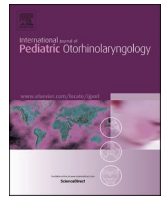




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# Maternal knowledge on infant hearing loss and acceptability of hearing aids as an intervention at a Referral Hospital in southwestern Uganda

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## ABSTRACT

**Objective:** Infant hearing screening enables early detection and management of hearing loss (HL) so that speech and language development delays are minimized. Parents play a critical role in successful screening and management of Infant Hearing loss (IHL) but there is limited data from resource limited settings on parental knowledge about HL and acceptability of IHL interventions. This study was aimed at exploring the maternal knowledge on the various causes of IHL and their acceptability of hearing aids as an intervention for IHL.

**Methods:** A cross-sectional study was conducted at a referral hospital in southwestern Uganda. A semi-structured questionnaire was used to interview postpartum mothers to assess their knowledge on causes of IHL and acceptability of a hearing aid if prescribed. Logistic regression was used to calculate odds ratio (OR) for the factors associated with hearing aid refusal.

**Results:** 401 mothers with a mean age of 25 years (Standard Deviation = 5.6 years) were recruited. Half of the mothers correctly identified at least five causes of IHL. The most well-known causes were measles (63.3%) and a positive family history of HL (61.6%). 60% of mothers held at least one superstitious belief as a cause of IHL. Majority of mothers (86%) would accept a hearing aid as an IHL intervention. Mothers with a positive family history of HL (OR = 0.42, p = 0.04), in middle or higher socioeconomic class (OR = 0.45, p = 0.01) and those with more than 3 antenatal visits in their recent pregnancy (OR = 0.44, p = 0.01) were less likely to refuse a hearing aid while mothers that were either widowed or separated from their spouses (OR = 15.64, p = 0.01) were more likely to refuse a hearing aid.

**Conclusion:** Although mothers had limited knowledge on some causes of IHL, there was a high acceptability of hearing aids as an intervention for IHL. Marital status, family history of hearing loss, socioeconomic status and antenatal care attendance are factors that could be used to identify mothers that might accept or refuse a hearing aid for their infant. There is need to increase awareness about causes of hearing loss to improve knowledge as well as dispel any non-biological beliefs held by communities.

## 1. Introduction

Hearing loss (HL) is a serious disability and globally, it affects and impacts a significant proportion of individuals within a wide age range, from newborns to the very old [1,2]. According to the World Health Organization (WHO), 34 million children have disabling hearing loss worldwide and of these, majority are from low and middle income countries (LMICs) [2]. Among these children, at least 75% of the established causes of the HL are preventable [1–3].

Parents play a critical role in the management of infant hearing loss

(IHL). Parental factors such as knowledge about IHL and beliefs in non-biological causes of IHL like bewitchment, curses, angry ancestors and evil spirits have been reported in LMICs [4–6] and these may influence acceptability of interventions for IHL such as hearing aids. However, there is paucity of information about parental awareness of the causes of IHL and this may have serious repercussions such as delayed or arrested speech and language development from neglect of IHL. This is particularly significant in developing countries where, despite the higher burden of hearing loss [1–3], there is limited access to hearing testing and hearing loss management services [2,7,8].

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In sub Saharan Africa, the few studies done show that while parents are more likely to identify measles [9], recurrent ear infections [4,9] and a family history of hearing loss [4,10] as causes of IHL, other causes such as jaundice [4,9], prematurity [4], and certain traditional medicines [4, 9] are less known among parents. More studies are needed to assess knowledge on IHL in these settings.

Globally, infant hearing screening is now recognized as a crucial service through which infants with hearing loss are identified early, and timely interventions are made in order to minimize or prevent language and speech development delays [2,11–15]. Among the different interventions available for infants with HL are hearing aids [2,16–18].

Despite recent technological advances in hearing rehabilitation, globally, only 17% of persons that could benefit from hearing aids actually use them [2] and it is further estimated that only 3% of the need for hearing aids in developing countries is met [2,7]. Although there is limited coverage of hearing aids in LMICs, it is not clear what proportion of parents would accept the intervention given potential constraints of limited knowledge and presence of certain cultural beliefs. Our study therefore was designed to explore maternal knowledge and awareness on the various causes of infant hearing loss, acceptability of hearing aids as an intervention for IHL and to identify the factors likely associated with refusal of a hearing aid among these mothers.

## 2. Materials and methods

### 2.1. Study design and setting

We conducted a cross-sectional study at Mbarara Regional Referral Hospital, a large tertiary referral hospital in southwestern Uganda that doubles as a regional referral hospital and a medical school teaching hospital. The hospital has a catchment population of approximately 4 million people and receives patients from several proximal and distant peri-urban health centers plus distant rural under-served areas in the region.

### 2.2. Inclusion and exclusion criteria

We recruited postpartum mothers of infants aged 1 day to 3 months of age, an age range within which infant hearing screening is recommended by the Joint Committee on Infant Hearing [15]. These mothers were recruited from the postnatal ward, the pediatric ward and those attending either the post-natal or pediatric out patients' clinics at the hospital. We excluded mothers that were too ill to take part in the study.

### 2.3. Study procedures

We enrolled mothers who were eligible using a systematic sampling approach. Our recruitment was based on the patient medical records at the wards and clinics. The medical records of the active patients in the hospital units are not stored in any particular order. We therefore assumed they were arranged randomly and recruited every 3rd mother from the daily stack of patient files in the respective wards and clinics. In the event a mother declined to participate in the study, the subsequent mother's file was considered. We collected data until the required sample size was achieved.

### 2.4. Data collection

We collected data using a semi-structured interview based questionnaire administered over a period of 9 months, between July 2018 and March 2019. The study tool utilized questions from the Udai Pareek questionnaire for assessment of socioeconomic status (SES) [19] which is considered ideal for assessing the SES of rural populations. This tool has a total of nine factors including level of education, employment, type of household and other items owned by the family. It excludes questions about income which may trigger negative emotions among some

respondents. Each response carries points used to compute a total score. The minimum possible score is 3 and the maximum is 49. The scores were graded into five categories as upper (more than 43 points), upper middle (33–42 points), middle 24 to 32 points, lower middle (13–23 points) or lower (less than 13 points) classes [19]. Mothers that had a first degree relative with hearing loss were considered to have a family history of hearing loss.

The tool used to assess maternal knowledge on IHL was adopted from a study by Govender and Khan in South Africa [4] and it comprises of questions on various known causes of infant hearing loss and possible cultural beliefs on HL held in communities. The respondents were required to answer either 'Yes', 'No' or 'I don't know' for each of the questions. A correctly identified response was scored 1, "and wrong responses were scored 0. Knowledge about angry ancestors and witch craft were reverse scored to fit the scoring. Given there were 13 items, the maximum score was 13 and the minimum score was 0. A score of more than 8 was considered as very good knowledge, 5 to 8 was good knowledge while less than 5 was considered poor knowledge.

An additional tool from Swanepoel et al. was adopted to assess maternal acceptability of hearing aids as an intervention for infant hearing loss [10], and this required 'yes' or 'no' answers when asked if they would allow a hearing aid for their infant.

### 2.5. Data analysis

Data were analyzed using STATA version 14.0. We used descriptive statistics to describe the maternal demographics such as age, SES and these were presented as frequencies. A Cronbach's alpha score was calculated to determine the internal consistency of the items in the questionnaire designed to assess maternal knowledge on causes of hearing loss. We obtained a score of 0.763, which was considered an acceptable level of internal consistency (a score above 0.7 is considered acceptable). Knowledge levels were reported as frequencies for poor, good and very good knowledge.

Hearing aid acceptability was calculated and presented as a frequency. The primary outcome for the logistic regression analysis was refusal of a hearing aid and the factors associated with hearing aid refusal were analyzed using bivariate analysis to generate crude odds ratios (cOR). The variables that were of statistical significance from the bivariate analysis ( $p < 0.05$ ) and variables with biological importance from literature were included in a multiple regression model. Multiple logistic regression analysis was used to calculate the adjusted odds ratios (aOR), and their 95% confidence intervals and p values for factors associated with refusal of a hearing aid. A level of significance of  $<0.05$  was used as the cut-off to determine the factors that were significantly associated with the primary outcome.

### 2.6. Human subject issues

The basic ethical principles were put into consideration in the design and conduct of this study. We received ethical approval from the Mbarara University of Science and Technology Research Ethics Committee (IRB no.05/04–18) before commencement of the study. All mothers who agreed to take part in the study provided a written informed consent while those mothers who declined to participate were informed of their rights to received routine care regardless of the decision not to participate in the study. We did not have any participants withdraw consent in the course of the study. Mothers aged less than 18 years were considered emancipated minors and enrolled based on the Uganda national research ethics guidelines. All interviews and tests were conducted privately in a quiet side room on the ward. Unique identifiers were used on the study tools to further ensure preservation of participant confidentiality.

**Table 1**  
Socio-demographic characteristics of the mothers in the study.

Characteristic	Frequency (N = 401) n (%)
Mean age in years (standard deviation)	25.8 (5.6)
Age (years)	
< 18	12 (3.0)
18–35	360 (89.8)
>35	29 (7.2)
HIV status	
Negative	363 (90.5)
Positive	38 (9.5)
Number of children	
≤4	351 (87.5)
>4	50 (12.5)
Marital status	
Single	25 (6.2)
Married	364 (90.8)
Separated or widowed	12 (3.0)
Family history of hearing loss	
No	297 (74.1)
Yes	104 (25.9)
Socioeconomic status	
Lower	0 (0.0)
Lower middle	133 (33.2)
Middle	241 (60.1)
Upper middle	27 (6.7)
Upper	0 (0.0)
Traditional medicine use	
No	146 (36.4)
Yes	255 (63.6)
Hypertension	
No	360 (89.8)
Yes	41 (10.2)
Diabetes	
No	398 (99.3)
Yes	3 (0.7)
Smokers	
No	393 (98.0)
Yes	8 (2.0)
Alcohol intake	
No	354 (88.3)
Yes	47 (11.7)

### 3. Results

#### 3.1. Socio-demographic and other characteristics

We enrolled a total of 401 post-partum mothers. The mean age of mothers was 25 years with a standard deviation of 5.6 years and almost 90% (360 of 401) were aged between 18 and 35 years. Majority of the mothers belonged to the middle socio-economic status level and 9.4%

**Table 2**  
Maternal knowledge on causes of infant hearing loss.

Knowledge questions	Responses (n = 401)		
	No n (%)	Yes n (%)	Don't know n (%)
A baby can be born with hearing loss	116 (28.9)	190 (47.4)	95 (23.7)
Hearing loss can be detected in a newborn baby	106 (26.4)	204 (50.9)	91 (22.7)
<b>Hearing loss in an infant can be caused by:</b>			
Family history of hearing loss	50 (12.5)	<b>247 (61.6)*</b>	104 (25.9)
Alcohol intake during pregnancy	68 (17.0)	144 (35.9)	189 (47.1)
Herbal medicine use during pregnancy	140 (34.9)	<b>98 (24.4)**</b>	163 (40.7)
Low birth weight	169 (42.1)	<b>113 (28.2)**</b>	119 (29.7)
Prematurity	82 (20.5)	209 (52.1)	110 (27.4)
Meningitis	27 (6.7)	239 (59.6)	135 (33.7)
Measles	52 (13.0)	<b>254 (63.3)*</b>	95 (23.7)
Neonatal Jaundice	108 (26.9)	<b>131 (32.7)**</b>	162 (40.4)
Ear abnormality	94 (23.4)	237 (59.1)	70 (17.5)
Ototoxic drugs	123 (30.7)	198 (49.4)	80 (19.9)
Delayed crying at birth	88 (22.0)	194 (48.4)	119 (29.6)
Angry ancestors	76 (18.9)	230 (57.4)	95 (23.7)
Witch craft	73 (18.2)	<b>242 (60.4)*</b>	86 (21.4)

\* high knowledge \*\*low knowledge.

(38 of 401) of mothers were HIV positive and receiving antiretroviral therapy (ART) as shown in Table 1.

More than 90% (364 of 401) of the mothers were married and majority (60.1% or 241 of 401) belonged to middle socio-economic class. Almost two thirds (63.6% or 255 of 401) of mothers reported herbal medicine use in the past pregnancy, and 25% (104 of 401) of mothers reported a history of hearing loss with in their family. Only 11.7% (47 of 401) and 2% (8 of 401) of mothers reported alcohol intake and tobacco smoking respectively.

#### 3.2. Maternal knowledge on causes of infant hearing loss

Only 47.4% (190 of 401) knew that a child can be born with HL and that this hearing loss can be detected at birth (50.9% or 204 of 401) as shown in Table 2. The most commonly known etiologies of IHL were measles (63.3% or 254 of 401), family history of hearing loss (61.6% or 247 of 401), meningitis (59.6% or 239 of 401) and presence of a visible congenital ear abnormality (59.1% or 237 of 401). On the other hand, the use of herbal medicines (24.4% or 98 of 401), low birth weight (28.2% or 113 of 401) and neonatal jaundice (32.7% or 131 of 401) were the least identified as possible etiological factors for IHL. About 60% of mothers held at least one superstitious belief as a cause of IHL with 60.4% (242 of 401) believing witchcraft and 57.4% (230 of 401) believing angry ancestors are a cause of hearing loss among infants.

Overall, 13% (52 of 401) of mothers had very good knowledge about causes of IHL, correctly identifying more than 8 of the 13 factors and approximately 50% (204 of 401) of mothers had good knowledge correctly identifying 5 to 8 of the 13 factors of the known causes of IHL as shown in Table 3. About 36.1% (145 of 401) of mothers had poor knowledge, only correctly identifying less than 5 causes.

#### 3.3. The maternal acceptability of hearing aids and factors associated with hearing aid refusal

Majority (86.3% or 346 of 401) of the mothers reported that they would accept a hearing aid as an intervention for IHL. We noted that

**Table 3**  
Level of knowledge of mothers about causes of Infant hearing loss.

Level of knowledge	Frequency (N = 401)
	N (%)
Poor Knowledge	145 (36.1)
Good knowledge	204 (50.9)
Very good knowledge	52 (13.0)

**Table 4**  
Logistic regression to show factors associated with refusal of hearing aids.

Variable	Would you refuse a hearing aid?		Crude odds ratio (cOR)		Adjusted Odds ratio (aOR)	
	No n(%)	Yes n(%)	cOR (95% CI)	p value	aOR (95% CI)	p value
<b>Mother's age in years</b>						
<18	10 (2.9)	2 (3.6)	1.0		1.0	
18–35	310 (89.6)	50 (90.9)	0.81 (0.17–3.79)	0.79	0.54 (0.10–3.05)	0.49
>35	26 (7.5)	3 (5.5)	0.58 (0.08–4.00)	0.58	0.43 (0.05–3.65)	0.44
<b>Marital status</b>						
Single	23 (6.7)	2 (3.6)	1.0		1.0	
Married	316 (91.3)	48 (87.3)	1.75(0.40–7.65)	0.46	2.87 (0.57–14.60)	0.20
Separated/widowed	7 (2.0)	5 (9.1)	8.21(1.29–52.0)	0.03	15.64 (2.04–119.80)	<b>0.01*</b>
<b>SES</b>						
Lower middle or less	107 (30.9)	26 (47.3)	1.0		1.0	
Middle or higher	239 (69.1)	29(57.2)	0.50(0.28–0.89)	0.02	0.45 (0.24–0.83)	0.01*
<b>HIV status</b>						
Negative	313 (90.5)	50 (90.9)	1.0	0.92	1.0	0.99
Positive	33 (9.5)	5 (9.1)	0.95 (0.35–2.54)		1.00 (0.36–2.79)	
<b>Family history of hearing loss</b>						
No	250 (72.3)	47 (85.5)	1.0	0.04	1.0	<b>0.04*</b>
Yes	96 (27.7)	8 (14.5)	0.44 (0.20–0.97)		0.42 (0.18–0.96)	
<b>Traditional medicine use</b>						
No	124 (35.8)	22 (40.0)	1.0	0.55	1.0	0.35
Yes	222 (64.2)	33 (60.0)	0.84(0.47–1.50)		0.75 (0.41–1.38)	
<b>Number of antenatal visits</b>						
≤3	128 (37.0)	29 (52.7)	1.0	0.03	1.0	<b>0.01*</b>
>3	218 (63.0)	26 (47.3)	0.53(0.30–0.93)		0.44 (0.24–0.81)	

\*- p value < 0.05, SES – socioeconomic status.

mothers who were either widowed or separated from their spouses had increased odds of refusing a hearing aid for their infant (aOR: 15.64, p value = 0.01) as shown in Table 4. On the other hand, mothers with a positive family history of hearing loss (aOR: 0.42, p value = 0.04), in middle or a higher socioeconomic class (aOR: 0.45, p value = 0.01) and those that had attended more than 3 antenatal visits in their last pregnancy (OR: 0.44, p: 0.01) were less likely to refuse a hearing aid for their infant as shown in Table 4. No association was found between age of the mother, HIV status or traditional medicine use and hearing aid refusal. We also found no significant association between level of knowledge about causes of hearing loss and hearing aid refusal.

#### 4. Discussion

Overall, mothers in this study had good knowledge on the possibility of infants having hearing loss at birth and the common causes of IHL. Similarly studies elsewhere in China [20] and in South Africa [10] have shown that maternal awareness of infant hearing loss and knowledge on its causes is high. While the reasons for the high levels of knowledge are not known, the finding is important as it provides an entry point for screening programs which will enable early identification of infants with hearing loss and timely intervention for such infants.

Our study showed there was a high awareness for measles as a possible cause of IHL and this finding has been demonstrated elsewhere in sub Saharan Africa such as in Nigeria where Olusanya et al. found 73% of mothers correctly identified measles as a cause of hearing loss [9]. Measles used to be a common childhood infection in Sub-Saharan Africa [21] and therefore mothers are familiar with the disease. Prior to widespread immunization and timely care [22], measles was a widespread infection and many communities were aware of the adversities of a measles infection such as hearing loss. In the same token, a study in China, a country where the prevalence of measles is lower [23], showed that there was low maternal awareness for measles with only 22.6% of mothers correctly identifying measles as a cause of hearing loss [20]. It is possible that in areas with a higher prevalence of measles, many mothers have either seen or heard of measles infection and may therefore be familiar with its complications like hearing loss. Although published literature has clearly shown that severe neonatal jaundice can cause infant hearing loss [24–26], neonatal jaundice was one of the least

known causes of IHL amongst mothers in this study. This lack of knowledge has been similarly demonstrated in several other studies, for example in China [20], Nigeria [27] and India [28] where neonatal jaundice was correctly identified by only 20%, 47% and 20% of parents respectively. We speculate that this low knowledge about jaundice may be due to the misconception in many rural communities that jaundice regardless of severity is normal in infancy.

The low maternal knowledge about some traditional medicines causing infant hearing loss demonstrated in our study is similar to reports from China [20] and Nigeria [27] where only 39.1% and 42% of mothers respectively, were aware of some traditional medicines that cause hearing loss. We suspect this low knowledge results from the popular cultural beliefs in the healing capabilities of these traditional medicines in many parts of Sub Saharan Africa where use of such drugs is commonly [29–31], many of these drugs are inappropriately used [32] and yet some of these medicines may cause hearing loss [33].

In addition, majority of mothers in our study held certain cultural beliefs about causality of hearing loss and these beliefs seem to be widespread as reported in other studies. For example, in South Africa, Govender and Khan reported 60% of mothers believed curses and bewitching can cause hearing loss [4] while in the Solomon Islands, 56% of mothers believed curses caused hearing loss [5]. In Saudi Arabia, Aljabri et al. also reported 46% of mothers believed curses cause IHL [34]. Although these traditional beliefs may often lead to poor acceptability of medical interventions, we did not observe this in our results as majority of mothers admitted that they would not refuse hearing aids despite the fact that a high percentage of participants that held these beliefs.

Our findings on the maternal acceptability of hearing aids as an intervention for IHL are very similar to reports from Nigeria [9] and India [6] where 84% and 92% of caretakers respectively, reported they would accept a hearing aid. However, it should be noted that this particular study in India only recruited grandmothers and not mothers. Locally in settings such as ours, mothers are the primary caregivers for their children and take on more responsibility for their well-being and healthcare and this may explain why high acceptability is reported in our study and related literature.

However, hearing aids are costly [35–37] and majority of people in resource limited settings will be unfamiliar with them. We hypothesized

that mothers in the higher socioeconomic group would be more familiar with them and also more likely to accept them. Our data confirmed that mothers in the higher SES were less likely to refuse a hearing aid. We believe this is because they are in a better position to understand the benefits of hearing aids, afford, operate and maintain them. We hypothesize that mothers in the lower SES categories may accept the hearing aids as an intervention if more information about their benefits is provided and if they are offered as a free service.

This study also found that mothers with a family history of hearing loss were less likely to refuse a hearing aid as an intervention for IHL. The possible explanation for this is that some of these mothers may have personally witnessed the limitations and social exclusion experienced by their relatives with hearing loss and thus would not refuse an intervention that can eliminate such limitations. The previous exposure to the health care system may also have helped to dispel some of the cultural myths that are associated with hearing loss and have potential to limit acceptability of interventions for hearing loss.

Some socio-demographic characteristics in our study provide insights into factors influencing refusal of hearing aids. Similar to our findings, previous studies comparable to ours have also shown that reduced support either through absence of a spouse such as through widowhood or separation [38], family [39] or other social support [40] increases the odds of hearing aid refusal. This lack of social support potentiates isolation and the absence of a trusted person to discuss treatment options may create fear and refusal of interventions. Although younger women have been reported to have more stigma towards hearing aid use than older women [41] and thus more likely to refuse hearing aids, our study showed no association between age of mothers and hearing aid refusal.

Our study has important strengths. It was conducted at a large referral hospital that serves both urban and rural communities making the results widely generalizable. Our study is one of the few that have examined the subject of knowledge of IHL and acceptability of related interventions in sub Saharan Africa and therefore provides a starting point to discuss programs for widespread screening and interventions for IHL. A key feature of hearing screening programs is the ability to identify persons with hearing loss, which enables timely referral of such persons for early intervention. For an infant hearing screening program, our data show that mothers may play a major role in the success of IHL intervention programs. However, a major weakness in our study is that paternal views on knowledge of IHL and acceptability of interventions were not obtained for this study yet in many African communities, fathers are the primary bread winners, serve as financial pillars of the home and influence critical decisions on when and where to seek health care. Future studies should consider including men in the survey. In addition, although this study was conducted at a large government hospital, majority of mothers were married and from a middle income category, features that may not be representative of the general population of mothers.

## 5. Conclusion

In conclusion, majority of mothers were knowledgeable about some of the common causes of IHL, although a significant number held traditional beliefs and myths about causation of IHL. The acceptability of hearing aids was generally high and mothers with a positive family history of hearing loss, higher number of antenatal care visits and those in the higher socioeconomic status were less likely to refuse a hearing aid while widowed or separated mothers were more likely to refuse a hearing aid as an intervention.

Antenatal care visits provide an opportunity for health care workers to introduce infant hearing screening programs. Since mothers play a central role in care of their children in many LMICs, there is still a need to increase awareness about hearing loss and its management among mothers, fathers and all other community members in order to dispel myths that may hinder hearing services.

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## Declaration of competing interest

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

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