

Prevalence of cerumen impaction and associated factors among primary school children in Mwanza City, Tanzania

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Abstract

Background: Cerumen impaction is a worldwide problem constituting a significant proportion of health problems in many settings and its prevalence varies. There is a paucity of published data regarding this condition in Tanzania with none from Mwanza region. The aim of this study was to determine the prevalence of cerumen impaction and associated factors among primary school children in Mwanza City and to assess the effect of cerumen impaction and its removal on hearing ability

Methods and Patients: This was a cross-sectional, community based study of primary school children with cerumen impaction that was carried out in randomly selected primary schools in Mwanza City between December 2016 and May 2017. Multistage cluster sampling technique was employed to obtain a required number of the study population.

Results: Out of the 406 participants, ninety-five (23.4%) had cerumen impacted in their ears. Of these, 56 (58.9%) were males and 39(41.1%) were females. The mean age at presentation was 11.24±8.86 years. Ear bud abuse (83.7%) was the most common predisposing factor for cerumen impaction. Cerumen impaction was found in the right ear of 9 (9.5%) patients and in the left ear in 31 (32.6%) patients and bilateral in 55 (57.9%) of patients. The major presenting symptoms were ear itching, otalgia, hearing loss and tinnitus. Ear syringing was used to remove cerumen impaction and caused significant improvement in hearing thresholds. There were no recorded complications.

Conclusion: Cerumen impaction is a common otologic presentation in our sub-region. Ignorance with the profound abuse of cotton buds is the major predisposing factor. Health education is of the essence as treatment is simple and effective.

Keywords: Cerumen impaction; prevalence; associated factors; Tanzania

Introduction

Cerumen impaction is a worldwide public health problem constituting a significant proportion of health problems in many settings and its prevalence varies (Jacob *et al.*, 1997; Kirfi *et al.*, 2014). Globally, the prevalence of cerumen impaction varies considerably from 8.9% to 20.0%, and it is a major cause of primary care consultation and common comorbidity in otorhinolaryngological patients (Grossan, 1998; McCarter *et al.*, 2007; Adegbiyi *et al.*, 2014). Many studies from Europe put the prevalence of cerumen impaction between 2% to 6%, whereas a few studies from African continent estimated the prevalence to be from 10% to 20% (Holocomb, 2009). The prevalence also varies between different age groups. The prevalence of cerumen impaction varies greatly among population with different characteristics; approximately 10% in children, 5% in normal healthy adults, up to 57% in older patients in nursing homes and 36% within patients with mental retardation (Al-Khabori *et al.*, 2007). In developing world like Tanzania, cerumen impaction has been reported to be the commonest ear disease or etiology of hearing impairment, with prevalence range from 8.4% to 52.6% (Minja and Machemba, 1996; Olusanya *et al.*, 2004; Subha & Raman, 2006; Al-Khabori *et al.*, 2007). At Bugando

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Medical Centre, cerumen impaction is one of the most common causes of consultation to the Otorhinolaryngological surgeons and its removal is the most common procedure performed at the Otorhinolaryngology clinic (Mushi *et al.*, 2016; Bugando Medical Centre-ENT database, 2016-2017, Unpublished).

The habit of self-cleaning ears by pointed objects, ear canal abnormalities, excess sebum production, foreign body in the ear, associated ear infection and ear trauma are some of the predisposing factors for cerumen impaction (Crandell & Roeser, 1993; Al-Khabori *et al.*, 2007). Other factors include use of ear hearing aids, cotton swab use and use of ear protection (Crandell & Roeser, 1993). In addition, different people appear to be at a higher risk of suffering from accumulation of cerumen, with an increased risk for the elderly, men, people with intellectual impairment and secondary-care populations (Crandell & Roeser, 1993; Meador, 1995).

Cerumen impaction is one of the leading causes of reversible hearing loss (Olusanya *et al.*, 2000; McCarter *et al.*, 2007; Adoga *et al.*, 2010; Eziyi *et al.*, 2011). Other problems associated with cerumen impaction are pain, tinnitus, itching and dizziness but cerumen impaction with conductive hearing impairment remains the most common indication for ear syringing (Olusanya *et al.*, 2000; McCarter *et al.*, 2007).

Various methods used in the removal of cerumen include the use of ceruminolytic agents, curette method (using either a probe or cerumen hook) and lavage (Olusanya *et al.*, 2000), but ear syringing is the most employed and efficient method for removing ear wax (Ogunleye & Awobem, 2004). Complications can occur during ear syringing and these include otalgia, tympanic membrane perforations, external auditory canal lacerations, dizziness and failure to syringe wax/foreign bodies or debris out (Ogunleye & Awobem, 2004).

Studies from the developing world have documented impacted cerumen as the commonest cause of hearing impairment among primary school children (Minja and Mchemba, 1996; Olusanya *et al.*, 2000; Olusanya *et al.*, 2004; Eziyi *et al.*, 2011). Previous studies have revealed an association between hearing loss and poor school performance (Olusanya *et al.*, 2000; Olusanya *et al.*, 2004; Eziyi *et al.*, 2011). Despite the well documented fact that cerumen impaction is one of the commonest otolaryngology diseases that is associated with hearing impairment among primary school children and the magnitude of the problem is not known in this part of the world; there is a paucity of literature on this ailment from our environment. The study aimed to determine the prevalence of cerumen impaction and associated factors among primary school children in randomly selected primary schools in Mwanza City. The secondary objective related to this study was to assess the effect of cerumen impaction and its removal on hearing ability.

Methods and Patients

Study area and design

This was a cross-sectional, community-based study of primary school children with cerumen impaction that was carried out in randomly selected primary schools in Mwanza City between December 2016 and May 2017. Mwanza City consists of two districts namely Nyamagana and Ilemela. The City has a total of 107 primary schools comprising of 80 public and 27 private schools. Each school has standard I to VII pupils.

Study population, selection criteria and sampling procedure

The study population included primary school children from randomly selected primary schools in Mwanza City during the period of the study. The study participants included all children (from standard

I to VII) who were diagnosed to have cerumen impaction during otoscopic examination and whose parents/caretaker consented for the study. Children with pre-existing ear problem like chronic suppurative otitis media, ear foreign body, external otitis media and those who were absent on the day of study were excluded from the study. Multistage cluster sampling technique was employed to obtain a required number of the study population (students). A sampling frame from the list of schools was prepared and used for drawing sample. From sampling frame (schools), study units (students) were sampled through simple random method until the required sample size was obtained.

Study variables

Independent variables in this study included socio-demographic characteristics (e.g. age, sex, area of residence, socio-economic status), predisposing factors, clinical presentation (such as the presenting complaint, duration of symptoms, laterality and history of any predisposing factors), associated co-morbidities and cerumen impaction removal methods. Dependent variables were cerumen impaction and hearing ability.

Recruitment of participants

The recruitment of participants was conducted in randomly selected primary schools in Mwanza City. On the day of the study a quiet classroom was selected at the school premises where the examination was conducted and the ambient noise measured using a sound level meter. The examination procedure was explained and demonstrated to the children. The examination commenced with otoscopic examination of both the right and left outer and middle ear and torch light examination of dentition. Each ear was examined by pneumatic otoscopy. All abnormal findings were confirmed by a trained otolaryngologist. The diagnosis of cerumen impaction was made if there was presence of visually occluding cerumen in the external auditory canal preventing view of the tympanic membrane with or without otalgia and complaint of decrease in hearing acuity/hearing impairment. Otoscopic finding was noted and those who were found to have ceruminous impaction, audiometry was done before (control group) and after (intervention group) the remove of the impacted cerumen to determine the presence of hearing loss and results were noted. History of ear bud usage and presence of pathology like missing tooth, caries tooth and malocclusion were noted.

Data collection and Statistical data analysis

Data was collected using a pre-tested coded questionnaire. The statistical analysis was performed using statistical package for social sciences (SPSS) version 20.0 for Windows (SPSS, Chicago IL, USA). The mean (+standard deviation) and ranges were calculated for continuous variables whereas proportions and frequency tables were used to summarize categorical variables. A Chi-squared (χ^2) test was used to assess significance of association between the independent and dependent (outcome) variables in the categorical variables. The level of significance was considered as $p < 0.05$.

Results

Socio-demographic characteristics

During the period of study, a total of 406 participants were enrolled into the study. Among these, 343 (84.5%) were from Nyamagana district and the remaining 63 (15.5%) participants were from Ilemela district in Mwanza City. Out of the 406 participants examined, ninety-five (23.4%) had cerumen impacted in their ears. Of these, 56 (58.9%) were males and 39 (41.1%) were females with a male to

female ratio of 1.4:1. Their ages ranged from 5 to 16 years with a mean of 11.24±8.86 years. The peak age incidence was 11-15 years accounting for 68.4% (Table 1).

Table 1: Age-sex distribution of children with cerumen impaction

Age group (years)	Sex		Total
	Male, N (%)	Female, N (%)	
0-5	0 (0.0)	1 (1.1)	1 (1.1)
6-10	17 (17.9)	9 (9.4)	26 (27.3)
11-15	37 (38.9)	28 (29.5)	65 (68.4)
16-20	2 (2.1)	1 (1.1)	3 (3.2)
Total	56 (58.9)	39 (41.1)	95 (100.0)

Predisposing factors among patients with cerumen impaction

The most common predisposing factor identified was ear bud usage in 340 (83.7%) participants. No predisposing factor was identified in 76 (18.7%) patients. Ear bud usage was significantly associated with cerumen impaction ($p=0.001$). There was no significantly association between age, gender, dental pathology and the presence of cerumen impaction ($p > 0.05$) (Table 2).

Table 2: Association between demographic factors, predisposing factors and the presence of impacted cerumen

Factor	Cerumen impaction		Chi-squared (X ²)	p-value
	Presence	Absence		
Age (years)				
6-10	151 (37.2%)	27 (6.6%)	0.947	0.214
11-15	160 (39.4%)	379 (93.3%)		
>15	2 (0.5%)	1 (0.2%)		
Sex				
Male	56 (13.8%)	126 (31.0%)	0.782	0.423
Female	39 (9.6%)	185 (45.6%)		
Ear bud usage				
Yes	82 (20.2%)	258 (63.5%)	32.876	0.001
No	13 (3.2%)	53 (13.1%)		
Dental pathology				
Yes	19 (4.7%)	69 (17.0)	0.635	0.564
No	76 (18.7%)	242 (59.6%)		

Clinical presentation among primary school pupils with cerumen impaction

Cerumen impaction was found in the right ear of 9 (9.5%) of patients and in the left ear in 31 (32.6%) patients and bilateral in 55 (57.9%) of patients. Table 3 shows sex distribution according to laterality. The majority of participants in this study were asymptomatic accounting for 50.7% of cases. The major presenting symptoms were ear itching and otalgia in 18.5% and 9.1% of patients, respectively. Table 4 shows distribution of study population according to clinical presentation. The duration of illness ranged from 1 day to 36 days with a mean of 10.02 ± 11.71 days.

Table 3: Sex distribution according to laterality

Laterality	Sex		Total
	Male N (%)	Female N (%)	
Right ear	7 (7.4)	2 (2.1)	9 (9.5)
Left ear	22 (23.1)	9 (9.5)	31 (32.6)
Bilateral	27 (28.4)	28 (29.5)	55 (57.9)
Total	56 (58.9)	39 (41.1)	95 (100.0)

Table 4: Distribution of study population according to clinical presentation

Clinical presentation	Frequency	Percent
Tinnitus	22	5.4
Hearing Loss	35	8.6
Ear Itching	75	18.5
Pain	37	9.1
Others	31	7.6
Asymptomatic	206	50.7
Total	406	100

Treatment and interventions among primary school pupils with cerumen impaction

Participants found with cerumen impaction were subjected to Audiometric examination to assess their hearing thresholds. The hearing thresholds before intervention (ear syringing) ranged from 5 to 58 dB with a mean of 30.54 ± 12.43 dB (Control group). The mean hearing thresholds after intervention (ear syringing) was 10.12 ± 7.22 dB in more than two thirds of participants. The difference in mean improvement in hearing between intervention and control groups was 20.42 dB (95% CI = 6.8 to 26.82) ($p < 0.001$). After intervention there was clinical relief of symptoms such as ear itching, hearing loss and pain. There were no documented complications after syringing.

Discussion

Globally, cerumen impaction is one of the most common ear pathology treated in the otorhinolaryngological clinic (McCarter *et al.*, 2007 ;Roland *et al.*, 2008). There is a marked variation in the prevalence of cerumen impaction worldwide, with western countries having a low rate compared to Africa (Crandell & Roeser, 1993). In this study, the prevalence of cerumen impaction among primary school pupils in our setting accounted for 23.4%. This concurs with figures of 10% to 25% that have been reported from various parts of Africa (Man *et al.*, 1985; Elango *et al.*, 1991; Hatcher *et al.*, 1995; Minja and Machemba, 1996). Our figure is higher than that of 2-6% reported in many studies in developed countries (Crandell & Roeser, 1993). However, a high prevalence of 46.7% was reported in Nigerian primary school pupils (Eziyi *et al.*, 2011). Olusanya *et al.* (2004), Adhikari *et al.* (2008) and Adhikari *et al.* (2009) found cerumen impaction to be a common ear disease amongst school children in Nigeria, Nepal, and Kathmandu valley with a comparable high prevalence of 52.6%, 62% and 60.6%, respectively. Our study can be supported by the findings of Minja and Machemba (1996) and other studies (Man *et al.*, 1985; Elango *et al.*, 1991; Hatcher *et al.*, 1995) with the prevalence rate varying between 8.6% and 28.2% in children of higher age group. These differences in the rate of cerumen impaction reflect differences in the prevalence and risk factors for developing cerumen impaction among different study settings.

More than two third of the study participants were in the age group of 11-15 years. This observation is in keeping with other studies which reported similar finding (Ologe *et al.*, 2005; McCarter *et al.*, 2007), but at variant with Kirfi *et al.* (2014) who found cerumen impaction was more prevalent among patients under nine years of age. We could not establish the reasons for the high rate of impacted cerumen in this age group. In our study, we found no association between the incidence of cerumen impaction and age. Other studies have reported a higher incidence of cerumen impaction in the elderly, in school-aged children and in patients with mental retardation (Olusanya *et al.*, 2000; Ologe *et al.*, 2005; Eziyi *et al.*, 2011).

In this study, male participants were more affected than females. The male preponderance in this study has been reported elsewhere (Kirfi *et al.*, 2014; Gabriel, 2015). We could not find in literature the reasons for this gender differences although it has been speculated that cerumen impaction is more common in males as the tragus or hair in the external auditory canal being larger and coarser that impair the natural dislodgement of cerumen.

The association between cerumen impaction in the ear canal and the use of cotton ear bud in paediatric age group was reported to occur mainly in the left ear (Sim, 1988). Mackenin *et al.* (1994) concluded that the use of ear bud might be associated with cerumen impaction. Cotton ear bud abuse was the most common predisposing factors identified in this study. Accumulation of excess cerumen may result from misguided attempts to remove cerumen with objects and also from the breakdown of the natural epithelial migration of the external auditory canal (Sim, 1988; Olusanya, 2003). Health education to discourage use of cotton buds alongside other objects in the ear is highly needed. The practice pushes the ear cerumen beyond the skin lined external auditory canal which subsequently gets retained and cannot be removed by the natural outward migration of the epithelium of the external auditory canal (Sim, 1988; Meyers, 1997; Olusanya, 2003). The danger of ear drum perforation, trauma to canal skin, infecting the external auditory canal amongst other health problems also remain a possibility if these wrong practices are not stopped.

Failure of the secreted cerumen to be expelled from the outer ear causes cerumen accumulation (Hatcher *et al.*, 1995). Ear cerumen is normally expelled by chewing movements of the jaw. The movement of the lower jaw aids in expelling the cerumen. So any dental pathology that interferes with chewing movements of the jaw causes cerumen accumulation (Fransman, 2006). Dental caries is common in children. In primary school children milk teeth falls and later there is eruption of permanent teeth. So these children will not be able to chew well (Adegbiyi *et al.*, 2014). Fransman (2006) has reported that there is a strong positive relationship between cerumen impaction

and absence of last molar tooth from his study. Therefore, children should be encouraged to chew well while eating foods.

In agreement with other studies done elsewhere (Adoga *et al.*, 2009; Eziyi *et al.*, 2011), our study found that bilateral ear impaction was commoner than either right or left ear affectation. Adegbiyi *et al* (2014) documented that unilateral cerumen impaction (75.1%) was more common than bilateral cerumen impaction. As reported in other studies (Adoga *et al.*, 2009; Eziyi *et al.*, 2011), more than half of participants in our study were asymptomatic and only few reported ear itching, hearing impairment, pain and tinnitus. The consequences of cerumen impaction includes complications such as otalgia, hearing impairment, tinnitus, vertigo, otitis externa apart from preventing the needed examination of the external auditory meatus and the tympanic membrane while audiologically, it affects audiometric test results or prevent testing. Studies from the developing world have documented impacted cerumen as the commonest ear disease or etiology of hearing impairment, with prevalence rates of 8.4% to 52.6% (Olusanya *et al*, 2004; Subha & Raman, 2006; Al-Khabori *et al.*, 2007). The impacted cerumen has also been shown to cause noticeable hearing problems in school children and this is a common finding in health surveys (Subha & Raman, 2006; Al-Khabori *et al.*, 2007; Eziyi *et al.*, 2011). Sharma *et al* (1992) and Jacob *et al* (1997) studies reported cerumen as the most common cause of hearing impairment, which accounted for 50.0% and 29.8% of cases respectively. Olusanya *et al* (2000) have reported impacted cerumen as the most common disorder in school children which has a significant association with hearing loss and school performance. Ear syringing is a common otorhinolaryngology procedure by which the external auditory canal is irrigated with saline at body temperature. Among various other options, ear syringing remains the first line procedure in management of cerumen impaction because it is safe, non-traumatic and effective (Ogunleye & Sogebi, 2005; Adoga *et al.*, 2009; Eziyi *et al.*, 2011). In this study, ear syringing was used to remove cerumen impaction and caused significant improvement in hearing thresholds.

In conclusion, this study demonstrated that cerumen impaction is a public health problem amongst primary school children in Mwanza City. The high prevalence of cerumen impaction in this region with its attendant problem of hearing impairment which can lead to poor school performance is a significant health problem. Ear bud usage was significantly associated with cerumen impaction. Ear syringing was the most common mode of treatment of our patients and caused significant improvement in hearing impairment. We therefore recommend continuing medical education and proper otological examination for children at school entrance and at regular interval for the early detection. Health education to improve the low level of awareness among parents and school authorities on the consequences of wax impaction should also be embarked upon.

Ethical consideration

Ethical approval to conduct the study was obtained from the CUHAS/BMC joint institutional ethic review committee before the commencement of the study. The permission to conduct the study was sought from Regional Administrative Secretary of Mwanza City as well as Nyamagana and Ilemela District Executive Directors. Permission was also obtained from respective primary school authority. Study participants were informed on the study purpose as well as rationale and that, participation was voluntary, hence parents/caretakers willing for their children to participate in the study signed in the consent form.

Conflict of interests: The authors declare no conflict of interests

References

- Adegbiji, W.A., Alabi, B.S., Olajuyin, O.A., Nwawolo, C. (2014) Earwax impaction: Symptoms, predisposing factors and perception among Nigerians. *Journal of family Medicine and Primary Care* 3, 379
- Adoga, A.A., Bakari, A.A., Kodiya, A.M., Ahmad, B.M. (2009) Cerumen auris: A survey of its management at the national ear care center, Kaduna, Nigeria. *Internet Journal of Otorhinolaryngology* 12, 1–5.
- Adhikari, P. (2009) Pattern of ear diseases in rural school children: Experiences of free health camps in Nepal. *International Journal of Pediatric Otorhinolaryngology* 73, 1278–80.
- Al-Khabori, M., Kumar, S., Khandekar, R. (2007) Magnitude of impacted earwax in Oman, its impact on hearing impairment and economic burden of earwax on health services. *Indian Journal of Medical Sciences* 61, 278.
- Crandell, C.C., Roeser, R.J. (1993) Incidence of excessive/impacted cerumen in individuals with mental retardation: A longitudinal investigation. *American Journal of Mental Retardation* 97, 568–74.
- Elango, S., Purohit, G.N., Hashim, M., Hilmi, R. (1991) Hearing loss and ear disorders in Malaysian school children. *International Journal of Pediatric Otorhinolaryngology* 22, 75–80.
- Eziyi, J., Amusa, Y., Nwawolo, C., Ezeanolue, B. (2011) Wax Impaction in Nigerian School Children. *East and Central African Journal of Surgery* 16, 40–5
- Fransman, D. (2006) Can removal of back teeth contribute to chronic earwax obstruction?. *British Journal of Learning Disabilities* 34, 36–41.
- Gabriel, O.T. (2015) Cerumen impaction: Challenges and management profile in a rural health facility. *Niger Medical Journal* 56, 390–393.
- Grossan, M. (1998) Cerumen removal—current challenges. *Ear, Nose & Throat Journal* 77, 541.
- Hatcher, J., Smith, A., Mackenzie, I., Thompson, S., Bal, I., Macharia, I., et al. (1995) A prevalence study of ear problems in school children in Kiambu district, Kenya. *International Journal of Pediatric Otorhinolaryngology* 33, 197–205.
- Holcomb, S.S. (2009) Get an earful of the new cerumen impaction guidelines. *Journal for Nurse Practitioners* 34, 14–9.
- Jacob, A., Rupa, V., Job, A., Joseph, A. (1997) Hearing impairment and otitis media in a rural primary school in South India. *International Journal of Paediatric Otorhinolaryngology* 39, 133–8.
- Kirfi, A.M., Mainasara, G.M., Sa'idu, A.T., Fufore, M.B., Joseph, Y. (2014) Cerumen auris in Abubakar Tafawa Balewa University teaching hospital Bauchi, North-eastern Nigeria. *Sudan Medical Monitor* 9, 75.
- Macknin, M.L., Talo, H., VanderBrug Medendorp, S. (1994) Effect of cotton-tipped swab use on earwax occlusion. *Clinical pediatrics* 33, 14–8.
- Mann, S.B., Bhardwaj, A., Gudi, S.P., Mehra, Y.N. (1985) Incidence of speech, hearing and ENT problems in school-going children. *Hearing Aid Journal* 2, 39–42.
- McCarter, D.F., Courtney, A.U., Pollart, S.M. (2007) Cerumen impaction. *American Family Physician* 75, 10.
- Meador, J.A. (1995) Cerumen impaction in the elderly. *Journal of Gerontology Nursing* 21, 43–5.
- Meyers, A. O. (1997) Managing cerumen impaction. *Postgraduate Medicine* 62, 207–9.
- Minja, B., Machelamba, A. (1996) Prevalence of otitis media, hearing impairment and cerumen impaction among school children in rural and urban Dar es Salaam, Tanzania. *International Journal of Paediatric Otorhinolaryngology* 37, 29–34

- Mushi, M.F., Mwalutende, A.E., Gilyoma, J.M., Chalya, P.L., Seni, J., Mirambo, M.M., Mshana, S.E. (2016) Predictors of disease complications and treatment outcome among patients with chronic suppurative otitis media attending a tertiary hospital, Mwanza Tanzania. *BMC Ear Nose and Throat Disorders* 16, 1
- Ogunleye, A.O., Sogebi, R.O. (2005) Otic foreign bodies in children in Ibadan, Nigeria. *Nigeria Journal of Surgical Research* 7, 305–8.
- Ogunleye, A.O., Awobem, A.A. (2004) Trends of ear syringing at Ibadan, Nigeria. *African Journal of Medicine and Medical Sciences* 33, 35-37
- Ologe, F.E., Segun-Busari, S., Abdulraheem, I.S., Afolabi, A.O. (2005) Ear diseases in elderly hospital patients in Nigeria. *The Journals of Gerontology Series A Biological Sciences and Medical Sciences* 60, 404–6.
- Olusanya, B.O., Okolo, A., Adeosun, A. (2004) Predictors of hearing loss in school entrants in a developing country. *Journal of Postgraduate Medicine* 50, 173.
- Olusanya, B.O. (2003) Hearing impairment in children with impacted cerumen. *Annals of Tropical Paediatrics* 23, 121-8.
- Olusanya, B.O., Okolo, A.A., Ijaluola, G.T. (2000) The hearing profile of Nigerian school children. *International Journal of Pediatric Otorhinolaryngology* 55, 173-9
- Roland, P.S., Smith, T.L., Schwartz, S.R., Rosenfeld, R.M., Ballachanda, B., Earll, J.M., et al. (2008) Clinical practice guideline: cerumen impaction. *Otolaryngology--Head and Neck Surgery* 139, S1-S21.
- Sharma, H., Bhusan, V., Dayal, D., Mishra, S.C. (1992) Preliminary study of hearing handicap in school-going children. *Indian Journal of Otolaryngology and Head Neck Surgery* 30, 119–24
- Sim, D.W. (1988) Wax plugs and cotton buds. *Journal of Laryngology and Otology* 102, 575–6.
- Subha, S.T., Raman, R. (2006) Role of impacted cerumen in hearing loss. *Ear, Nose & Throat Journal* 85, 650.
- Ulaganathan, M., Shalini, R. (2015) A descriptive study of prevalence of impacted wax and its predisposing factors in school children. *International Journal of Healthcare and Biomedical Research* 4, 136-143