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HEARING SCREENING IN A GROUP OF PAEDIATRIC PATIENTS ATTENDING AN HIV/AIDS CLINIC: A PILOT STUDY

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Abstract

The aim of this investigation is to screen hearing function in a group of paediatric patients attending a HIV/AIDS clinic at a hospital in Gauteng, South Africa. There is a dearth of published research in this area, particularly from developing countries. A total of 62 paediatric patients attending a virology clinic at a teaching hospital in Johannesburg participated in the study. The sample included both males and females from ages 18 months to 6 years. An exploratory descriptive, non-experimental and observational design with no control group and non-randomization of participants was used. The participants' age and medical history were the independent variables, while the audiological tests (otoscopy, tympanometry & otoacoustic emissions) were the dependant variables. Audiological measures that included case history and medical record reviews, otoscopic examination, immittance, as well as otoacoustic emissions testing were conducted on participants. After completing the test measures, each participant was classified as having either pass or refer screening findings. A closer descriptive analysis was then conducted of the participants who presented with refer findings. Both qualitative and quantitative analysis of the data was performed. The estimated prevalence of abnormal hearing screening results among the participants assessed was found to be 26% in the current study. These findings were found at the various stages of the disease, and the symmetry, estimated type and degree of the auditory dysfunction was variable. Furthermore, otitis media was found to be prevalent in 23% of participants and was the most prevalent possible cause of hearing loss in the sample evaluated. These findings highlight the need for audiologists and otolaryngologists' involvement in the assessment and management of this population.

Key words: HIV/AIDS; otitis media; hearing screening, paediatric, otoacoustic emissions

Introduction

The Human Immunodeficiency Virus (HIV) and the acquired immune deficiency syndrome (AIDS) have created challenges in patient care and management throughout the world. The general manifestations of the disease as well as its treatment, alongside the side effects of the treatments, have been widely studied and reported. However, reports on the auditory manifestations of this disease have been limited, and this paucity of literature is particularly true in paediatric patients. Literature that is available on auditory symptoms in the paediatric population is based on case reports and none of the literature is from developing countries such as those in Southern Africa where the disease is at its highest prevalence (Posel et al., 2007), hence the current study. Investigating the auditory function in a group of paediatric patients attending a HIV/AIDS clinic will afford clinicians with the ability to more efficaciously evaluate and treat these patients if the auditory presentation has been well described. An additional acquisition of research data that is relevant to the context will enhance the clinicians' ability to employ evidence based practice in their case assessment and management.

In South Africa, the first few cases of HIV and AIDS were identified in the late 1980s (Department of Health South Africa, 2006) – considerably later than in the United States. Significant progress has been made in

the past two decades in learning about the onset and development of the HIV/AIDS disease process worldwide. Specific to South Africa, progress seem to have been made in public awareness campaigns regarding the disease, and in allaying the concerns of the general public with regard to the virus. Expenditure on HIV and AIDS activities seems to have increased substantially over the past few years when one compares the budget allocated to these activities on a yearly basis. The availability and provision of antiretroviral therapy in accredited public health facilities in South Africa commenced in the first quarter of 2004 as part of the Plan for Comprehensive HIV and AIDS Care, Management and Treatment for South Africa [Department of Health, South Africa (2006]. However, much still needs to be done to dispel the many myths surrounding HIV/AIDS, as well as in terms of the provision and administration of antiretroviral drugs to slow down the course of HIV/AIDS in the majority of the South African infected population (Posel et al., 2007). To this end, much still needs to be done in researching the presentation of the disease itself as well as its response to medication within this developing country context.

It has been reported that 29.1% of all pregnant women living in South Africa have HIV (South African Department of Health, 2006). Transmission of the virus from mother to child can occur during pregnancy, labour and delivery, or during breastfeeding (Noble and Kanabus, 2006). Without treatment, it is postulated that around 15-30% of babies born to HIV positive women could become infected with HIV during pregnancy and delivery and a further 5-20% could become infected through breastfeeding (Noble and Kanabus, 2006). Although a baby is most likely to contract the virus through mother-to-child transmission, there are various other modes of transmission. These modes of transmission, although most largely seen in the adult population, include infection through unprotected sexual intercourse, sharing of contaminated needles or transfusion of contaminated blood (WHO, 2007).

The signs and symptoms that an individual who is infected may present with seem unique to each individual, however, the most prevalent signs and symptoms in the paediatric population are abnormal loss of weight or slow weight gain as well as a slow rate of growth and a delay in significant milestones such as language development (Wolters et al., 1995). Other signs and symptoms include dehydration, diarrhoea, fever and seizures (WHO, 2007; WHO, 2006), and the presentation of these signs and symptoms are correlated with the stage of the disease (WHO, 2006). There are four stages of HIV/AIDS in children as classified by the World Health Organization; with the first stage (stage 1 - asymptomatic stage) being when the child is still healthy and has a CD4+ blood count of greater than 500 cells/mm³ (WHO, 2006), while the second and third stages, with CD4+ blood count between 200-499 cells/mm³, are known as the mildly and moderately symptomatic stages, respectively. The last stage (stage 4) is a severely symptomatic stage where the virus has evolved to full-blown AIDS, indicated by a CD4+ blood count of less than 200 cells/mm³ (Bankaitis, 1996; WHO, 2006).

Throughout each of these progressive stages there are varied manifestations of the HIV infection specific to the paediatric population, with auditory manifestations being one of these presentations. Because the infant has not yet been exposed to infectious agents that lie dormant within the body and arise when the immune system becomes compromised, HIV/AIDS manifestations in the paediatric population tend to be those of opportunistic infections, with the three most commonly reported infections being Pneumocystis Carinii Pneumonia (PCP), oral and oesophageal candidiasis, and Mycobacterium Avium Complex (Klatt,, 2007). HIV may also lead to an increased risk of bacterial infections, and failure to thrive (which may include low birth weight, growth retardation and delayed developmental milestones) in the paediatric population. Neurologic diseases such as encephalopathy may also manifest as well as Cerebral Vascular Accidents (Larsen,1998); and some of these presentations underlie communication disorders.

HIV/AIDS manifestations underlying communication disorders may be in the form of neurologic manifestations, including that of opportunistic infections that attack the central nervous system, or that of ear, nose and throat manifestations (Larsen,1998). The ear, nose and throat manifestations may include middle ear pathologies, hearing loss as well as viral and fungal infections found in the ear, nose, throat and mouth (Larsen,1998). Such opportunistic infections may cause repeated middle ear infections and ultimately hearing loss (Chandrasekhar et al., 2000). It is also the effect of the HIV on the inner ear as well as neurological infection that may add to the increased risk of poor audiological function (Chandrasekhar et al., 2000).

Research has shown that audiological presentation of adult patients with HIV/AIDS is consistent with their HIV/AIDS status (Khoza and Ross, 2002). The same authors also assert that opportunistic infections increase the risk of audiological sequelae. If these findings are also true for children, there may be a noticeable increase in communication developmental delays in these children. Should the child have a hearing impairment, then not only are developmental delays a concern, but also the quality of life of that child may be compromised in as far as their general health, physical functioning, symptoms, psychological well-being, and social and role functioning is concerned. It is for this reason that the hearing function of the HIV/AIDS infected paediatric patients needs to be screened and possible intervention implemented. The focus, therefore, shifts onto the non-life threatening problems associated with the virus (Chandrasekhar et al., 2000). This shift in the view of treatment of HIV and its' associated problems is no longer a view of one dying from AIDS but rather one of living with HIV. It is due to this more recent view that quality of life becomes a concern where the most important aspect of treatment would be to preserve a patient's physical well being (Ross and Deverell, 2004).

The reality that HIV treatment is dependent on long term use of medications causes ototoxicity to be a potential contributing factor for audiological changes (Bankaitis and Keith, 1998). There has been research on the effects of antiretroviral therapy in adults however less so on children (Christensen et al., 1998). These authors examined the audiological findings in a child that had been on antiretroviral therapy for more than a year and this case report revealed a high frequency hearing loss that the authors suggested may have been attributable to the antiretroviral drugs (Christensen et al., 1998). These authors do not, however, state whether this child's hearing had been screened at birth and if the mother was on antiretroviral therapy during pregnancy. Langhendries, Battisti, Bertrand and François (1998) also highlighted the fact that the various medications prescribed to the paediatric patients, even within the recommended dosage, may be ototoxic. These researchers also reinforce how important hearing screening is in infants infected with HIV so as to plan intervention for prevention of communication disorders, which highlights once more the importance of this study.

Method

Aim of the study

The main aim of the current study was to explore the audiological function in a group of paediatric patients attending an HIV/AIDS clinic at a teaching hospital in Johannesburg, Gauteng. There were four specific sub-aims to the study:

1. To determine the prevalence of audiological dysfunction represented by refer screening results within this population
2. To estimate the type, degree and symmetry of the audiological dysfunction
3. To establish the prevalence of otitis media within this group of patients, and lastly
4. To determine if there is a relationship between the hearing screening findings and medical histories obtained.

Research design

As an extensive literature search yielded a paucity of both South African and internationally published data on this topic, the current study adopted a descriptive cross-sectional research design that was exploratory, non-experimental and observational in nature with no control group and non-randomization of participants (Devore, 1999; Schiavetti and Metz, 2006). The participants' ages and medical histories were the independent variables, while the audiological tests (otoscopy, immittance and otoacoustic emissions) were the dependant variables (Schiavetti and Metz, 2006).

Participants

Participant Selection Criteria

The participant selection criteria included the following:

- Participants' HIV/AIDS status had to have been confirmed by serology studies, as the study was aimed at patients infected with HIV/AIDS.
- Participants needed to have been between the ages of 18 months and 6 years as the study was focusing on the paediatric population.
- Participants should not have a congenital hearing impairment (based on medical histories of risk factors associated with hearing loss) or any hearing conditions attributed to any complications during pregnancy or birth.

Sampling Procedure

A nonprobability convenience sampling technique was utilized in the current study since the study was restricted to a part of the population that was readily available (Schiavetti and Metz, 2006). It is acknowledged that generalization of the findings from the current study is influenced by the nature of the sampling technique adopted in that participants were only recruited from one facility. Caregivers of the participants volunteered to participate in the study by having their children undergo a hearing screening evaluation following referrals by doctors at the virology clinic. A verbal explanation of the purpose of the study and what the testing procedures entailed was provided by the researcher before testing commenced. Written information letters were also provided to ensure informed consent.

Participant Description

An initial sample size of 70 participants was recruited; however, eight participants were omitted from the study due to difficulties encountered during testing, including problems attaining the seal of the probe for OAE testing and uncooperative participant behaviour at the time of testing. Therefore, a total of 62 paediatric patients participated in the current study. They ranged from ages 18 months to 6 years with a mean age of 3.3 years. The sample included both males and females.

Testing procedures and materials

Following infection control measures proposed by Kemp and Roeser (1998, all testing was conducted in a quiet room at the virology clinic. The noise levels in the room used were kept sufficiently low and constant and were monitored through the use of a sound level meter to ensure minimal interference with testing. A detailed case history was obtained as an initial step for each participant. This case review was then followed by otoscopic examination (where a Welch Allyn otoscope and its accessories was used) and immittance (through the use of Inter-acoustic AZ26 audiotympanometer and its accessories). Lastly, otoacoustic emisions (OAEs) in the form of Distortion Product OAEs and Transient Evoked OAEs were performed on each participant. For OAEs, a Biologic Scout Otoacoustic emissions meter was used. All equipment used had been recently calibrated and biologic calibrations were performed prior to every testing session.

Case history form

To enhance the reliability of the information obtained from case history collection, self-reports were kept to a minimum by relying more on medical record reviews than on participants caregivers' reports. The researchers therefore obtained some of the information (specifically demographic information, family history of hearing loss, and history and presence of auditory symptomatology) through an interview with the caregivers. The rest of the information was obtained from participants' medical records. The case history form consisted of the following:

- Demographic Information: To determine the nature of the sample, information was obtained regarding the participants' age, gender, and schooling.
- Medical History: Areas that were examined within medical history included:
  - Problems during pregnancy and birth that may have contributed to the onset of hearing loss (Diefendorf, 2002).
  - Antiretroviral use by the mother during pregnancy as it has been reported that various antiretroviral drugs may be ototoxic and may result in hearing loss (Christensen et al., 1998).
  - Risk factors for hearing loss: family history of childhood sensorineural hearing loss, complications at birth such as very low birth weight, an Apgar score of less than 3 at 5 minutes and prolonged ventilation, etc are all risk factors for hearing loss (Diefendorf, 2002).
  - Childhood illnesses such as bacterial meningitis as such illnesses are known to be associated with sensorineural hearing loss (Dodds et al., 1997; Diefendorf, 2002; Asadi-Pooya et al., 2008).
  - Medical signs and symptoms associated with hearing loss were then explored including otorrhea, otalgia and trauma to the ear as these indicators place an infant or child at risk for progressive or delayed onset sensorineural and/or conductive hearing loss.
  - The names of antiretroviral drugs that the child was taking at the time of the study including dosage and the period of consumption as research has shown that prolonged use of various ototoxic drugs may result in hearing loss (Christensen et al., 1998).
  - CD4+ blood count at the time of audiological testing so as to determine if the occurrence of refer screening findings had any relationship with the patients' immunologic status, (i.e. the CDC categories - asymptomatic, symptomatic and full-blown AIDS stage).
  - Speech and motor development milestones: delayed milestones may indicate presence of conditions such as neurological conditions which may place the child at risk for communication impairments.

Otoscopic examination

Otoscopic examination was performed before other testing to assess the condition of the outer ear and the status of the tympanic membrane, as well as to rule out any signs of trauma or infection and to eliminate the possibility of obstruction or collapse of the walls of the external auditory canal (Rappaport and Provençal, 2002).

Immittance screening

Immittance screening was conducted to establish the middle ear status of the child as middle ear function has significant impact on OAE testing (Fowler et al., 2002). This measure was also done because one of the aims of the current study was to determine prevalence of middle ear pathology. A standard single frequency tympanometry using an 85dB SPL tone set at 226Hz with a broad band noise ipsilateral acoustic reflex was performed on each participant. The tympanogram results were analyzed according to the documented Jerger system with the type A regarded and reported as normal and all other types (A_s, A_d, B, C, D) as abnormal; with present reflexes at 95dBHL taken as indicating normal middle ear function (Fowler et al., 2002; Harris et al., 2005).

Otoacoustic emissions

All participants with normal middle ear functioning (type A tympanograms with normal reflexes) underwent OAE testing. Distortion product otoacoustic emissions (DPOAEs) and transient evoked otoacoustic emissions (TEOAEs) were used to ensure comprehensive testing of all frequencies. DPOAE is an alternative to TEOAE, with its major advantage being its ability to detect emissions at frequencies over 5kHz, frequencies often minimally affected by noise which is often a variable to consider during paediatric hearing screening. Although this is sometimes not considered critical for newborn hearing screening (Olusanya et al., 2004) testing of the high frequencies may also be important in ototoxicity monitoring in high-risk neonates, such as the case in the current study. The use of DPOAEs with high-frequency stimuli appears to be more sensitive to cochlear dysfunction than TEOAEs (Hall, 2000). In addition, because outer hair cells are vulnerable to insults causing sensory hearing loss, DPOAEs are useful measures of peripheral sensory hearing loss (Prieve, 2002). According to Prieve (2002) they are able to accurately identify auditory status for middle and high frequencies. In the current study, these two measures were also used in an attempt to estimate the degree of hearing loss, only to the moderate ranges, which the patients presented with (Prieve, 2002; Wrightson, 2007).

Although differing pass/refer criteria may affect referral rates (Swanepoel et al., 2006; Swanepoel et al., 2007; Hatzopoulos et al., 2007], for the purposes of this study, pass/refer criteria was assessed using 2 to 8 kHz, requiring a bilateral pass result at, at least four of the six frequencies, with 3 of those frequencies being consecutive to one another. This criteria was chosen because poor reliability of OAEs at the lower frequencies has been established (Olusaaya et al., 2008; Gorga et al., 2000] and more reliable data has been obtained in higher frequencies (Gorga et al., 2000).

Validity and reliability

For all audiological assessments conducted in the current study , precautionary measures advocated by Bess and Humes (1990) and Hall (2000) were followed in terms of proper maintenance and calibration of the equipment used; optimizing testing environment; and proper probe placement for all participants. To ensure accurate findings, the researchers adopted the necessary precautions to eliminate variables that could negatively influence the testing. Specifically, all testing was conducted in a quiet room with equipment that was calibrated, with biologic calibration conducted before every test session. All administration of all test and research procedures was standardized for all participants, and tests conducted were objective in nature; therefore participants' level of active participation did not play a role in the findings. For OAE testing, the noise floor was consistently monitored and deeper probe placement was done to enhance the quality of the responses obtained.

Data analysis and statistical procedures

After completing the test procedures with all participants, each participant was classified as having either pass or refer screening results. To pass the audiological screening, each child was required to pass the otoscopic examination where no anomalies were found, have normal immittance results, and present with a pass in both DPOAEs and TEOAEs bilaterally. A closer analysis was then conducted of the group of participants who presented with refer results. These participants were analyzed in terms of which test each participant did not pass, whether the refer finding was unilateral or bilateral, the estimated degree of the hearing loss, as well as the documented medical history associated with the audiological presentation. Both qualitative and quantitative statistical procedures were utilized to handle the data.

Ethical considerations

Ethical clearance was obtained from the University of the Witwatersrand, Human Research Ethics Committee (medical) before the study was conducted (protocol number: M70314). The researchers ensured that

permission was obtained from the relevant authorities at the research site. The participants were then invited to participate in the study, and written informed consent to participate in the study was obtained before the participants were tested with an assurance that confidentiality would be maintained. Furthermore, to ensure anonymity, participants were assured that no personal or identifying information would be included in the research report as research coding numbers instead of identifying information were to be used. Moreover, participants were assured that they could stop participating in the study at any moment without any negative consequences thereby ensuring that their autonomy is not violated. Lastly, the participants were given the opportunity to request to see the research results if they were interested (South African Medical Research Council, 2003). All participants presenting with refer findings were referred for detailed diagnostic testing to ensure direct benefit from participating in the current study.

Results

The results obtained from this study are presented in accordance with the specific aims of the study. A demographic profile of the participants is displayed in Table 1.

Table 1: Demographic profile of all participants in the study (N=62)

Factor	Sub-Category	Number	Percentage
Age Range	18months to 6 years	62	(mean age: 3.3years)
Gender	Male	25	40%
	Female	37	60%

There were 62 participants in the study (as seen in Table 1) ranging in age from 18 months to 6 years with a mean age of 3.3 years. Participants included both males and females.

The prevalence of audiological dysfunction represented by refer screening findings

The auditory function was seen to be variable at each of the four stages of the disease. As illustrated in Table 2; of the 62 participants 42 (68%) had normal screening results (pass) while 20 (32%) presented with abnormal findings.

Table 2: Audiological profile of all participants in the study

Factor	Sub-Category	Number	Percentage
Auditory Function (N=62)	Normal	42	68%
	Abnormal	20	32%
Type of auditory dysfunction (n=20)	Conductive	18	90%
	Sensorineural	2	10%
Symmetry of refer findings (n=20)	Unilateral	7	35%
	Bilateral	13	65%

The type, degree and symmetry of the audiological dysfunction
Type

Two definitive types of auditory dysfunction were found in the study (Table 2). There were 20 participants found to have abnormal auditory function as represented by refer findings on screening. Table 2 illustrates that of these 20, 18 (90%) presented with some conductive or mixed impairment (abnormal otoscopy, immittance and OAE findings) while the remaining 2 (10%) presented with a purely sensorineural impairment.

Degree

The degree of loss was difficult to estimate due to the high number of participants presenting abnormal middle ear function which precluded the use of OAEs. However, of the 2 participants presenting with sensorineural impairment, both passed distortion product OAEs and failed transient evoked OAEs. These findings can be interpreted as implying the presence of a mild degree of hearing impairment [30] based on the sensitivity levels of each of these measures to hearing thresholds below 50dB.

Symmetry of the refer findings

The symmetry of the refer findings is illustrated in Table 2 above. Findings indicate that of the 20 participants who did not pass the hearing screening, 7 (35%) were affected unilaterally while a more significant 13 (65%) were bilaterally affected.

Table 3: Medical and detailed audiological profile of all participants in the study (N=62)

Factor	Sub-Category	Number	Percentage
CD4+ Count (/mm³)	Asymptomatic (Stage 1) >500 cells/mm³	13	21%
(CDC Stages)	Symptomatic (Stage 2 & 3) 200-499 cells/mm³	8	13%
	AIDS (Stage 4) <200 cells/mm³	41	66%
Screening Results	Pass: Stage 1	9	21%
	(n=42) Stage 2 & 3	6	14%
	Stage 4	27	64%
	Refer: Stage 1	4	20%
	(n=20) Stage 2 & 3	2	10%
	Stage 4	14	70%

The prevalence of otitis media within this population

In the total sample tested (N=62), 23% of the participants presented with otitis media as recorded in their medical records and confirmed by otoscopic and tympanometric findings. As can be seen in Table 2, 18 (90%) of the participants (n=20) who had obtained refer findings in the hearing screening presented with otitis media.

The relationship between the hearing screening findings and medical histories obtained

When looking at the detailed medical and audiological profile of participants (Table 3), results indicated that a large majority (76%) of the participants were at the symptomatic and AIDS stage of the disease according to the CD4+ count, with a larger number of refer findings presenting at stage 4 of the disease.

Of those who did not pass the hearing screening (Table 3), a large majority 14 (70%) were at stage 4. The relationship between the failed screening results and the different stages of the HIV/AIDS disease can also be seen in Figure 1.

Of the 20 participants with refer findings, 18 had middle ear pathology in the form of otitis media (as confirmed by the medical doctors' reports from the virology clinic in conjunction with immittance results consistent with middle ear pathology) which is known to contribute to a conductive component if a hearing loss is present. Of the 2 participants with clear otoscopic findings and normal immittance results presenting absent OAEs, an assumption of a sensorineural impairment was made. For one of these participants a diagnosis of meningitis had been made while the other one had a history of ototoxicity as well as meningitis.

Because in the current study (Figure 2), only 23 (38%) participants were on antiretroviral therapy, the effect of this treatment on hearing could not be established. The one participant who presented with possible ototoxicity was not on antiretroviral therapy but had a history of TB treatment which may be ototoxic in nature.

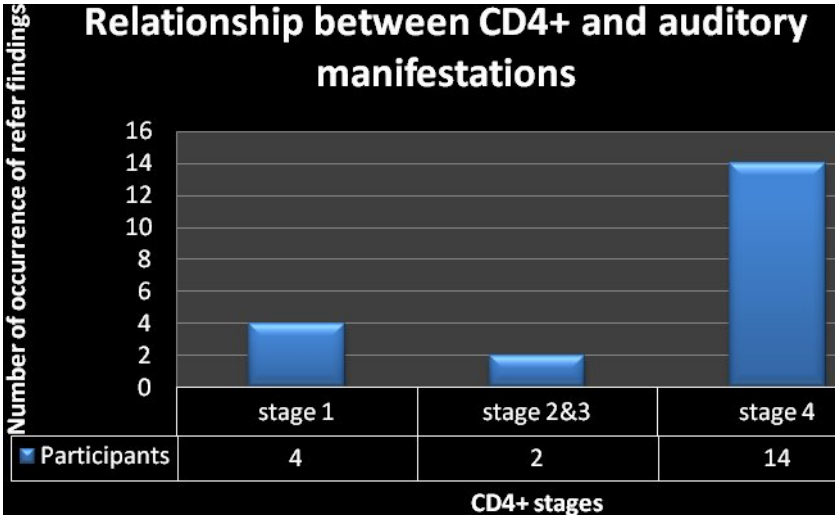

Figure 1: CD4+ count in the participants with refer findings (n=20)

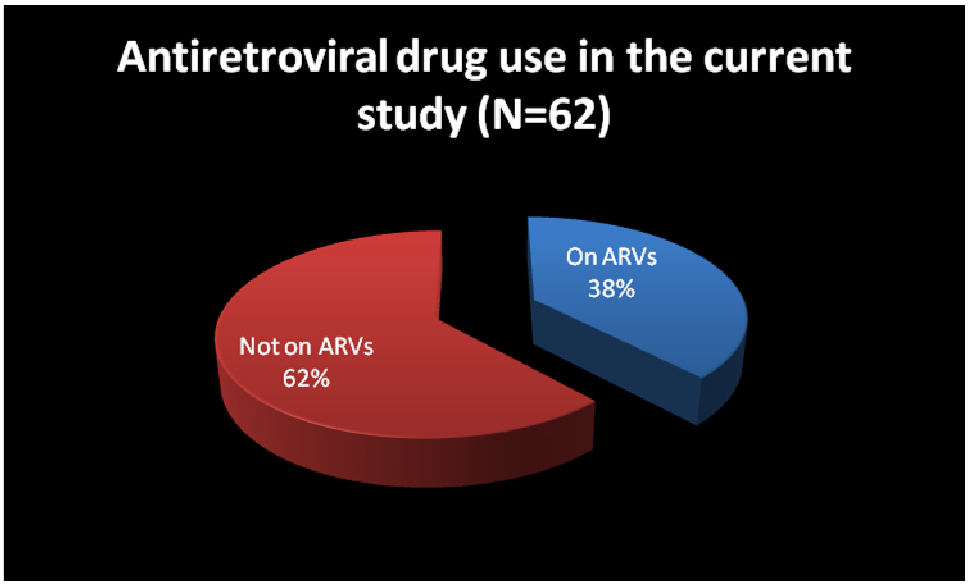

Figure 2: The percentage of participants on antiretroviral therapy (n=62)

Of those participants on antiretroviral therapy at the time of the study, there were various different types of medications being taken. These are illustrated in Table 4.

Table 4: The various antiretroviral therapy drugs and other medications used in the current study

Function	Drugs
Nucleoside Reverse Transcriptase Inhibitors	• Stavudine (d4T) • Zidovudine (ZDV) • Neviropine (NVP) • Lamivudine (3TC)
Non- Nucleoside Reverse Transcriptase Inhibitors	• Efavirenz (EFZ)
Protease Inhibitors	• Ritonivir
General Antibiotics	• Amoxyl • Flagyl • Augmentin

Discussion

As can be seen in Table 1, the sample for the current study was felt to be fairly representative of the South African paediatric population infected with HIV/AIDS as there were more females than males in the sample. This is consistent with data from the general South African population where it is estimated that of children over the age of two, 8.2% of males are HIV positive as opposed to 13.3% of females (Matkin et al., 1998)

As far as prevalence of refer screening results found within the current study (Table 2), current results seem consistent with previous findings reported on adults. For example, Khoza and Ross (2002) reported that of the 150 adult participants in their study, 23% presented with auditory symptoms including tinnitus, vertigo and hearing loss. Generally, literature suggests that prevalence of hearing impairment varies in the population infected with HIV/AIDS and that up to one third of patients may experience otological and audiological complications (Chandrasekhar et al., 2000). More specifically, that hearing impairment may be present anywhere from 20.9% to 49% of patients with HIV/AIDS (Kantu et al., 1996). These figures may be under-estimated in developing countries where a host of other factors more prevalent in low socioeconomic groups may be contributing to the disease presentation.

The percentage of audiological complications found in the current study is of concern due to the increasing prevalence of the virus in Africa, particularly the prevalence of infected women; hence a possible increase in risk of mother-to-child transmitted HIV in babies if contracted in-utero. Because the prevalence and rate of progression is known to be rising at a rapid pace, the number of paediatric patients who are infected is most likely higher than predicted due to the difficulties with diagnosis of HIV in this population group (Matkin et al., 1998). These difficulties, such as different diagnostic criteria across the various countries, may have a significant delaying effect on early identification and intervention of HIV. This places a child at a greater risk for compromised health care therefore allowing for opportunistic infections to occur that may ultimately lead to hearing loss (Matkin et al., 1998).

With regard to the type of auditory dysfunction, current results differ from findings reported in adults. In the current study, conductive impairment was the most prevalent as opposed to sensorineural impairment which has been reported in adults (Khoza and Ross, 2002). Current findings are however consistent with reports by Prasad, Bhojwani, Shenoy and Prasad (2006) who reported that of the otological manifestations in their study, chronic suppurative otitis media was the most common, occurring in 13% of their participants. The high prevalence of chronic suppurative otitis media predisposes this population to an anticipated higher occurrence rate of conductive hearing impairment.

The high prevalence of refer findings in the hearing screening from the current study is not surprising as various complications of HIV/AIDS may lead to conductive and sensorineural hearing loss. Conductive hearing impairment often occurs due to the accumulation of fluid caused by obstruction of the Eustachian tube by a mass of lymphoid tissue, which is often formed in response to the HIV infection (Lubbe, 2004). Furthermore, due to the compromised immune system, the patient is often susceptible to opportunistic infections that may lead to otitis media (Lubbe, 2004). These opportunistic infections can also contribute to the development of sensorineural hearing loss. Such opportunistic infections may include cryptococcal meningitis, TB meningitis, tertiary syphilis and middle ear disease that spreads to the inner ear (Lubbe, 2004). However, more recently the aetiology of sensorineural impairment has been attributed to neoplasms and medications with ototoxic effects (Prasad et al., 2006).

The estimated type and degree, as well as the symmetry of the refer results found in the current study indicate a need for increased and earlier involvement of the audiologist in the assessment and management of paediatric patients with HIV/AIDS. The fact that a large percentage presented with a conductive impairment, which often when treated, is reversible highlights the fact that if these children are identified early and appropriately treated, communication development delay can be prevented and the child's cognitive functioning, social, and academic functioning could be optimized. The fact that the symmetry of the abnormal results found tended to be more bilateral than unilateral in nature is of significant concern, and may indicate that auditory dysfunction in paediatric patients with HIV/AIDS occurs more frequently than realized. Bilateral hearing impairment is reported to impact more severely on communication than unilateral, and therefore requires prompt diagnosis and management (Stephens,1997). The higher prevalence of bilateral dysfunction is of concern also because it is known that binaural hearing is crucial in detecting the direction of a sound source, solving the problem of echoes as well as in extracting required information from multiple sound sources (Kidd, 2002).

The above negative hearing screening results were found to occur mostly at stage 4 (full blown AIDS) of the disease with 70% of the participants manifesting with refer findings at this stage. This finding is supported with evidence suggesting that the manifestations of the virus become worse and opportunistic infections occur more frequently when the immune status is more compromised (Chandrasekhar et al., 2000), as it is the case in stage 4 of the virus. Although, in the current study, the sample size consists more of participants at stage 4 than the earlier stages; and this may have influenced the presentation found.

The fact that the prevalence of otitis media in the current study was as much as 23% may attest to the effect that the compromised immune system has on the infected body. The prevalence rate of otitis media found in the current study is consistent with previous evidence that suggests that otitis media with effusion and acute otitis media occur most frequently in this population when considering the audiological manifestations of the virus (Khoza and Ross, 2002). However, otitis media is common in all children regardless of whether they are HIV positive or not. Therefore, a need for more clinical studies that have control groups or studies that determine the expected prevalence of otitis media in the general South African paediatric population is highlighted. This is particularly important as early and prompt referral to an Ear, Nose and Throat specialist can reverse the consequences of otitis media if treatment is successful, thereby mitigating the effects of subsequent hearing loss. Otitis media often leads to conductive hearing impairment and may range in severity, occurring anywhere from a slight to a significant hearing impairment. Due to the high prevalence of otitis media in the current study and the fact that the sample consisted of paediatric patients between the ages of 18 months and 6 years, it is possible that the prevalence is even higher since eustachian tube maturation plays a key role in reducing the prevalence of otitis media (Matkin et al., 1998), and is still occurring in this age group.

The other medical conditions related to the abnormal hearing screening results found in the current study included meningitis and ototoxicity. Although the effects of cryptococcal meningitis may be milder than bacterial meningitis, there is a higher incidence in HIV/AIDS and this is significant as it is a known cause of sensorineural hearing impairment (Matkin et al., 1998). On the other hand, the severity of ototoxic effects depends largely on the sensitivity of the patient, the dosage of the medication as well as the duration for which it was consumed (Matkin et al., 1998). Although there was only 1 participant who had possible ototoxic-related hearing loss, the effects of medications on the ear in this population needs to be characterised since prescription is long-term. In the current study because only a few participants were on antiretroviral therapy, the effect of this treatment on the ear could not be established, and so establishing any relationship between the use of ART and auditory function within this sample would have been inappropriate.

Conclusions

The current study reveals that abnormal hearing screening findings are present in a group of HIV/AIDS infected paediatric patients attending an academic hospital clinic in Gauteng, South Africa. Various other studies have presented results that concur with the findings of this study with regards to the relationship between HIV/AIDS and audiological function (Bankaitis, 1996; Matkin et al., 1998; Khoza and Ross, 2002; Lubbe, 2004). The estimated prevalence of participants with refer findings among paediatric patients in the current study was 26%. The signs and symptoms occurred at all the various stages of the disease and the type and symmetry of the dysfunction was variable. However, there was a greater prevalence of a conductive component to the impairment found, and the abnormal findings tended to be more bilateral than unilateral in nature; with the majority of cases presenting at stage 4 of the disease. Furthermore, otitis media was found to be prevalent in 23% of all participants and seemed to be the most prevalent probable cause of auditory dysfunction in the current sample. These findings could not have been influenced by antiretroviral therapy (ART) use since only 38% of participants were on this treatment. The effect of ART on the auditory system in this population needs characterisation, particularly since the treatment is long-term and the patients may have to live longer with unidentified adverse effects, which may significantly impact on their quality of life.

Results of this study are useful since they highlight otitis media as a possible leading audiological manifestation of HIV/AIDS in paediatric patients, even though otitis media is also very prevalent in the non-HIV/AIDS population. Nonetheless, findings from this study allow for appropriate assessment and timeous intervention plans to be put in place for this population, particularly since otitis media effects can be reversed. The current study did however have limitations including that of the fact that only screening audiometry was conducted and no diagnostic audiological testing was performed, and the fact that unavoidable uncooperative behaviour of some of the participants precluded them undergoing the full test battery planned for the study. Because the test battery used was insufficient for diagnostic purposes, particularly for determining the degree of hearing impairment in those who presented with a hearing loss, further more detailed studies should be conducted on this population. This provides implications for future research where a more comprehensive test battery may be utilized including Auditory Brainstem Response to further clarify the type, degree and configuration of the hearing loss. These future studies need to be conducted in larger sample sizes from different sites to increase generalizability of the results, and the possible impact of antiretroviral therapy on auditory function needs characterisation in this population group.

In conclusion, this study provides results that indicate that there are definitive auditory manifestations in immuno-compromised paediatric patients. The depressed immune system function may lead them to susceptibility to opportunistic infections, which may cause auditory dysfunction to be of increasing consequence as the disease progresses. Audiologists, therefore, need to be involved in both the assessment and management of paediatric patients with HIV/AIDS to ensure that early identification and intervention occurs.

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