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The Magnitude and Factors Associated with Ear Infections in a Tertiary Hospital in Dar es Salaam, Tanzania

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Abstract

Background: Ear infection is a common public health problem in developing countries. There is limited data on the factors associated with ear infections, which have hastened their spread and the repercussions of ear infections, including hearing loss. The study aimed to determine the magnitude and factors associated with ear infection among patients attending the Otorhinolaryngology clinic at Muhimbili National Hospital, Dar es Salaam, Tanzania.

Methods*:* A hospital-based cross-sectional study was conducted from March to July 2021. Participants with signs and symptoms of ear infection who attended the otorhinolaryngology clinic at Muhimbili National Hospital, Dar es Salaam, Tanzania, were recruited into this study. The clinical information from the participants was collected using a standardized data collection tool, and an ear swab was collected and taken to the lab for culture and identification. Data analysis was conducted using Statistical Package for the Social Sciences (SPSS v23), and proportions and percentages were used to indicate the magnitude. The Chi-square test was employed to assess associations between variables, with statistical significance determined at a p-value of 0.05. Logistic regression was used to measure the strength of the association between dependent and independent variables.

Results: A total of 255 eligible participants were enrolled, with ages ranging from 1 to above 50 years (median 31 years; IQR: 15–49). The magnitude of ear infection was found to be 53.3% (136 out of 255). The majority (26.8%) of participants with ear infection were elderly above 50 years, followed by children under 10 years (17.9%). Additionally, we observed that the factors such as cotton buds use (AOR 2.78, 95%CI 1.08–7.15, p=0.035) and ear cleaning using objects other than cotton buds, including keys, pins, and pens (AOR 3.45, 95%CI 1.44–8.25, p=0.005), p=0.035), cerumen impaction (AOR 12.86, 95%CI 2.78-59.33, p <0.001), p=0.035), cerumen impaction (AOR 12.86, 95%CI 2.78-59.33, p <0.001), recurrent upper respiratory tract infection (URTI) (AOR 3.43, 95%CI 1.22-10.03, p=0.019), and nasal /congestion/discharge (AOR 3.55, 95% CI 1.36-9.27, p = 0.010) were independently associated with ear infection.

Conclusions: The present study has revealed a 53.3% magnitude of ear infection, with elders above 50 years and children below 10 years accounting for most cases. Our study findings showed that nasal

congestion, recurrent URTI, use of cotton buds, cerumen impaction and ear cleaning were potential risk factors for ear infection.

Recommendations: Health education campaigns promoting safe ear hygiene, early treatment of URTI and nasal congestion, and discouragement of the use of cotton buds and sharp objects for ear cleaning are recommended to reduce the burden of ear infections in similar settings.

Keywords: *Ear infection, Associated factors, Prevalence, Otorhinolaryngology.*

Background

Ear infections are a tenacious global public health issue, affecting individuals across the world. In developing countries, they are a major cause of hearing loss, especially in children (1). Otitis media is a type of ear infection which is highly prevalent and widespread, impacting around 11% of the global population annually. This condition mostly affects children specially those who are under five years. When left untreated, acute otitis media can progress into chronic suppurative otitis media (CSOM). Moreover, approximately half of those with CSOM will experience hearing impairment, which is equivalent to approximately 0.3% of the entire global population (1). Children are at significant risk of ear infections and experience complications of ear infections. Such consequences may have long-term effects on a child's quality of life and general well-being. (2–4). This is a cause of concern because it emphasizes how important it is to identify ear infections quickly and to treat them. Early diagnosis and the right medical attention can stop the spread of ear infections, potentially avoiding the serious and protracted effects of CSOM. The prevalence of ear infections is particularly high in developing countries, including Tanzania (2). Ear infection can result in extended hospital stays, increased antibiotic use, and the emergence of complications that can result in hearing loss. The management and quality of life for those who are affected can be negatively impacted, and treatment costs and mortality rates can rise because of a lack of knowledge and understanding of the contributing factors. Several factors have been reported to be associated with ear infection, such as the use and sharing of earphones, frequent use of ear cleaning tools like cotton buds, age, pre-existing ear conditions, weakened immune systems, habitual swimming, and parental cigarette smoking, which can all contribute to an increased risk of ear infections. (5–10). However, the extent to which these factors are associated with ear infections in our local setting remains to be fully described.

Therefore, this study aimed to determine the magnitude and factors associated with ear infections among patients attending the otorhinolaryngology clinic at Muhimbili National Hospital, Dar es Salaam, Tanzania, and to identify the causative microbial organisms through culture and sensitivity analysis, to establish a laboratory-confirmed basis for the reported magnitude of ear infection in this setting.

Methods

Study design and study area

A hospital-based cross-sectional study was conducted from March to July 2021at the otorhinolaryngology clinic in Muhimbili National Hospital (MNH) in Dar es Salaam, Tanzania. Muhimbili National Hospital functions as a national referral hospital, research centre, and university teaching hospital. It is also the most extensive tertiary care centre in the country, with a capacity of 1500 beds. MNH serves a significant number of outpatients and inpatients each week, attending to 1000 to 1200 outpatients and admitting 1000 to 1200 inpatients. The hospital's otorhinolaryngology department has separate inpatient and outpatient units, and around 50 to 100 patients visit the outpatient clinic each day.

Study population, sample size and sampling procedure

In this study, a simple random sampling technique was utilized to recruit a total of 255 participants from patients attending the otorhinolaryngology clinic, MNH. Eligible participants included individuals experiencing ear complaints such as a sensation of ear fullness, ear pain, ear itching, ear discharge (otorrhea), and, on examination, bulging and perforation of the eardrum as assessed by an Ear, Nose, and Throat specialist. All eligible participants who provided consent or assent to participate in the study were enrolled on the study. Patients with other ear disorders, such as congenital malformations or physical head injuries, and those who were undergoing regular checkups were excluded from the study.

Data collection

A comprehensive data collection tool was employed to capture the demographic, risk behaviour practices and clinical details of the participants. The demographic data encompassed age, sex, marital status, occupation, and educational background, while risk behavioural characteristics included factors such as swimming habits, frequent use of earphones and cotton buds, use of sharp items, and cigarette smoking. Clinical data, such as the type of ear infection, use of hearing aids, antibiotic use, nasal congestion or blockage, recurrent Upper Respiratory Tract Infection, breastfeeding, and cerumen impaction, were also collected from the medical records of the patients and through a physical examination conducted by an ENT specialist. Before use, the questionnaire was tested for feasibility and validity at the Ear, Nose and Throat department of Muhimbili National Hospital.

Specimen collection and laboratory procedures

A sterile swab was used to collect the specimen, which was then preserved in Stuart transport medium. All samples were transported to the Central Pathology Laboratory (CPL) of MNH for processing and analysis. The specimen was cultured in both selective and non-selective

agar, such as Chocolate agar (CA), Sheep-Blood agar (sBA), and MacConkey agar (MCA). In the case of suspected otomycosis, the specimen was also inoculated in Sabouraud dextrose agar (SDA). To identify bacterial isolates, interpretation of colony morphologies, microscopic examination (Gram stain), and biochemical tests were conducted. Additionally, biochemical testing using API 20E and API 20NE was used to confirm phenotypic identification of the bacterial isolates.

To differentiate between mould and yeast fungal isolates, preliminary growth on SDA plates was observed, and mould colonies were identified as filamentous, while yeast colonies were creamy to white. A germ tube test was used to identify Candida albicans as a type of fungal isolate.

Quality control

To ensure the sterility and accuracy of the media and methods used, several quality control measures were taken. E. coli ATCC-25922 and S. aureus ATCC-27065 were used as control strains to assess lactose fermentation and hemolysis, respectively. The sterility of newly prepared media was confirmed by incubating them at 35-37°C for 18-24 hours and checking for growth of any contaminants. Daily monitoring and documentation of the operating room, refrigerator, and incubator temperatures were conducted. Additionally, proper sample collection, transportation, and storage at 4-8°C were ensured to maintain the quality of collected specimens.

Data Analysis

The data was analyzed using SPSS v23 software. Median was used to represent continuous variables with an uneven distribution, while proportions and percentages were used to indicate the magnitude. The Chi-square test was used to evaluate the association between different variables, and a p-value of 0.05 was considered statistically significant. Logistic regression was used to determine the strength of the association between dependent and independent variables.

Results

Socio-demographic, clinical and risk behavior characteristics of the study participants

The study enrolled 255 participants who were clinically diagnosed with ear infections. Of the participants, 134 (52.5%) were males. The median age of the study population was 31 years, with an interquartile range (IQR) of 15-49. More than half of the participants (53.7%) reported being single, and 32.9% had completed higher education.

In addition, the study found that the median duration of ear complaints was 210 days IQR (21 -1095). Almost half of the study participants (49.1%) had a history of taking antibiotics in the past month, with ciprofloxacin ear drops being the most used and chloramphenicol being the least prescribed (Table 1). The study also revealed that 33.3% of the participants had

nasal congestion or blockage or discharge, 28.2% had recurrent upper respiratory tract infections, and 43.9% used cotton buds, with 45.9% using them 2-3 times per week. Moreover, 16.1% of the participants used earphones, with 51.2% using them 2-3 times per week, and 76.7% reported sharing earphones. In addition, 23.5% of the participants had a habit of scratching their itchy ears with sharp objects, such as keys, pins and pens being the most used items (Table 2).

Table 1: Socio-demographic information (N=255)

Variables	n	Percentage (%)
Age	(Median age) 31 years IQR: (15 - 49)	
Sex		
Male	134	52.5
Female	121	47.5
Marital status		
Single	137	53.7
Married	107	42
Divorced/separated	11	4.3
Occupation		
Self-employed	56	22
Civil servants	62	24.3
Retired/Jobless	49	19.2
Other	9	3.5
Students	77	30.2
Housewife/husband	2	0.8
Education		
Primary	75	29.4
Secondary	59	23.1
College	84	32.9
Illiterate	37	14.5
Residence		
Within Dar es salaam	215	84.3
Outside Dar es salaam	40	15.7

Table 2: Clinical and risk behavioral characteristics of the study participants (N=255)

Variables	n	Percentage (%)
Duration of ear infection	Median 210 days IQR (21 -1095)	
Nasal discharge/blockage		
Yes	85	33.3
No	170	66.7
Recurrent URTI		
Yes	72	28.2
No	183	71.8
Swimming behavior		
Yes	8	3.8
No	200	96.2
Earphone use		
Yes	41	16.1
No	214	83.9
Cotton bud usage		
Yes	112	43.9
No	143	56.1
Sharp item usage		
Yes	60	23.5
No	195	76.5
Ear cleaning		
Yes	119	46.7
No	136	53.3
Cerumen impaction		
Yes	45	17.6
No	210	82.4

The magnitude of ear infection among patients attending the otorhinolaryngology clinic at MNH, Dar es Salaam, Tanzania

In this study, the prevalence of ear infection was found to be 53.3% (136/255) of the total study population. Ear infection was observed more frequently in participants aged above 51 years (26.8%), followed by participants aged less than 10 years (17.9%). Among the confirmed ear infection cases, Chronic Suppurative Otitis Media (CSOM) was the most predominant type, accounting for 50% of all diagnosed ear infection subtypes, followed by Otitis Externa (OE) at 38.7%, with the difference across infection types being statistically significant (p-value = 0.001). (Table 3).

Table 3: Distribution of ear infection by socio-demographic and clinical characteristics among participants confirmed to have ear infection (n=136)

Variables	N (%)	Proportion of Ear infection n (%)	Chi- Square test (p-value)
Age(years)			0.209
1-10	45(17.6)	30 (22.1)	
11-20	46(18.0)	23 (16.9)	
21-30	30(11.8)	21 (15.4)	
31-40	42(16.5)	29 (21.3)	
41-50	26(10.2)	20 (14.7)	
>50	66(25.9)	45 (33.1)	
Sex			0.546
Female	121 (47.5)	82 (60.3)	
Male	134 (52.5)	86 (63.2)	
Type of ear infection			<0.001
OE	115(45.1)	65(38.7)	
CSOM	105(41.2)	84(50.0)	
OM	24(9.4)	11(6.5)	
Otomycosis	11(4.3)	8(4.8)	

Factors associated with ear infection among patients attending the otorhinolaryngology clinic at MNH, Dar es Salaam, Tanzania

In the univariate analysis, participants with nasal blockage or discharge (cOR 7.16, 95%CI 3.37–15.22, p-value<0.001), recurrent URTI (cOR 7.21, 95%CI 3.15–16.58, p-value<0.001), cotton bud use (cOR 5.35, 95%CI 2.90–9.88, p-value<0.001), ear cleaning (cOR 7.80, 95%CI 4.12–14.76, p-value<0.001), and cerumen impaction (cOR 14.62, 95%CI 3.45–61.97, p-value<0.001), had an increased chances of more than 5 times odds to develop ear infection compared to those without nasal discharge/blockage, recurrent URTI, cotton bud use, ear cleaning habit and cerumen impaction. Nonetheless, individuals with a history of earphone use (cOR 2.41, 95%CI 1.06–5.48, p-value 0.035), and use of sharp items to clean the ear (cOR 2.50, 95%CI 1.25–5.01, p-value<0.001), had more than 2 times increased odds of developing ear infection compared to those without a history of using earphones and sharp objects.

However, in the multivariate logistic regression analysis indicated that cotton buds use (aOR 2.78, 95%CI 1.08-7.15, p=0.035), cerumen impaction (aOR 12.86, 95%CI 2.78-59.33, p <0.001), recurrent URTI (aOR 3.43, 95%CI 1.22-10.03, p=0.019), nasal congestion/discharge (aOR 3.55, 95% CI 1.36-9.27, p = 0.010) and ear cleaning (aOR 3.45,

95% CI 1.44-8.25, p = 0.005) were independently associated with ear infection. In contrast, earphone use (aOR 0.88, 95%CI 0.30-2.58, p=0.816) and use of sharp items in cleaning the ear (aOR 0.79, 95%CI 0.30-2.11, p=0.637) were not significantly associated with ear infection (Table 4).

Table 4: Univariate and Multivariate analysis of factors associated with ear infection

Variables	Positive Ear infection (%)	Bivariate Analysis		Multivariate analysis	
		cOR (95% CI)	P-value	aOR (95% CI)	p-value
Age(years)					
0-10	30(66.7)	2.0(0.86-4.67)	0.109		
11-20	23(50.0)	Ref			
21-30	21(70.0)	2.33(0.88-6.16)	0.087		
31-40	29(69.0)	2.23(0.93-5.34)	0.072		
41-50	20(76.9)	3.33(1.13-9.81)	0.029		
>50	45(68.2)	2.14(0.99-4.66)	0.054		
Nasal congestion or discharge					
Yes	76(89.4)	7.16(3.37-15.22)	<0.001	3.55(1.36-9.27)	0.010
No	92(54.1)	Ref			
Recurrent URTI					
Yes	65(90.3)	7.21(3.14-16.58)	<0.001	3.43(1.22-10.03)	0.019
No	103(56.3)	Ref		Ref	
Earphone use					
Yes	33(80.5)	2.41(1.06-5.48)	0.035	0.88(0.30-2.58)	0.816
No	135(63.1)	Ref			
Cotton buds use					
Yes	95(84.8)	5.35(2.90-9.88)	<0.001	2.78(1.08-7.15)	0.034
No	73(51.0)	Ref		Ref	
Use of Sharp items					
Yes	48(80.0)	2.50(1.25-5.01)	0.010	0.79(0.30-2.11)	0.637
No	120(61.5)	Ref			
Ear Cleaning habit					
Yes	104(87.4)	7.80(4.12-14.76)	<0.001	3.45(1.44-8.25)	0.005
No	64(47.1)	Ref		Ref	
Cerumen impaction					
Yes	43(95.6)	14.62(3.45-61.97)	<0.001	12.86(2.78-59.33)	<0.001
No	125(59.5)	Ref		Ref	

Discussion

Ear infection is a significant problem in developing countries, particularly in African nations, yet insufficient knowledge about its extent and contributing factors has hindered efforts to address it and its complications. This

study aims to determine the prevalence of ear infection and identify associated factors.

The study found a significant prevalence of ear infections, particularly in children under 10 years old and adults over 50 years old. Chronic Suppurative Otitis Media and Otitis Externa were found to be the dominant type of ear infection. These results are similar to a previous study conducted in Ethiopia, Bangladesh, and India, which revealed a significant prevalence of ear infection (11–13). Moreover, a study by Martha et al in Tanzania also found a significant proportion of CSOM cases(8). The results are also consistent with a study done in Kigali, Rwanda, and with the World Health Organization's (WHO) estimated prevalence of ear infections in African children under five years old, which ranges from 0.4% to 46%(1,14).

Furthermore, the present study revealed several factors contributing to ear infection in our local settings. The study found that cotton bud use, recurrent URTI nasal discharge or blockage, cerumen impaction, and ear cleaning were independently associated with an increased risk of ear infection. These findings are in line with previous studies conducted in various settings, in India, Italy, and Israel (15–17). The association between Ear infection and these factors may be explained by the fact that nasal congestion can block the Eustachian tube, leading to fluid buildup in the middle ear and providing a breeding ground for bacteria or viruses. Using cotton buds or over-cleaning the ear can push wax deeper and create micro-tears, allowing bacteria or viruses to cause infection. Cerumen impaction can also block the flow of air and increase the likelihood of infection(5,7,8,16).

Nonetheless, other characteristics, such as earphone use and swimming, have been shown to have a statistically significant association with ear infection in other previous studies (17). This could be owing to differences in study participants' risk behavioural traits, such as the fact that just a few of our participants reported that they were frequent swimmers and used earphones.

Limitation

Due to financial constraints and a lack of equipment, it was also not possible to isolate anaerobic bacteria from the collected pus specimen.

Conclusions and Recommendations

The study found that ear infection was prevalent among patients visiting the otorhinolaryngology clinic, with elders above 50 years and children below 10 years being the most affected group. The nasal congestion, recurrent URTI, use of cotton buds, cerumen impaction and ear cleaning were identified as risk factors for developing ear infection. These findings highlight the need for community education on proper ear hygiene, including safe cotton bud use. It is also crucial to address and treat URTI and cerumen impaction early to prevent the development of ear infections and their potential complications.

Abbreviations

ATCC: American Type Culture Collection
BA: Blood agar
CA: Chocolate Agar
CLSI: Clinical and Laboratory Standards Institute
CSOM: Chronic suppurative otitis media
MCA: MacConkey Agar
MNH: Muhimbili National Hospital
URTI: Upper Respiratory Tract Infection

Declarations

Ethical approval and consent to participate

The study adhered to ethical principles. Ethical clearance was obtained from the MUHAS Senate Research and Publication Committee (with reference number DA.282/298/01.C/), and permission was granted by the Muhimbili National Hospital to conduct the research. Adult patients provided written informed consent, teenagers provided assent, and the parents/guardians of children provided consent for their children. The patients' information was kept confidential and secured with codes.

Availability of data and material

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

Competing interests

The authors do not have any potential, perceived, or real conflicts of interest relating to this work.

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Authors' contributions

AS, DK, and WM contributed to the study's conceptualization, methodology, data analysis and manuscript preparation. WM, AS, DK, SM, UOK, AGM, and AM are involved in preparation. JM and MM were involved in profoundly reviewing the manuscript. All authors have seen and approved the final version of the manuscript.

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