), whereas wax impaction was the most frequently cited cause (17.4%), followed by infection (10.5%), trauma 5.8% and foreign bodies 7.8%. Several studies indicated varying usage percentages, but one from England revealed that 68% of people used cotton buds was in Kaduna the northwest of Nigeria and the Osun states revealed a 90%, 93.4%, and 44.9% usage rate, respectively (Aldawsari et al., 2018).

## OBJECTIVES

### Main Objective

To study the prevalence of wax impaction and its associated factors, cultural practices that lead to wax impaction and to discuss the common treatments of wax among primary school learners in Lilongwe, Malawi.

### Specific Objectives

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## MATERIAL AND METHODS

### Introduction

This chapter will outline the research methodology used to determine the prevalence of wax and associated factors among primary school learners in Lilongwe, Malawi. Which will include: study area, recruitment process, study design, sample size, inclusive criteria data collection and analysis.

### Study Area

The study was conducted in selected rural and urban primary schools in Lilongwe district because it was convenient to the researcher.

### Recruitment Process

A list of primary schools from Lilongwe district was obtained by the researcher from the District Education Manager. The Headteachers of the selected schools were contacted by the researcher prior to the study, through phone calls or by physically visit as the first step of invitation to participate in the study. The communication was done a week before the data collection date.

### Study Design

This study used quantitative methods conducted in primary school children in Lilongwe, Malawi where one referral hospital is located. The researcher assembled a screening team which they will meet for training on how to operate the hearing equipment, and discuss the role of each personnel, as well as related ethics in the data collection process.

### Sample Size

The study used a random sampling method. Six schools were randomly selected from the list of schools. Three schools from urban, namely, Kalonga primary, Shire primary and Kalambo primary. Three schools were selected from rural schools, namely, Chimwala primary, Yepa primary and Chantambe Primary. The participants were randomly selected from each school from standard 5 to standard 8 and the total number was 150 learners, 25 learners were selected from each school. Upon arriving at school 38 learners were randomly selected from classes 5, 6, 7 and 8. The ones that were selected were mixed in one class, a total of 150 beans were mixed in a small which included 125 red beans 25 white beans, each learner was allowed to pick one bean and those that picked the white beans were the ones that participated in the study.

### Inclusion Criteria

1. Consent form was signed by the Head Teachers.
2. Participants were only those that were registered and were present at school on the day of the screening.
3. Participants with mental or physical disability were included
4. Participants in class 5-8, aged 10 and above.

### Exclusion Criteria

The participants who met the following characteristics were not allowed to participate in the study.

1. Primary school pupils below the age of 10.
2. Pupils from schools not selected into the study.
3. Pupils who cannot read or write in English or Chichewa.
4. Pupils who do not give consent to participate in either the study.

### Data Collection

A structured questionnaire was used to collect data from respondents in order to estimate the prevalence of wax and its related predisposing factors in Lilongwe Malawi. The questionnaire used both open-ended and closed-ended questions and the questionnaire has been included in an appendix. In order to establish a welcoming environment for learners, data collection obtained direct on one-on-one interaction with learners a result, result and feedback must be more quickly and precisely gathered.

## Findings and Dissemination

In this research, the prevalence of wax impaction was conducted in the central region of Lilongwe, Malawi. The research study designed participation of the primary schools learners from six government schools in Lilongwe. Three schools from rural west and three from Lilongwe urban. The purpose of the study was to determine the prevalence of wax and related factors among primary school children, which will then be used to determine the prevalence of hearing impairment in the southern region. The procedure adopted included questionnaires, interviews and physical examination.

## Physical Examination

**Otoscopy**

The Welch Allyn otoscope was used to examine the pinna, external auditory canal, and tympanic membrane (TM). This helped to determine whether wax was present or not in the ear canal.

**Tympanometry**

Tympanometry testing involved the use of the interacoustic MT10 tympanometer. A 226 Hz reference test tone was utilized. Berger and Liden's criteria were used, which distinguish between seven different tympanogram types (A, As, Ad, B, C, D and E). Evaluation of the generated tympanograms' form Tympanograms of type B or type C were considered abnormal. The range of +50 to -150 daPa is regarded as the normal range for middle ear pressure. The volume of the tympanogram was also evaluated in Type B in order to identify conductive hearing losses caused by wax impaction and potential otitis media cases.

**Audiometry**

The interacoustic D226 audiometer was used to measure the participants' level of hearing. The hearing test is a smart application that utilized a calibrated and standardized Audiometric. This gadget is a hand-held audiometer that can only detect pure tone air conduction. Every frequency, the test starts at 40 dB HL. The strength is 10 dB lower if the patient hears the tone. If not, the intensity is raised in 5 dB stages until a response is obtained. The following 500, 1000, 2000, and 4000 Hz average thresholds for each frequency were determined. Bone conduction was performed whenever there was a hearing loss at 5000Hz, 1000Hz, 2000Hz and 4000Hz. Clinical judgement was made on the basis of otoscopy, tympanometry and audiometry. The Sound level meter application was used to measure and record ambient noise, although not all student noise levels were captured.

According to WHO standards, a pass in audiometry is defined as 25 dB or better in a better hearing ear. Additional grading of hearing loss severity using the WHO's definition of mild (26 to 40 dB), moderate (41-60 dB), severe (61-80 dB), and deep (above 80 dB) (more than 80 dB). Participants Hearing tests were performed to all participants, including those with impacted wax.

## Referral System

Participants who had ear wax, ear infection and foreign body were referred to the ENT clinic/ Audiology at Kamuzu central Hospital for treatment and further management. The staff and doctors at the ENT clinic were informed of the study, the outcomes of the study and ear assessments, and appointments were given to those who required further follow-up or treatment through the headteacher. The referral cards were given for booking appointment to avoid clinic overload. The staff will enter each patient's follow-up clinic results into the preserved record.

### Study Team

The study's group included: one Audiologist from ABC, one ENT clinical officer, one ENT Nurse, two Clinical officers in audiology and one volunteer. The audiologist and audiology Technicians were testing the equipments to be used and conducting the hearing assessments. At every school, there was a nurse and a volunteer who were tasked to set up the testing stations and provided childcare.

### The Testing Setting

The screening was done during school hours at a location and time where there was as quite as possible, although it was very difficult to manage the noise level in the area. To minimize noise and interference, the audiology stations were spaced as far apart as possible.

The chosen Primary schools classrooms or a neighboring hall were used for the ear and hearing evaluation, as stated. At the schools, the most practical location was picked. A screening was conducted while they wait outside in the classroom of the chosen class or in a spare area at the school in the staff room or the principal's office testing period while all of the pupils were in the classroom and screenings were being done during school hours. There were four stations data, otoscopy, tympanometry, audiometry and final check. However, primary schools had a mid-morning break, which added to the raucous atmosphere.

### Data Collection

Data that was collected during the study, including the participant's school, name, date of birth, gender and class, then testing was done on children with impacted wax before and the wax was removed. Sweets were given to a child for completing the ear and hearing assessment and they were praised for being courageous enough for taking part in the study.

The ear and hearing test report for every child was given to the head teacher, who would later pass it on to the parents or caregiver. Every child who required follow-up had an appointment date attached to this report and the business card. The ENT staff nurses, and ENT clinical personnel were informed about the appointment.

### Maintenance and Calibration of Equipment

A mobile audiometer and tympanometer were biologically checked daily to make sure they were calibrated before use. This included inspecting the cables and verify all connection points and that the headset can hear sound at all frequencies.

### Study Limitation

The design of this investigation was not informed by any pilot studies. The study also screened children from Lilongwe, the nation's capital, and this study population was not typical of the full country's population. In addition, a longitudinal cohort study will be important to study the effects of wax effectively and conclusively. To reduce noise interference, masking was not used, and an audiometric booth was not utilized.

### Assumptions

1. The sample size will be a good representation of the study population
2. The participants will provide an honest and open response.
3. The staff and volunteers collecting the data will adhere to all established guidelines for the project

### Expected Results and Dissemination

The study's results would be made public through:

Peer review journals and copies will be sent to the Ministry of health Office, Central hospital directors office, local library District health offices and community outreach initiatives.

### Data Analysis

The data was analyzed by Statistical Package for Social Science (SPSS, Version 16.0).

### Research Ethics

A consent to conduct the study in Malawi government schools was given by the Ministry of Education Science and Technology through the district education manager's office. Before data collection, consent was also obtained from Head Teachers of the selected schools who are the primary caretakers of learners in the schools. A consent form and information sheet for the participants was created. The information was in English and the volunteer was translating it to Chichewa, which is the main language in the central region in Lilongwe, Malawi. Participation was voluntary and learners were allowed to withdraw during the survey if they wanted to do so.

## RESULTS

### Otoscopy and Wax

Out of 150 students that were administered and examined on cerumen impaction, it was observed that 51 students had cerumen available in either side of the ear, representing (34 %) of the total sample. A total of 99 students (66%) appeared had no wax upon being examined by otoscope. Thus, 25 students (33.3%) from the urban area appeared to have impacted wax present in their ear and 50 students (66.7%) had no wax impacted in either side of the ear. There were 26 students (34.7%) from the rural areas who appeared to have impacted wax in either side of the ear, a figure that almost equals the one observed from urban areas. There were 49 students (65.3%) from the urban areas had no wax impaction. Therefore, study showed no significant difference of prevalence of wax between rural and urban public primary schools.

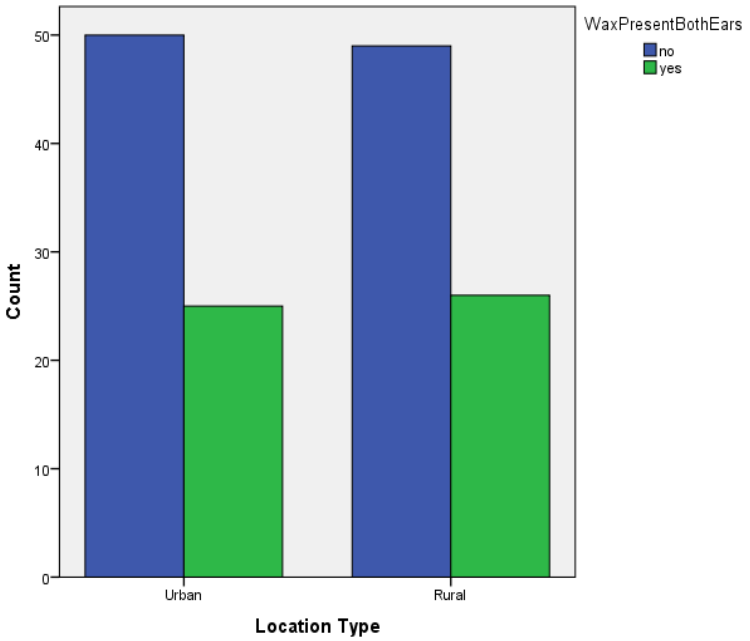


Figure 1. A bar graph of wax and location type.

The following table summarises the results and problems identified in three Urban and three rural public school during the survey which include wax impaction, Hearing loss CSOM and foreign body.

Table 1. Summary of results in both urban and rural schools

| | Name of School | Normal | Wax | Hearing loss | Infection | Foreign Body | Total |
|---|---|---|---|---|---|---|---|
| Urban | Shire | 12 | 9 | 4 | 0 | 0 | 25 |
| | Kalonga | 16 | 6 | 2 | 1 | 0 | 25 |
| | Kalambo | 14 | 10 | 0 | 0 | 1 | 25 |
| Rural | Yepa | 8 | 13 | 4 | 0 | 0 | 25 |
| | Chantambe | 16 | 5 | 2 | 2 | 0 | 25 |
| | Chimwala | 15 | 8 | 1 | 0 | 1 | 25 |

## Respondent´s Age Distribution

Out of the 150 respondents that were administered with the questionnaire in all schools, the sample appeared to comprise students that had a relatively small mean age (M=13.43, SD=2.15). The minimum and maximum age for the sample distribution were 9 years and 26 years, respectively, irrespective of the location type, gender, age, class level and school. 72.7 percent of the students fall within the age range of 9-14 years, 26.7 percent fall within the age range of 15-20 years and 0.7 percent fall within the range of 21 to 26 years. From the total sample size, 75 respondents were from the schools situated in the rural areas and the rest of 75 from the schools situated in the urban areas, thus, sharing 50% split.

Schools from the rural areas appear to have a youngster population as well as represented by the sample (M=13.41, SD=1.75), with minimum and maximum ages of 10 and 19 respectively. 57.3 percent of the students fall within the age range of 10-13 years, 37.3 percent fall within the age range of 14-16 years and 5.3 percent fall within the range of 17 to 19 years. Likewise, sample from the schools situated in the urban areas also appear to be representative of a youngster population (M=13.45, SD=2.51) with minimum and maximum ages of 9 and 26, respectively. 68.0 percent fall within the age range of 9 to 14 years, 30.7 percent fall within the range 15 to 20 years and 1.3 percent of them within the range of 21 to 26 years.

## Age Distribution and Wax Prevalence

Out of the 43 students that were categorized under the age range 9-14 years in rural areas, 72.1 percent of them had no wax present in either ear, 20.9 percent had wax in one side and 7.0 percent had wax present in all left and right ears. Out of the 28 students that were within the age range 15-20 years, 64.3 percent had no wax, 25.0 percent had wax present in either their left or right ear and 10.7 percent had wax present in both left and right ear. Out of the 4 students in the age range 21-26 years, 25.0 percent had no wax, 50.0 percent had wax on one side and 25.0 percent had wax in both ears. Out of the 32 students that were categorized under the age range 9-14 years in urban areas, 32 students (62.7%) had no wax, 14 students (27.5%) had wax in one side and 5 students (9.8%) had wax present in all sides. Out of the 28 students that were within the age range 15-20 years, 17 students (73.9%) had no wax, 4 students (17.4%) had wax present in either their left or right ear and 2 students (8.7%) had wax present in all sides. Only one student falling within the age range 21-24 had no wax present.

In as much as there is some differences in the availability of wax in either side or both sides of the ear in rural area sample, running a chi-square test of independence ( $\alpha = 0.05$ ) reveals there is no statistically significant association ($X^2 = 3.928, p = 0.416$) between the age ranges and existence of wax in either side of the ear even though some differences are observed.

### Sex and Wax

Otoscopic analysis was done to explore whether there is a significant amount of wax present in either left ear, right ear, or both with respect to gender. The results revealed some differences in wax impaction with respect to gender (6). Out of all the 150 students, 99 of them registered to have no wax present in either ear, with 51 (51.5%) of them were female students, whilst 48 (48.5%) of them were males. 40 (26.7%) respondents disclosed to have experienced excessive wax accumulation either left or right ear only, with males registering a relatively higher percentage (60.0%) as compared to 40.0% observed in female students. A total of 11 (7.3%) revealed the excessive accumulation of wax in all sides of the ear. However, even though there are some differences in percentages observed Pearson chi-square test of independence ($\alpha = 0.05$) Thus to say, there is no statistically significant association between the sex differences and the presence of excessive wax accumulation even though some percentage differences are observed. Among the students sampled from the rural areas, 50 (66.7%) of them had no wax present in either ear. 54.0% of them were females and 46.0% males. A total of 18 students had wax impaction either in their right or left ear, with 61.1 percent of them being females and 38.9 percent of them being males.

### Guardian´s Education Level

The results showed that 7 (4.7%) of them had uneducated parents/guardians, 45 (30.0%) of them had guardians that attained primary as their highest level of education, 66 (44.0%) of them had guardians that attained secondary as their highest level of education and 32 (21.3%) of them have parents/guardians that reached university as their highest level of education. Out of the 66 students that had parents who attained secondary school as their highest level, 62.1 percent appeared to have no wax accumulation in either side of the ear, and 37.9 percent had accumulation of wax in either their left or right ear. The absence of wax appeared to occur in those students that had their parents who attained primary and tertiary as well and also the uneducated ones.

The general outcome of the study shows that those without wax accumulation had a relatively higher percentage in all the categories of the education level. However, even though there are some differences in the percentages across all groups, Cochran-Armitage test reveals that there is no statistically significant trend ( $X^2 = 0.624, p = 0.804$) that can be deduced from the results. Thus, to say, there is no significant association between the accumulation of wax and the level of education.

### Wax Accumulation and Hearing Loss

An analysis was done to explore whether there is a significant association between the excessive accumulation of wax in either ear or the type of hearing losses. A relatively greater percentage (92.9%) of students that reported to have no significant problems with their hearing were those that reported to have no excessive wax in both their left and right ear. Those who reported to have impacted wax in either side of their ear upon examination, 43 (84.3%) of them also reported to have no problems with their hearing. 8 students who appeared to have excessive wax in either ear reported to experience conductive hearing loss; which is 72.7 percent of all those that experienced conductive hearing loss. Only 3 (27.3%) out of the students that had no hearing problems were found to have conductive hearing problems.

In an attempt to determine and validate if the differences in the percentages of the hearing losses are significant and if they are dependent on whether excessive accumulation of the cerumen or not, Pearson chi-square test of independence was carried out at $\alpha = 0.05$. The test statistic ($X^2 = 9.690$) revealed that there is a significant association ($p = 0.008$) between the excessive accumulation of the wax and the type of hearing. More specific, those that appear to have excessive cerumen are most likely to experience conductive loss hearing more than those without cerumen. Conversely, those without excessive cerumen in either side of their ear are most likely to have no problems of either magnitude; be it conductive, sensorineural nor mixed.

## Cerumen Cleansing Methods

When queried on the methods adopted in removing cerumen from their ear, most (38.7%) of the students from the urban areas responded to have mostly used cotton buds, seconded by those that used matchstick (34.7%) as their preferred methods. The aforementioned two were the most adopted methods in urban areas in that particular order. It appears most (34.7%) of the students from the rural areas cleanse themselves using stick, with matchstick (29.3%) being the second most preferred method. Chi-square test of independence reveals that there is a statistically significant association ($X^2 = 34.095, p < 0.05$) between the location type and the preferred cleansing method. Thus, to say, the preferred method of cleansing is strongly dependent on where the student resides. Most of the students from the urban areas use cotton bud whilst students from rural areas usually prefer stick to cleanse the ear. It appears students from both location types do not let the ears of their children to naturally clean on their own, with those of urban and rural registering 4.0 percent and 18.7 percent, respectively. The Northwestern Nigerian research showed that the primary motivation because utilizing cotton buds was considered hygienic, which was in line with our results (Aldawsari et al., 2018).

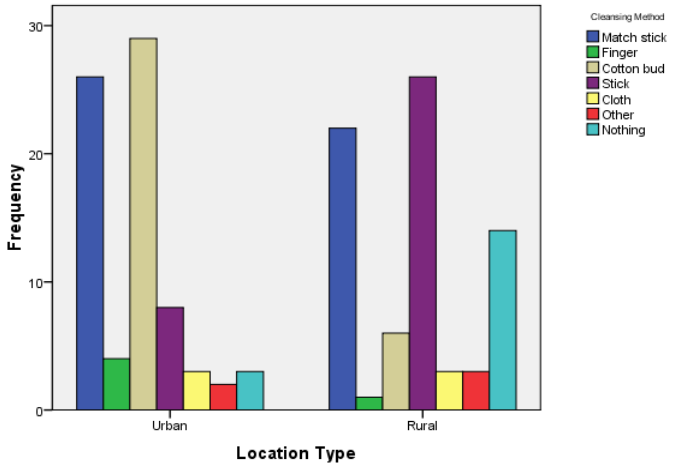


Figure 2. Preferred cleansing methods with respect to location type.

## Clinical Presentation of Wax

There were 21 out of 40 (52.5%) learners that had wax impaction in either ear, revealed to have experience itching as the most predominant effect associated with the cerumen impaction. There were 17 of them (42.5%) who had reported to experience pain as one of their main problems associated with the cerumen accumulation with feeling of blockage (14 students) along the ear canal being the third most reported problem. Ringing of the ear showed to be the least condition associated with cerumen impaction with no student responding to have experienced it. Only 2 students, 5 students and 7

students reported to have experienced dizziness, ear discharge and reduced hearing, respectively.

## DISCUSSION

The most common ear problem identified in this study, affecting 34% of all the learners, was wax impaction. In the majority of cases, it was asymptomatic. In agreement, with a study done by (Phanguphangu, 2017) in Limpopo, south Africa on otoscopic examination reveals high prevalence on outer and middle pathologies in pediatric which showed a significant 36% (n = 392) had impacted cerumen while (Takwoingi et al., 2021) stated that the most typical finding was ear wax. Representing 41.9% of the population under investigation. To add this the most prevalent ear condition among Nigerian school children was discovered to be impaction of ear wax 52.6% of the sample, had this condition (Al Khabori et al., 2007).

As revealed by a study done by Mahfouz (2021), the higher percentages of the clear ears could be attributed to self-cleaning of the ear at all ages. The ear itself has a natural biological tendency to clear the wax effectively without using any material. some natural daily activities like jaw movement ably remove cerumen from the ear (Mahfouz, 2021). Some studies have shown that the population in the rural areas register a relatively higher percentage when compared to the students sampled from urban areas. This has been attributed to the disparity in the economic stance that is there between these two areas. It is believed most of the students from the rural areas are exposed to poor sanitary and hygienic conditions which facilitates the development of excessive wax and subsequently resorting to hearing impairment. Conversely, the urban areas are reported to register a comparatively lower percentage of hearing impairment which results from impacted wax. Students from these socio-economic status usually dwell in conducive sanitary and hygienic conditions and these conditions protect them from excessive accumulation of wax, hence low hearing impairments.

A significant number of studies with samples from within the African continent reveal a rather similar result to this study. Study on comparative analysis of ear disease occurring in students from both lower-level and high-level status (Takwoingi et al., 2021). Private school students represented students from a higher economic status and public school students were representative of lower economic status students. Outcome of the study conformed to the results of this study. In as much as public school students registered a relatively higher percentage than the students from the private schools, chi-square test of independence also revealed that there was no statistically significant association between the wax impaction and socio-economic stance.

Malawi is lagging behind in the knowledge pertaining to the wax accumulation and cleansing methods as compared to other countries, especially those in developed countries. It is with this reality aspect of the problem statement that accounts for fact that there is no significant disparity in wax accumulation irrespective of where the students are coming from. It is evident from the results of the study that guardians from both rural and urban areas are ignorant of wax and self-cleansing mechanisms, a problem that ought to be taken into consideration in order to mitigate ear problems associated with inconvenient methods of cerumen removal that impact the wax inside the ears. As

highlighted by Takwoingi et al. (2021), neglecting cerumen impaction issues results in hearing impairments, which eventually affects the students' performance in class. This has a negative social impact as well because their poor performances lead to social isolation and depression (Takwoingi et al., 2021).

The results of the study correspond to what has been concluded in various studies on the prevalence of hearing difficulties in children. Most of the problems associated with hearing losses are attributed significantly mild to conductive hearing losses condition have type B tympanogram in leaners which result in poor academic performance (Oladeji et al., 2015) which is in conformity to the outcome of the study. The study clearly reveals that most of the children that had excessive accumulation of the wax in either side of their ear registered a relatively higher percentage of CHL conditions as compared to the ones that had no wax present in their side of their ear.

Furthermore, it has been argued that CHL is one of the reasons why some students do not perform well in schools. Development of the CHL is believed to affect the speech and language development due to the interference with the mobility of the membranes and ossicles hence which compromises with the normal hearing capabilities. Unfortunately, the study shows lack of information in concepts pertaining to excessive accumulation of cerumen, its treatment and where they are supposed to consult for professional diagnosis. Cleansing method of the ear justifies the argument in this study as only a few learners leave the ears to undergo self-cleansing as advised scientifically.

As per highlighted by Chalya et al. (2019) on the presence of cerumen and its associated factors among learners, there seemed to be a significant association between usage of cotton buds and the impaction of cerumen in either side of the ear(Chalya et al., 2019). Usage of cotton buds was the most predominating cleansing methods that was observed in the study, which is in conformity to the outcome of the study on the students from urban areas. This could be attributed to the financial stance these homes are, which capacitate them to procure cotton buds as the seemingly most convenient way to remove the wax. However, despite the outcome of this, the results revealed that there is no statistically significant association ($p>0.05$) between age, gender and the impaction of cerumen.

Cerumen impaction has proven to be significantly present in most of the African countries as compared to the percentages registered in European countries and other well-developed countries. Nigeria and Nepal, for instance, registered higher relatively percentages, which is observed in this study and many of African countries. A study done by (Chalya et al., 2019) provided a recommendation on the introduction of the civic education specifically to discourage the usage of cotton buds as a method of clearing cerumen from the ear. Cotton buds push back the cerumen into the deepest part of the ear and, consequently, blocks the passage which, subsequently affects the hearing capability and other hearing problems. Most people remove impacted wax using objects to self-clean their ears with a variety of objects because they think earwax is bad for them (Adegbiji et al., 2014).

Several studies reveal contradictory outcomes depending on a country of concern. Most of the countries that regard ear-related information with great concern have citizens that make better choices of cleansing mechanisms without affecting their

ears. Atwal conducted a study to explore the level of knowledge pertaining to the cleansing mechanisms of the ear found out that there was a statistically significant association between the level of knowledge and gender, with females having a relatively higher level of knowledge when compared to males. Oladeji et al., (2015) similarly found out in his research that there was a statistically significant association between the level of knowledge on cerumen cleansing methods and gender. Females were reported to have a higher knowledge when compared to the knowledge males had. Govindaraju , in his study to explore the type of instrument used for ear cleansing, also reported a higher percentage (92%) of usage of cotton bud in an attempt to remove cerumen from the ear (Lee et al., 2005). Metal probe and towel were also preferred materials, even though these were reported to be used occasionally and by few people.

Knowledge of wax and cleansing mechanism has an influence on the choice of cleansing methods people choose and subsequently can be hypothesized to reduce hearing impairment predicaments and negative effects associated with it. Unavailability of civic education on cerumen and its cleansing methods in Malawi have unsurprisingly resorted to many citizens using unsafe materials to clean cerumen from their ears, despite level of education nor socio-economic stance. This lack of information possibly accounts for the fact that a higher percentage from the urban areas use cotton buds to clean wax from the ears of their children, seconded by a matchstick, which are all unsafe methods of cleansing the ear (see Figure 2). It is the same reason that possibly accounts for the fact that learners from the rural areas use sticks to remove wax from their children's ears, seconded by matchsticks, which are both detrimental to the ear.

It could be deduced from the statistical outcome that most of the students with wax impaction struggle with itching, pain and ear canal blockage as the three conditions associated with it. Several studies reveal outcomes that are different to the outcome of this study. Hearing loss predominantly appears in most of the studies as the hearing problem attributed to the cerumen impaction in children, a problem that appears to be one of the least felt as responded by the respondents. Out of those that experienced hearing impairment, only 7 of them had cerumen impaction and 33 had no cerumen impaction, suggesting that wax impaction could not necessarily be the problem accounting for most of the hearing losses A study done by Takwoingi et al. (2021) on the comparative study of the ear diseases in children revealed that there was no statistically significant association that could be deduced from the outcome between ear wax and hearing loss, an outcome that statistically conforms to this study. Thus, hearing impairment in this study is independent $(X^2 = 1.11, p = 0.292)$ of wax presence. According to Minja & Machemba (1996) found out that itching (18.5%) and pain (9.1%) of the ear were two most predominating problems that were seen to occur in children, an outcome that conforms to this study.

Use of cotton buds could be the main reason why cerumen causes itching of the ear in students because most of the cerumen is pushed back in the ear and, consequently, causes some discomforts due to over accumulation. Use of sticks and matchsticks are some of the most unsafe methods to adopt when clearing cerumen from the ear, and this ought to be discouraged to ensure cases associated with ear pains are mitigated. Sticks and matchsticks injure the ear and might cause some bruises inside the canal and can damage the ear drum. It was recommended

that the use of ear syringing by an ENT specialist as a convenient way of removing excess cerumen from the ear of the children aged between 7-17 in schools (Kirfi et al., 2019)..

**Areas of further study**

The preference of wax and related factors among learners in Lilongwe, Malawi was the focus of this study. In addition to the topics covered in this study, the researcher recommends that additional research be done to determine the reasons the reason why cotton buds is common in urban while matchstick in rural areas, and also determine why itching and pain are the common sign for impacted, more research could be conducted.

## CONCLUSION

Wax impaction is the most common ear condition among primary school learners in Malawi. This study revealed that there is no significant different of wax impaction between urban and rural public primary schools. The used of object to clean the ears and lack of knowledge are significantly correlated. It is recommended that school-aged children undergo routine otoscopy, awareness and ear and hearing school screening programmes in order to discover hearing impairment early and receive therapy, which will improve their academic performance.

Lastly, it may be said most of identified problems are preventable if the right steps are done.

Recommendations:

1. The outcome points out a need for sensitization programs that will specifically equip guardians with the necessary knowledge required pertaining to safe ear cleansing which, subsequently, has the potential to alleviate cases pertaining to ear trauma and hearing loss.
2. A national survey is required to determine the prevalence of wax impaction in the Malawi is needed.
3. Health worker to improve knowledge of patient counseling and education about ear wax.
4. The training of more ear and hearing professionals and other mid-level healthcare professionals to join the hearing screening team to organize more frequent ear wax removal of clients.
5. More attention should be paid to early identification of the ear diseases so that appropriate interventions can be initiated.
6. The results show that the majority of the respondents conductive hearing loss and the occurrence of conductive hearing impairment was higher than These findings have significant implications on the need of resource development for prevention and rehabilitation
7. To ensure adequate ear and hearing care services, ring-fenced funding must be included in the national budget.
8. Basic hearing instruction and supplies should be covered by the budget designated for primary health care.
9. Public safety practices must be promoted by health professionals.

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## DEDICATION

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