Evaluating the outcomes of a hearing screening service for grade one learners in urban areas at Durban, South Africa

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Abstract

Early intervention through hearing screening can reduce the negative impact of hearing loss for children. Optimal outcomes are achieved when an appropriate screening protocol is selected, a pathway for follow up care is established, and when a hearing conservation component is included. This study aimed to describe the outcomes of a hearing screening service provided to grade one learners in urban areas at Durban. A cross-sectional design was employed. Learners (n=241) were conveniently sampled from six randomly selected schools. They were screened using otoscopy, tympanometry and pure tone audiometry. Fifty eight participants (24%) obtained a refer result, with 33% referred for diagnostic assessments, 29% for middle ear pathology and 38% for cerumen management. Findings further revealed that only 33% of referrals were followed up indicating poor compliance. Association between test results and income levels (P=0.38) as well as distance to the nearest health care facility (P=0.22) did not influence test outcomes. School aged children do present with common ear problems. Appropriate protocol selection, ensuring compliance to recommendations and education on hearing conservation are essential components of any health initiative.

Introduction

The prevalence of auditory dysfunction amongst children is a global concern.[1] The occurrence of hearing loss was noted to be greater in sub-Saharan Africa, with an estimated prevalence of 1.9% amongst children aged 5-14 years.[2] In South Africa, approximately 1.5 million children under the age of 15 years present with auditory pathology.[3] Monitoring of auditory function in this population is essential due to the negative consequences of ear related pathologies particularly on academic performance and on social and emotional development.[4,5] Prevalence of auditory pathology amongst school-aged children can be attributed to poorly managed pre and post natal complications and middle ear pathologies.[6-11] HIV/AIDS and tuberculosis also adds to the increased prevalence.[12-14]

Cerumen impaction is also common in this population with prevalence rates ranging from 7.4% to 63% in low socio-economic countries.[15,16] The above mentioned conditions could result in permanent hearing loss. Permanent hearing loss occurs in approximately 5.6% of children with a hearing impairment of greater than 30 dB hearing level (HL) in one or both ears.[17,18] The consequences are significant and can go undetected due to its subtle nature but can have adverse effects on speech and language development.[19,20]

School health programs can improve overall outcomes of the educational system and reduce common health challenges.[21,22] The South African government has prioritized child care in line with the Millennium Development Goal's (MDG), and to this effect, the Integrated School Health Programme was developed (ISHP) with the aim of identifying avoidable health problems.[23] Hearing screening which is defined as a process designed to separate those with auditory disorders, from those without, in a simple, safe, rapid and cost effective manner is part of the package of care.[24]

The Screening test battery outlined by the ISHP should consist of otoscopy, and pure tone screening at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz at an intensity of 20 dBHL.[25] According to the American Academy of Audiology (AAA),[26] tympanometry screening should be conducted on very young children (grade one and below). All learners who obtain a refer result for the pure tone screening at one or more frequencies should undergo an immediate rescreen. If a refer result on pure tone testing is still obtained then they should be immediately referred for diagnostic testing. Learners that obtain a refer result the tympanometry screening should be rescreened in a few weeks in order to allow any acute infections to clear up. Those that obtain refer results both tympanometry and pure tone audiometry should be followed up in eight to ten weeks. Should the rescreen present with the same result, then a referral must be made for diagnostic testing. Every hearing screening program must have an established referral pathway to ensure continuation of care.[26,27]

Hearing screening services in South African schools has been challenging.[28] A review of the ISHP with nurses in 2011 highlighted various challenges including lack of human and technical resources, lack of transport to schools and cost implications.[28,29] The high rate of false positives obtained during the screening test battery, aspects regarding rates of over referrals and loss to follow up are additional concerns.[29-31] Despite the challenges, there are many benefits to screening including obtaining prevalence data which can be used to direct services to areas that require it the most and can be used as evidence to motivate for government funding and support.[32] Hearing screening programs also facilitates the identification of risk factors of hearing loss which in turn can enhance timeous management by parents. However, such programs need to be carefully implemented, with measurable outcomes and ongoing evaluation. According to the Centre of Disease Control,[33] evaluation of the outcomes of health programs has been stated as important criteria for measuring its effectiveness, particularly in countries like South Africa, where funding and resources are limited. Measuring outcomes is beneficial to both health care providers as well as to the patient.[34-36]

The aim of the study was to describe the outcomes of a hearing screening service for grade 1 learners in urban areas at Durban, South Africa.

Objectives

Outcomes were determined by: i) describing the results of a hearing screening test battery conducted on grade one learners; ii) describing relationships between screening results and variables: distance to the nearest health facility and income levels; iii) describing participant experiences post the hearing screening service via a survey; iv) describing the percentage of follow up rates by parents.

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Materials and Methods

Research design and study sites

A cross-sectional design with quantitative method of analysis was employed. A descriptive survey design was employed for the third objective. There are a total of eight districts in the Durban region. Each district has approximately 12 public/ordinary schools; therefore, one school from each district was randomly sampled based on the lottery method by assigning unique numbers to each school per district and then drawing out one number from a box. This method allows for a better representation of the population under study.[37]

Sampling strategy and sample

Convenience sampling was applied. Learners that were present at school on the day of the initial visit were given information letters as well as letters of consent and assent. The sample size was calculated using Raosoft sample size calculator with a 5% margin error and confidence of 95%.[38] The representative population in Durban central was 22580 registered grade one learners for the year 2014. A minimum sample of 378 learners was required. However, an additional requirement for inclusion was that only learners that brought back their consent forms and who completed a letter of assent were included into the final study sample therefore a total of 562 were invited to participate. These included all grade one learners that were present on the day that information documents and consent as well as assent forms were issued out.

Data collection procedure

Once permission from relevant gatekeepers was obtained, grade one learners from the selected schools were given information letters to take home to their parents. Attached to the letter requesting consent from the parent, was a biographical and short health questionnaire that was to be completed on behalf of the child. The questionnaire was reviewed prior to screening in order to identify any risk factors for hearing loss. The questionnaire also requested information regarding distance from the home to the nearest health care facility, income level of the family, and parents were asked to record if there were any complications during birth and/or pregnancy, if the child had any chronic diseases and consumed any chronic medication, as well as if the child presented with any risk factors for hearing loss, which they were able to select from a list provided. Once a signed consent form was obtained, a letter of assent was issued to the learner. Instructions were given in a simple manner in the child's language of preference. Audiometric screening was conducted in a quiet room with low ambient noise by four final year audiology students. Learners were screened using otoscopy, tympanometry and pure tone audiometry.[26,27] Screening was conducted using a hand held otoscope as well as a calibrated GSI pure tone screener and tympanometer. Pass and fail criteria was determined according to ISHP guidelines.[26,27] A standardized screening data record form was used to record participant results. Learners presenting with a refer result on pure tone audiometry; possible middle ear pathology and impacted cerumen were appropriately referred. All parents received a copy of the results together with recommendations and letters of referrals. Instructions were given in the child's first language. The hearing screening concluded by issuing all learners with information pamphlets and thereafter, all learners viewed a short power-point presentation regarding ear and hearing care. Parents of children that obtained a refer result were contacted telephonically three weeks after the screening program in order to determine if follow up was completed or at least initiated.

Data analysis

Results obtained for the screening test battery was tallied for otoscopy, tympanometry and pure tone audiometric screening at 500 Hz, 1000 Hz and 2000 Hz and 4000 Hz.[25-27] Data was analyzed descriptively through frequency and percentage counts. The fishers exact was conducted in order to ascertain the association between the test results and variables including distance from home to the nearest health care facility and income levels. The level of significance was set at 5%.

Ethical considerations

Ethics approval was obtained from the School of Health Sciences Research Ethics Committee of the University of Kwazulu-Natal (clearance certificate number: SHSEC 033/14). Permission to conduct the study was obtained from the South African Department of Basic Education as well as the principles at the various schools. Parents were given information documents and a consent form to complete two weeks before the screening program commenced and letters of assent was also completed with learners. Learners were informed of their right to withdraw at any change of the study. Participants were informed of the testing procedure, which was facilitated through the use of pictures. Confidentiality was maintained by replacing participant names with research codes.

Results

Of the eight schools (one per district) that were contacted, six granted permission. A total of 562 learners were given information letters and consent forms based on their availability and school schedule at the time. It must also be noted that the study was conducted in the last two weeks before the term break, therefore, attendance was poor. Parental consent and learner assent was obtained from a total of 241 learners, yielding a response rate of 43%.

Objective one

Fifty eight participants (24%) obtained a refer result, with 33% (n=19) referred for diagnostic assessments, 29% (n=17) for middle ear pathology due to abnormal tympanometry results and 38% (n=22) for cerumen management. Figure 1 displays the reasons for referrals.

Objective two

A comparison of pass and referred results was made to two variables namely income and distance from the nearest health care facility.

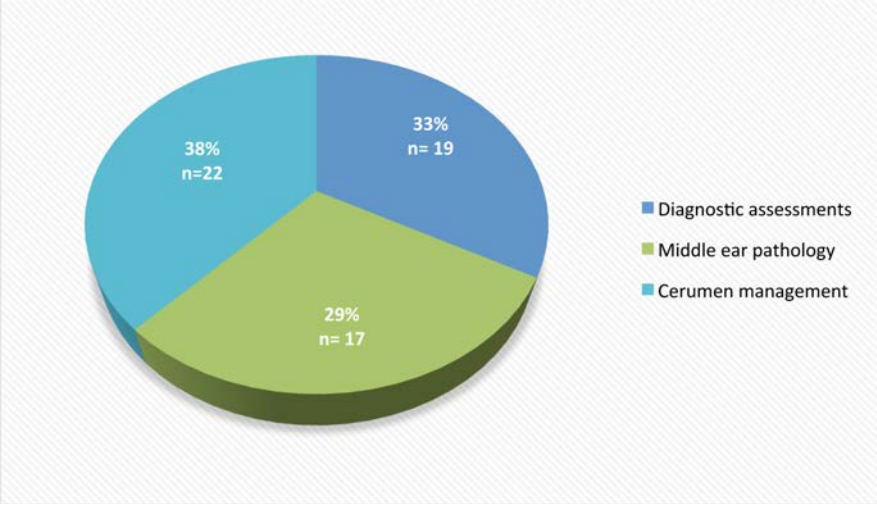

Figure 1. Reasons for referrals.

Parents were asked to describe their monthly household income by selecting a bracket of earnings with the lowest being R1000. The minimum amount was correlated to the South African care dependency grant, which is just over a R1000. The results revealed that 43% (n=25) of the referred group had a household income that was greater than R1000 per month and 31% (n=18) relying on a state grant. The remaining 26% (n=15) were either unemployed or received an income of less than R1000 a month (Figure 2). Comparative statistics revealed that income level did not influence the pass or refer result (P=0.38). Almost 60% of the referred sample traveled less than 15-30 minutes to get to the nearest clinic and only 5% reported they travel more than an hour to get to the nearest clinic. Distance to the nearest health care facility was correlated to the pass/fail results revealing that distance did not influence results (P=0.22).

Objective three

Three simple questions were asked to determine the percentage of learners who previously underwent a hearing screening either at school or at doctor's rooms, to determine if the instructions given by the audiologist were substantial for the learners to make an informed choice and reveal reliable responses and the last question probed into knowledge gained during the hearing and ear care component of the service. Results revealed that of the total number of learners that participated in the study (n=214) only 5% (n=10) had previous hearing screening conducted, 100% (n=241) were aware of what was expected of them and all learners indicated that they gained knowledge regarding their hearing and ear care.

Objective four

Attempts were made to contact the parents of all children that were referred. Contact was attempted telephonically or via email three weeks after the screening service. Only 64% (n=37) were successfully contacted. Of the 64%, only 32% (n=12) of parents adhered to the recommendations made in the referral letter for further management, whilst others stated that they will follow up but indicated no urgency in doing so. No information on the diagnosis could be obtained from the parents, either because they didn't have the reports with them at the time that contact was made or that they were required to attend follow up visits to the health professional for confirmation of the diagnosis.

Discussion

Early detection of auditory pathology can improve overall health outcomes for a child.[39-41] Prieve *et al*.[42] conducted a systematic review on the diagnostic accuracy of hearing screening instruments for preschool and school-aged children. The findings of the study revealed that pure-tone audiometry screening has a high sensitivity and is considered the preferred tool when compared to other tests such as otoaccoustic emissions. According to the ISHP, AAA and ASHA guidelines,[26-28] otoscopy and pure tone audiometry are the minimum requirements with a recommendation to include tympanometry for younger children. Whilst the goal of any hearing screening service is to ensure a high rate of true predictive values, high ambient noise levels, distractibility and fatigue may contribute to false positives, particularly for results within the low frequency range during air conduction testing.[43] However literature indicates that false positives are reduced in school hearing screening program when compared to new-born hearing screening programs due to the age of the child.[43-45] The findings of the present study indicated that the test battery was able to identify possible pathology and although specificity could not be measured, the inclusion of tympanometry testing was a valuable component of the screening protocol as 29% of children were referred based on abnormal tympanometry results. This inclusion could have improved sensitivity of the screening test battery.

It is important that the protocol is sensitive in identifying mild hearing loss. The present study adhered to the protocol outlined by the ISHP,[26] and used a 20 dB HL intensity level which is sensitive in identifying those with mild and unilateral hearing losses.[46]

Seely *et al*.[47] states that a high prevalence of hearing loss amongst children in lower socio-economic countries are due to factors such as chronic untreated or unrecognized ear infections as well as undetected hearing loss due to pre and post-natal complications during infancy. Therefore, the utilization of pretest health questionnaires is beneficial in identifying at risk children, especially in developing contexts where the burden of disease is high. Almost 90% of infants born with hearing loss reside in developing countries,[48] primarily due to lack of new-born hearing screening programs. Many of these children go undetected for years until displaying academic difficulties in the classroom. Similar hearing screening programs in developing countries as to the one conducted in the present study revealed a high prevalence of hearing loss amongst school aged children. Prevalence rates of hearing loss amongst school aged children ranged from 6.7 to 8.9% in Nigeria,[49] and prevalence of hearing loss amongst children in Kenya, Zimbabwe and El-Kom District in Egypt of hearing loss greater than 30 dBHL in one or both ears is stated to be approximately 5.6%, 2.4% and 20.9% respectively.[50-52] School based hearing screening conducted in South rural India obtained a prevalence of 11.9%.[53] There are therefore, beneficial outcomes related to the implementation of school based hearing screening programs.

Middle ear pathology continues to remain a concern as a common risk factor of hearing loss in this population. In a study conducted to determine predictors of hearing loss in a developing country, seven factors were found to be associated with hearing loss, and of these, six were related to middle ear pathology.[54] Olusanya states that otitis media is considered to be the most common cause of childhood hearing loss in developing countries.[54] Various studies conducted in Malaysia, India, Turkey, Bangladesh Swaziland Egypt and Nigeria reported high prevalence rates of otitis media (OM) particularly OM with effusion (OME).[54-60] The key risk factors for OME were

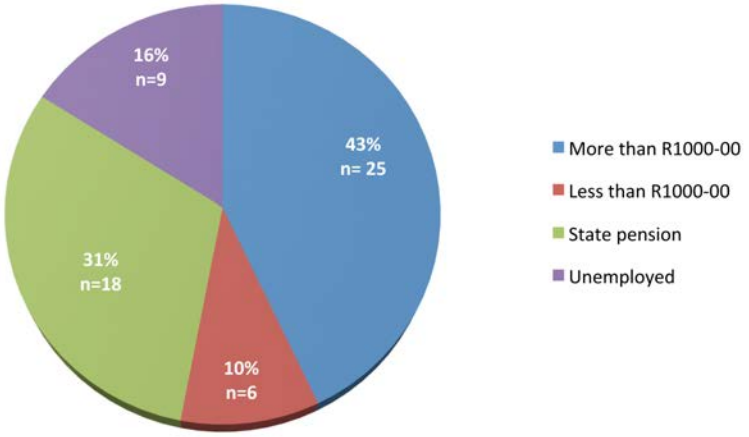

Figure 2. Description off household income.

identified to be poor hygiene, poor nutrition, poor housing conditions, viral/bacterial infection and upper respiratory allergy.[61] These risk factors are common in developing countries like South Africa.

Impacted cerumen is one of the most common pathologies identified during school hearing programmes.[5,52,53,62] Impacted cerumen was also the most commonly occurring pathology in the present study. Cerumen needs to be monitored as it impacts on hearing ability.[62-64] It has been suggested that excessive/impacted cerumen could be a related to anatomical changes, genetics and ear cleaning practices.[65] Due to the high prevalence of impacted cerumen in developing countries, detection of children with this condition through hearing screening programs will lead to favorable outcomes.

Research findings have shown that there is a relationship between health status of an individual and socio-economic conditions.[66] Findings of the present study did not show a relationship between socio-economic factors (distance from a health care facility and income levels), however, a review of literature conducted by Kaplan and Keil revealed that poor socioeconomic conditions which was measured by education, occupation and income was associated with high prevalence of diseases.[66] Poor health conditions are related to historic inequalities and ineffectiveness of health programs and lack of education.[67,68] Almost a third (37%) of South Africa's children lives too far from the primary health care facility to access care.[69] In a study conducted by Siddartha *et al*.[70] otitis media had a higher prevalence in children of the lower class schools and less in that of the upper class. The reasons were attributed to poor hygiene standards, overcrowding and most importantly poor nutritional status of these children. According to Adoga,[71] in developing countries, ear infections and deafness are usually neglected due to insufficient funds, work force and facilities. The findings of the present study did not find a significant association between income levels or distance to the nearest health care facility when compared to pass and referred groups; however, the schools that participated in the study were situated in urban areas. Olusanya states that such associations are usually seen in rural areas.[54] Health care facilities are better resourced in urban areas with specialization of services concentrated in pockets around more affluent areas of Africa.[72] In a study conducted by Shaheen *et al*.[73] it was stated that an improvement of socio-demographic status can prevent vulnerable children from developing chronic otitis media. The researchers concluded that it is important to consider the background of the individual when treating children as environmental, social and financial factors can affect their health and overall outcomes. The present study has potential to be replicated in rural areas with more careful consideration for social and financial factors.

Participant's experiences can have an influence on the outcome of a test procedure as well as their view on future procedures. There are various considerations that need to be adhered to in order to enhance participant's experiences. These include the method and language of instruction. It has been recommended by Wolthers that the content, the language, and the mode of communication should be adapted to assist the child to make an independent decision.[74] The present study ensured that the content and language of the instructions as well as the post-test questionnaire was simple to understand and user friendly. This resulted in all participants indicating that they understood and enjoyed the hearing screening service. It is important that in addition to consent from parents, assent should be obtained from the child so that he/she does not feel removed from the decision making process. According to Kost, Lee, Yessis, Wesley, Henderson, Coller,[75] participants would be more inclined to participate if they understand what is being done. This in turn would also create awareness and the participant would be more compliant regarding follow-up. The use of simple instructions provided in the learner's first language was beneficial to the program as Wolthers state that self-confidence and self-esteem is established when a participant is clear as to the task.[74] The use of pictures to facilitate communication and instruction giving proved beneficial in the current study.

The prescreening survey revealed that only 5% of children had a hearing screening upon school entry. This information was confirmed in the health survey completed by the parents. The ISHP states that all grade one learners should be screened upon entering school.[23] According to Swanepoel *et al*.[76] South Africa presents with low hearing screening rates. Frequency of screening of hearing and other health condition is generally poor within the African context. Effort needs to be made to improve such primary health care services. Such services will lead to an increase in awareness of signs and symptoms of hearing loss. Poor follow up rates that were obtained in this study indicated a fundamental weakness in the hearing screening service. According to Baroch,[77] screening is only the initial step of care for children with a hearing impairment and compliance with follow up testing requires improvement. Screening programs should endeavor to make sure that parents fully understand the importance of following up referrals. Poor follow up rates relating to various health screening programs were attributed to demographical factors, patient's knowledge of health conditions, lack of accessibility, cost and income, social support, inability to miss work and the severity of disease.[78] In a study that explored socioeconomic conditions and poor follow-up rates of parents with infants exposed to HIV, financial factors such as unemployment and dependency on grants were cited as reasons for poor follow up by more than 50% of parents.[79] These factors are more common in sub Saharan Africa, where resources are strained. Understanding these challenges are paramount to improving follow up rates as Cloete states that the primary reason for unsuccessful screening programs is the lack of consideration for the context.[21] Jin *et al*.[78] states that further studies should be conducted to evaluate and address the issue of non-compliance as it is a continually pressing problem, especially in developing countries.

The program concluded with a health promotion and education presentation. According to Elemraid,[80] little awareness of health care professionals, poor knowledge regarding early detection of hearing loss as well as lack of guidelines regarding monitoring and surveillance are key issues that need to be addressed

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Conclusions

School aged children do present with common ear problems namely cerumen impaction, middle ear pathologies and possible hearing loss. School based hearing screening services are beneficial in the early identification of auditory pathology. Findings of the study indicated overall positive outcomes regarding the identification of auditory pathology. Poor outcomes were obtained regarding follow up rates. In order to improve the outcomes of hearing screening services, the context and socio-economic profile of the population should be considered, ensuring that follow-up services and provision of intervention is feasible, realistic and achievable.

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