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Research Article

Patterns of Hearing Loss Among HIV Adult Patients Attending Clinic at Tertiary Hospital, Tanzania

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Abstract

Introduction: Hearing is a complex sense involving both the ear's ability to detect sounds and the brain's ability to interpret those sounds, including the sounds of speech. Hearing loss is the most frequent sensory deficit in human populations, affecting more than 250 million people in the world. Consequences of hearing impairment include inability to interpret speech sounds, often producing a reduced ability to communicate, economic and educational disadvantage, social isolation and stigmatization.

HIV/AIDS is among infectious diseases that has significant detrimental effects on the auditory system. As many as 75% of adults living with HIV are reported to experience at some point in time, auditory dysfunction secondary to HIV infection. The exact prevalence and mechanisms of auditory dysfunction remain unclear to date and poses challenges in the assessment, treatment and monitoring of these patients.

Objective: To determine the pattern of hearing loss among HIV/AIDS adult patients attending antiretroviral therapy(ART) clinic at Tertiary Hospital in Tanzania.

Study design: Descriptive cross-sectional study design based in hospital.

Methodology: A total of 371 HIV/AIDS adults patients attending ART clinic were enrolled. Patients were interviewed by the structured questionnaire followed by otoscopic examination and pure tone audiometry. The patient's medical files were reviewed to get the recent CD4 count. All information obtained was entered in a computer and analysed using SPSS version 17 software. The Chi-square test for proportions were used to determine the differences among different groups

Results: The study included 371 HIV/AIDS adults patients 39.1% were males and 60.9% were females, 80.6% were on ART and 19.4% were not on ART. The prevalence of hearing loss was 33.2%. As age advances, there was an increase in hearing loss from 28.3%, 30.4% and 57.7% respectively which was statistically significant ($P < 0.05$). The study found that SNHL was high 19.1%, followed by conductive 11.6% and mixed hearing loss 2.4% ($P < 0.05$). Among the study population 32.3%, 30.5% and 37.2% were found to have hearing loss corresponding to CD4 <200, 200-499, and >500 respectively. These findings were not statistically significant ($P > 0.05$). There was an increase in the prevalence of SNHL15.5%, 18.1%, 22.5% and conductive hearing loss 10.8% 11.3%, 12.4% which was corresponding to increases in CD4 count CD4 <200, 200-499, and >500 respectively. Mild hearing loss was found to be 23.5% with decrease in percentage as severity of hearing loss increases. There was high prevalence of hearing loss in those not on ART 44.4% compared to 30.4% in those on ART. These findings were statistically significant ($P < 0.05$).

Conclusion: Hearing loss is of high prevalence in HIV patients. It is more prevalent in those not on ART as compared to those on ART. Further studies are important to see the correlation with these factors.

Keywords: Patterns of Hearing Loss; Human Immunodeficiency Virus; Adult Patients

Abbreviation

HIV: Human Immune Deficiency Virus; CDC: Centers for Disease Control; AIDS: Acquired Immune Deficiency Syndrome; ARV: Antiretroviral; ART: Antiretroviral Treatment; WHO: World Health Organization; NRTI: Nucleoside Reverse Transcriptase Inhibitors; NNRTI: Non Nucleoside Reverse Transcriptase Inhibitors; PI: Protease Inhibitors; FI: Fusion Inhibitors; HAART: Highly Active Antiretroviral Treatment; HL: Hearing Loss; SNHL: Sensorineural Hearing Loss; CHL: Conductive Hearing Loss; CNS: Central Nervous System; ABR: Auditory Brain Response; HSV: Herpes Simplex Virus; CMV: Cytomegalovirus; MTB: Mycobacterium Tuberculosis; MNH: Muhimbili National Hospital**;** PGL: Persistent generalized lymphadenopathy; VCT: Voluntary Counselling and Testing

Definition of terms

Hearing loss

A person who is not able to hear as well as someone with normal hearing – hearing thresholds of 25 dB or better in both ears – is said to have hearing loss. Hearing loss may be mild, moderate, severe or profound. It can affect one ear or both ears, and leads to difficulty in hearing conversational speech or loud sounds [1].

Hard of hearing

Refers to people with hearing loss ranging from mild to severe. They usually communicate through spoken language and can benefit from hearing aids, captioning and assistive listening devices. People with more significant hearing losses may benefit from cochlear implants [1].

Deafness

'Deaf' people mostly have profound hearing loss, which implies very little or no hearing. They often use sign language for communication [1].

Conductive hearing loss

This is the type of hearing loss where sound is not transmitted into inner ear. It is related to pathology in either the outer ear or middle ear that blocks the transmission of sound waves in to the inner ear.

Sensorineural hearing loss

This is the type of hearing loss due to pathology in the cochlear or acoustic nerve (cranial nerve VIII) impairment. The majority of human sensorineural hearing loss is caused by abnormalities in the hair cells in the organ of Corti [2]. The hair cells may be abnormal at birth or damaged during the lifetime of an individual.

Mixed hearing loss

This is the combination of a conductive and sensorineural hearing loss. For example, when the same person have pathology that causes CHL and another pathology causing SNHL [3,4].

HIV infection

HIV (human immunodeficiency virus) is the virus that causes AIDS. This virus is passed from one person to another through blood-to-blood and sexual contact. In addition, infected pregnant women can pass HIV to their babies during pregnancy or delivery, as well as through breast-feeding. People with HIV have what is called HIV infection. Most of these people will develop AIDS as a result of their HIV infection [5,34].

Acquired immunodeficiency syndrome (AIDS)

These present with number of infections and the diseases manifests itself due to decreased immunity. The diseases are termed as AIDS defining illness. The terminal stage is termed as AIDS where the patient succumb array of diseases and infection and patients often presents with multiple opportunistic infections [6].

Introduction

To understand hearing loss, it is important to understand how normal hearing occurs. There are two pathways by which sound waves produce the sensation of hearing, the air conduction and bone conduction. Air conduction, sound waves from the surrounding are collected by the pinna and directed to the external auditory canal to the tympanic membrane (the ear drum). The sound waves hit the tympanic membrane and cause the tympanic membrane to vibrate in and out. The vibration of the tympanic membrane in and out causes vibration of small bones in the middle ear which are connected to the tympanic membrane. These 3 bones are called the malleus, the incus and the stapes. Movement of the stapes causes pressure waves in the fluid-filled inner ear in the cochlea. The cochlea is an inner ear structure surrounded by fluid. It contains multiple small hairs. Pressure waves in the fluid cause the hairs to move. This movement stimulates the auditory nerve. Different frequencies of noises stimulate different hairs on the cochlea, which translate to the sensation of sounds of different pitch. Hearing by bone conduction occurs when a sound wave or other source of vi-

bration causes the bones of the skull to vibrate. These vibrations are transmitted to the fluid surrounding the cochlea and hearing results.

Picture 1: Anatomy of the ear.

Hearing loss is a common problem caused by noise, aging, disease, and heredity. Hearing is a complex sense involving both the ear's ability to detect sounds and the brain's ability to interpret those sounds, including the sounds of speech. Hearing loss will negatively affect a person's quality of life. The determinants that influence the quality of life include, the degree of the hearing loss, the pattern of hearing loss across different frequencies (pitches), whether one or both ears is affected, the areas of the auditory system that are not working normally—such as the middle ear, inner ear, neural pathways, or brain and the ability to recognize speech sounds. The causes of hearing loss and deafness can be divided into congenital causes and acquired causes. Congenital causes lead to hearing loss at birth or acquired soon after birth. Hearing loss can be caused by hereditary and non-hereditary genetic factors or by certain complications during pregnancy and childbirth. It involves the following, Infections –TORCH, low birth weight**,** birth asphyxia**,** use of ototoxic drugs (such as aminoglycosides, cytotoxic drugs, antimalarial drugs and diuretics) during pregnancy and severe jaundice in the neonatal period. Acquired causes leads to hearing loss at any age after birth. It involves infectious diseases such as meningitis, HIV infection, measles and mumps mostly in childhood, but also later in life.

- Chronic ear infection, which commonly presents as discharging ears. In certain circumstances this condition can also lead to serious, life-threatening complications, such as brain abscesses or meningitis.
- Collection of fluid in the ear (otitis media).
- Use of ototoxic drugs such as some antibiotic (Aminoglycosides) and antimalarial medicines.
- Head injury or injury to the ear.
- Excessive noise, including working with noisy machinery, and exposure to loud music or other loud noises, such as gunfire or explosions, can harm a person's hearing.
- Age-related hearing loss (presbycusis) is caused by degeneration of sensory cells.
- Wax or foreign bodies blocking the ear canal.

Hearing loss is grouped according to International Classification of Diseases and Related Health Problems, into three groups, conductive hearing, sorineural hearing loss and mixed hearing loss. However in other studies on top of the three main types they add functional and central hearing loss [3]. Conductive hearing loss is the type of hearing loss where sound is not transmitted into inner ear. It is related to pathology in either the outer ear or middle ear that blocks the transmission of sound waves in to the inner ear, thus the sensory cells receive decreased or no stimulation. The maximum conductive hearing loss is approximately 60 dB [3]. Many causes of conductive hearing loss are amenable to medical or surgical correction [2]. Sensorineural hearing loss is a type of hearing loss due to pathology in the cochlear or acoustic nerve (cranial nerve VIII) impairment. The majority of human sensorineural hearing loss is caused by abnormalities in the hair cells in the organ of Corti [2]. The hair cells may be abnormal at birth or damaged during the lifetime of an individual. There are extrinsic causes [environmental factors] like noise trauma and infection, and intrinsic abnormalities which are genetic or acquired from the maternal. Sensorineural hearing loss is the most common type of hearing loss among adults [occurs in 80 percent of adult cases]. In general, it is not amenable to medical or surgical correction. Most sensorineural hearing loss can be successfully rehabilitated with hearing aids [4]. Mixed hearing loss is the combination of a conductive and sensorineural hearing loss. Example, when the same person has a pathology that causes CHL and another pathology causing SNHL [3]. In central hearing loss, the problem lies within the central nervous system, in the brain. In this type, patients can hear well but have trouble interpreting or understanding what is being said. There is no good treatment for central auditory processing disorders other than educating the person, family, and friends, and trying to control the environment. Functional hearing loss is a type

of hearing loss due to psychological or emotional problem hence cortical or supratentorial, rather than physical damage to the hearing pathway. Individuals with this type of hearing loss do not seem to hear or respond; yet, in reality, they have normal hearing.

The effect of HIV in the auditory system

HIV infection is known to cause a significant manifestation in the ear [7-10]. Hearing loss is well known to cause a decrease in quality of life [11]. The effect on quality of life has shown to be directly influenced by the level/severity of HL [12]. e.g. poor communication, social isolation and withdraw, depression, dementia frustration decreased functional status and maladaptive behavior [12,13]. Frustration due to HL is not limited to the affected person only but also extends to family and people dealing with the individual [12]. The effect of HL on quality of life emphasize the importance of early treatment by healthcare professionals in order to prevent and minimize these effects as well as to positively impact quality of life for these individuals and their families. As many as 75% of adults living with HIV are reported to experience at some point in time, auditory dysfunction secondary to HIV infection [14]. The exactly prevalence and mechanisms of auditory dysfunction remain unclear to date and poses challenges in the assessment, treatment and monitoring of these patients. In order for the hearing care professional to appropriately make assessment, treatment, management and monitoring these patients, more information is needed on the prevalence and mechanism of auditory dysfunction in these patients. HIV infected individuals as well as health care providers should also be educated regarding the possible manifestation on the auditory system as a result of HIV/AIDS. This will improve early detection of auditory dysfunction which may facilitate appropriate treatment and effective treatment outcome.

HIV infection affects numerous systems in the body of Immunocompromised patients and has various clinical manifestations, some of which may be due to opportunistic infections [15]. Some of these manifestations have been researched extensively; however, some areas of research such as the relationship between HIV and the auditory system have been neglected to some degree. Although there are reports that HIV has a definite effect on the human auditory system either directly or indirectly, few collaborative studies are available and those that have been done report a range of findings demonstrating great variation [9,16-18]. It is clear that hearing loss in HIV/AIDS patient is important due to impairment of the quality of life. SNHL and CHL both do occur either sudden or gradually [9,19-21] Although there is evidence that support the high incidence of HL in HIV/AIDS patients it is important to find the underlying mechanism in order to find the direct and indirect causes of HL in HIV/AIDS patients [22].

Pathophysiology of HL in HIV/AIDS Patients

Studies done previously reported that HIV/AIDS has significantly and often overlooked detrimental effects on the auditory system [22,23]. Human Immunodeficiency Virus manifests itself in the auditory system in various ways as follows [22]. HIV may affect direct to the CNS by affecting the integrity of nerve pathway and interfere with conduction of impulse to high centers. HL may occur due to the effect of opportunistic infection which may lead to CHL or SNHL in patients with HIV/AIDS. HL due to ototoxic drugs used in the HIV patients. These can be either the use of HAART or the use of other ototoxic drug for the treatment of opportunistic infection. Research has shown that HIV has an affinity for the CNS and PNS and these leads to hearing loss directly attributed to HIV infection [23-25]. Patients infected with HIV may present with subclinical CNS and PNS involvement [22,26]. Human Immunodeficiency Virus infection has the potential to affect the 8th cranial nerve resulting to SNHL [27]. Auditory Brainstem Response [ABR] testing has an important value to assess the retro cochlea pathologies at early stage of HIV infection in the CNS that involve subcortical demyelization and local demyelination due to infection of the glial and neurological cells. Thus ABR may be abnormal at early stages before any significant clinical manifestation is observed [17,28]. Evidence also exist that HIV infection lead to pathological changes in the temporal bones and vestibular end organ of AIDS patients. The researcher studied ten temporal bones from five HIV patients obtained through autopsy. The finding showed that changes in the otological structures where responsible for the otological manifestation occurring in HIV/AIDS patients [28].

Auditory manifestation/HL and opportunistic infections

HIV is known to impair the immune system which leads to occurrence of opportunistic infections [15]. Some of these infections can lead to hearing loss [9,14,23]. The cut off CD4 levels have been recommended for the occurrence of opportunistic infection, however the cutoff point are only for references values [15]. Two major groups were mentioned; those leading to CHL and those leading to SNHL. Research found that several opportunistic infections have direct or indirect effect or cause of CHL in HIV/AIDS patients otitis media, KS are an example of opportunistic infection that lead to

CHL [9,23,29]. Sensorineural hearing loss can be caused by opportunistic infection in HIV/AIDS patients [22]. SNHL occurs due to damage to the cochlea, the cochlea nerve [VIII] or the brain. Several infections have been reported such as CMV infection, reactivation of HZV and meningitis [29].

Hearing loss due to ototoxic drugs

The ototoxic effect usually depends on duration of drug administered and dosage [23]. Example of ototoxic medication used include Aminoglycosides group, and Quinidine derivative limited report exist on HL due to ototoxicity, specifically in HIV/AIDS. It can be concluded that ototoxicity in the treatment of opportunistic infection in HIV/AIDS patients remain a problem especially in many developing countries [29]. The use of combination drugs in the treatment of HIV/AIDS are referred as "highly active antiretroviral treatment" [HAART]. Currently four groups of ARV are available. The adverse effect of these drugs has proven to include potential ototoxicity. Study has shown each class of ART has different ototoxicity effect as compared to others [30-34].

Methodology

Research design

Descriptive cross-sectional study design aimed to determine the prevalence and characteristics of hearing loss in HIV/AIDS patients.

Study population

Adult HIV/AIDS patients attending ART clinic at tertiary hospital in Tanzania.

Sampling technique

Convenience sampling was used by the researcher by selecting the study population the researcher introduced the study topic to the participant verbally. Those who were willing to participate were given the consent form with detailed information regarding the study topic. Those who met criteria were recruited and signed the consent before the interview, examination and other tests. Sample size of 371 participants were involved in this study.

The inclusion criteria

Adult subjects from 18 years old with HIV/AIDS confirmed serologically, able to give their consent, speaking and willing to participate were included in the study.

Exclusion criteria

Those unable to give their consent independently and those who were not willing to participate.

Ethical consideration

The Ethical clearance was obtained from MUHAS Ethical Committee. Each patient was informed that no harm was expected either physically or psychologically during or after the study.

All participants read the informed consent to know the aim of the study, advantage, disadvantage and their voluntary right to drop from the study without prior information or penalty when they fail to do so. Participants were assured about the confidentiality of the information from the start of data collection, data analysis and release of the report/publication. Coding as an identity of individual participant was used in the questionnaires and other material to maintain confidentiality. This coding was accessible by the researcher and the supervisor only. Those opted to terminate participation in this study were not penalized but they were given the same treatment and benefits as other patients.

Data collection

Interview Questionnaire

Structured questionnaire was used and each questionnaire was filled after patient interviewed and retrieving other information from the patient's card.

Otoscopy

Otoscopic examination was done by the principal investigator. Any pathology in the ear(s) were treated accordingly.

Audiometer

Interacoustics clinical Audiometer AC40 with TDH 39P supra-aural earphones was used for audiometric test. Both air and bone conduction were performed to each participant in the sound proof room by a trained clinical Audiologist. This test was intended to provide the information regarding the types of hearing loss (CHL, SNHL or Mixed HL) and the threshold of the hearing. All frequency were tested (250, 500, 1000, 2000, 4000, 8000Hz) and the average threshold of all frequency in each patients were determined. Hearing loss wad defined by hearing threshold above 20 dB in all frequency. Degree of hearing loss was classified as follows; 21-40 dB mild, 41-70 dB moderate, 71-90 dB severe and above 90 dB as profound hearing loss.

Data analysis

The analysis was conducted as follows; coding of the data was done and entered to SPSS version 17 followed by data cleaning. Descriptive analysis was done by using the SPSS version 17. Chi-square test was used to determine the association of qualitative variables. P value of <0.05 was considered as statistically significant.

Results

Among 371 HIV/AIDS participants, 145 (51.2%) were males and 226 (60.9%) were females. In this study 159 (42.9%) were aged 30-39 years, while 112 (30.2%) were aged 40-49 years.

	Hearing loss		
Sex	**No %**	**Yes %**	**Total %**
Male	103 71.0%	42 29.0%	145 39.1%
Female	145 64.2%	81 35.8%	226 60.9%
Total	248 66.8%	123 33.2%	371 100%

Table 1: Prevalence of hearing loss by sex.

Among all studied population,248 (66.8%) had normal hearing threshold while 123 (33.2%) had hearing loss in at least one ear. High prevalence of hearing loss was found in female 35.8% compared 29.0% in males (p value 0.17).

	Lateralization of hearing status/loss				
Sex	**Normal %**	**Left %**	**Right %**	**Bilateral %**	**Total %**
Male	103 71.0%	13 9.0%	12 8.3%	17 11.7%	145 39.1%
Female	145 64.2%	19 8.4%	18 8.0%	44 19.5%	226 60.9%
Total	248 66.8%	32 8.6%	30 8.1%	61 16.4%	371 100%

Table 2: Lateralization of the hearing status by sex.

Among the study population 248 (66.8%) had normal hearing, 32 (8.6%) had left ear HL while 30 (8.1%) had right ear HL and 61 (16.4%) had bilateral HL. There was almost similar prevalence in both sexes.

There was a tendency of hearing loss to increase with age in this study and those above 50 years of age had the highest prevalence of hearing loss (57.7%). This observation was statistically significant. (P < 0.05).

	Hearing loss		
Age group (yrs)	**No %**	**Yes %**	**Total %**
18-29	34 70.8%	14 29.2%	48 12.9%
30-39	114 71.7%	45 28.3%	159 42.9%
40-49	78 69.6%	34 30.4%	112 30.2%
>50	22 43.3%	30 57.7%	52 14.0%
Total	248 66.8%	123 33.2%	371 100%

Table 3: Prevalence of hearing loss by age.

	Hearing pattern				
Age group (YRS)	**Normal %**	**Conductive%**	**Sensorineural%**	**Mixed %**	**Total %**
18-29	34 70.8%	5 10.4%	8 16.7%	1 2.1%	48 12.9%
30-39	114 71.7%	14 8.8%	28 17.6%	3 1.9%	159 42.9%
40-49	78 69.6%	15 13.4%	19 17.0%	0 0.0%	112 30.2%
>50	22 42.3%	9 17.3%	16 30.8%	5 9.6%	52 14.0%
Total	248 66.8%	43 11.6%	71 19.1%	9 2.4%	371 100.0%

Table 4: Prevalence of hearing types by age.

Among 371 participants, 248 (66.8%), 43 (11.6%), 71 (19.1%), and 9 (2.4%) had normal hearing, conductive, sensoneural and mixed hearing loss respectively. There was an increase in the prevalence of SNHL as age increase with high prevalence of CHL (17.3%) and mixed hearing loss (9.6%) seen in the age above 50 years (p value 0.002).

Among the participants males had high prevalence of SNHL29 (20.0%) while females had high prevalence of conductive and mixed hearing loss (P value 0.115).

Among 371 participants 21 (32.3%), 54 (30.5%) and 48 (37.2%) were found to have hearing loss corresponding to CD4 <200,200-499, and >500 respectively. There was no statistical correlation between hearing loss and CD4 counts (P value 0.46).

	Hearing loss		
CD4 count	**No %**	**Yes %**	**Total %**
<200	44 67.7%	21 32.3%	65 17.5%
201-499	123 69.5%	54 30.5%	177 47.7%
>500	81 62.8%	48 37.2%	129 34.8%
TOTAL	248 66.8%	123 33.2%	371 100%

Table 6: Prevalence of hearing status according to CD4 count.

CD4 count	Hearing pattern				
	Normal %	**Conductive %**	**Sensorineural %**	**Mixed %**	**Total %**
<200	44 67.7%	7 10.8%	10 15.4%	4 6.2%	65 18.6%
201-499	123 69.5%	20 11.3%	32 18.1%	2 1.1%	17 47.4%
>500	81 62.8%	16 12.4%	29 22.5%	3 2.3%	129 34.0%
Total	248 66.8%	43 11.6%	71 19.1%	9 2.4%	371 100%

Table 7: Hearing patterns according to CD4 counts.

Among the participants who had hearing loss most of them had SNHL 19.1%. There was also an increase in the percentage of SNHL from low CD4 count to high CD4 count (15.4%,18.1% and 22.5%) conductive HL were predominant in CD4 count between 200-499 and mixed HL in CD4 count <200 (P value 0.33).

CD4 count	Hearing status					Total %
	Normal %	**Mild %**	**Moderate %**	**Severe %**	**Profound %**	
<200	44 67.7%	16 24.6%	4 6.2%	1 1.5%	0 0.0%	65 18.6%
201-499	123 70.1%	41 23.2%	9 5.1%	2 1.1%	1 0.6%	177 47.4%
>500	81 62.8%	30 23.3%	14 10.9%	4 3.1%	0 0.0%	129 34.0%
Total	248 67.1%	87 23.5%	27 7.3%	7 1.9%	1 0.3%	371 100%

Table 8: Hearing status according to CD4 count.

Among all participants there were decrease in the prevalence of HL from mild 87 (23.5%) to profound1 (0.3%). High prevalence was also observed in the CD4>500 with 10.9% and 3.1% for moderate and severe HL respectively (P value 0.55).

Among 299 (80.6%) of patients on ART, 91 (30.4%) had hearing loss while 72 (19.4%) of patients not on ART 32 (44.4%) had hearing loss. This finding is statistically significant (P value 0.02).

	Hearing loss		
Started ART	**No %**	**Yes %**	**Total %**
Yes	208 69.8%	91 30.4%	299 80.6%
No	40 55.6%	32 44.4%	72 19.4%
Total	248 66.8%	123 33.2	371 100%

Table 9: Comparison on the prevalence of HL among those on ART and those not on ART.

	Types of hearing loss				
On ART	**Normal %**	**Conductive %**	**Sensoneural %**	**Mixed %**	**Total %**
Yes	208 69.6%	32 10.7%	56 18.7%	3 1.0%	299 80.6%
NO	40 55.6%	11 15.6%	15 20.8%	6 8.3%	72 19.4%
Total	248 66.8%	43 11.6%	71 19.1%	9 2.4%	371 100%

Table 10: Comparison of prevalence of hearing loss types among those on ART and those not on ART.

Among 72 (19.4%) participants who were not on ART 15 (20.8%), had SNHL followed by, conductive,15.6% and mixed 1.0% HL while 299 (80.6%) who were on ART 56 (18.7%) had SNHL, then conductive 10.7% and mixed 1.0% HL (P value 0.001).

	Degree of hearing loss					
On ART	**Normal %**	**Mild %**	**Moderate %**	**Severe %**	**Profound%**	**Total %**
Yes	209 69.9%	63 21.1%	21 7.0%	5 1.7%	1 0.3%	299 80.6%
No	40 55.6%	24 33.3%	6 8.3%	2 2.8%	0 0.0%	72 19.4%
Total	249 67.1%	87 23.5%	27 7.3%	7 1.9%	1 0.3%	371 100%

Table 11: Comparison between prevalence of hearing loss degree among those on ART and those not on ART.

Mild hearing loss was found to be high in both groups with 63 (21.1%) on ART and 24 (33.3%) not on ART. The prevalence of HL was decreasing as degree of HL was increasing (P value 0.181).

Discussion

Studies done found that audiological manifestation in HIV/AIDS has been neglected in developing countries Tanzania being among them. The magnitude of hearing loss has not yet been established and it is not clear about the interaction that exists between different factors that may contribute to hearing loss such as CD4 level, age, ART treatment and drugs that are used for the treatment of opportunistic infections.

The study included 371 HIV/AIDS adults' patients 145 (39.1%) were males and 226 (60.9%) were females. Among them 299 (80.6%) were on ART and 72 (19.4%) were not on ART.

Prevalence and pattern of hearing loss by age and sex

Among the 371 participants 248 (66.8%) had normal hearing threshold while 123 (33.2%) had hearing loss at least in one ear by audiometry >20 dB average of all frequency range (p >0.05 chi square). Among the participants with hearing loss 16.4% had bilateral hearing loss while 16.7% had unilateral hearing loss. Of those with unilateral hearing loss, 8.6% had left hearing loss and 8.1% had right hearing loss.

The finding was similar to the study by Chandraselchar., *et al*. (2000) who found the prevalence of hearing loss to be 29%. In Kenya a similar study found that hearing loss (HL) was present in 33.5% of HIV positive compared to 8.1% in negative subjects.

A study done in South Africa found the prevalence of hearing loss among HIV positive patients to be as high as 23%. Another study by Soucelc and Micheals (1996) done in London (UK) found the prevalence of HL among HIV positive patients to be 69% greater than 20 dB in part of the frequency range.

A study by De-lange 2007 done in South Africa found that when define HL at pure tone averages greater than 25 dB the prevalence of HL was 40%. However when considering HL to be a threshold greater than 25 dB at any frequency, Khoza and Ross (2002) found the prevalence to be 23% Sooy (1987) found 49%, and when threshold larger than 20 dB at any frequency, Sowcek and Micheals (1996) found the prevalence to be 69%. This shows even when the definition of hearing loss is, the difference in the prevalence was found. He also found that the prevalence of SNHL was higher compared to CHL. The prevalence of unilateral HL 22% was almost similar to that of bilateral HL 19.5%.

Greater variation in the prevalence of hearing loss among HIV patients in different studies can be explained by different definition of hearing loss, environment where the test was carried and the type of test used to assess the patients.

In this study 29.0% of males and 35.8% of females had hearing loss at least in one ear (P > 0.05). The findings between gender and hearing loss among HIV/AIDS patients were not statistically significant. In a study done in Kenya at the VCT found that there was no gender bias in hearing loss among HIV patients.

The age groups 30-39 years and 40-49 years constituted the majority of patients in the study with 42.9% and 30.2% respectively. As age advances from 30-39,40-49 and above 50 years there was an increase in hearing loss from 28.3%,30.4% and 57.7% respectively which was statistically significant (P < 0.05). The study found that SNHL was high 19.1%, followed by conductive 11.6% and mixed hearing loss 2.4% (P < 0.05). Patients above 50 years shows high prevalence of conductive, and SNHL compared to other age groups. The study also found that males had high prevalence of SNHL 20% and females had high prevalence of conductive hearing loss 13.7% (P > 0.05).

A comparative study by Bell., *et al*. (1988) done in Chicago (USA) of HIV patients and non HIIV patients found that there was significant correlation between hearing loss and increase in age above 55 years. However, in young age there was no significant correlation between age and hearing loss. They also found that HIV/AIDS was significantly associated with an increased risk of developing SSHL in patients aged 18 to 35 years, particularly among male patients. It was concluded that the findings may be due to other factors such as presbycusis and cumulative effect of noise induced hearing loss.

A study by Lalwani and Sooy (1992) done in North America found that the prevalence of HIV related SNHL was between 21% and 49% which was similar to my study.

Prevalence and pattern of hearing loss according to CD4 count

Among 371 HIV/AIDS participants 32.3%, 30.5% and 37.2% were found to have hearing loss corresponding to CD4 <200, 200-499, and >500 respectively. These findings were not statistically significant (P > 0.05). There was an increase in the prevalence of SNHL 15.5%, 18.1%, 22.5% and conductive hearing loss 10.8% 11.3%, 12.4% which was corresponding to increases in CD4 count CD4 <200, 200-499, and >500 respectively.

Mixed hearing loss was high in the CD4 count below 200.Mild hearing loss was found to be 23.5% with decrease in percentage as severity of hearing loss advances. There was an increase in the prevalence of hearing loss in moderate and severe hearing loss as the number of CD4 increases (P > 0.05).

A study done in South Africa reported that the prevalence of HL in HIV/AIDS patients increases throughout the progression of the disease. However they did not consider the effect of ototoxic drugs such as ART and aminoglycosides that are used for the treatment of opportunistic infections thus some of the participants might have been exposed to the ototoxic drugs that could influence the prevalence of HL in the subjects.

An increase of HL was proportional through CDC categories with prevalence of 18%, 23% and 35% in CDC 1, 2, 3. However the findings were not statistically significant (P > 0.5).

A study in South Africa found that the prevalence of bilateral SNHL was 33% in CDC category 3, 26% in category 2 and 18% in category 1. This increase was found to be statistically significant (P < 0.05; chi-square). However, with CHL 15% category 1, 16% category 3 and 12% category 2. There was no statistically significant finding in the prevalence of CHL throughout the disease progression. It was concluded that high prevalence of SNHL at category 3, might be contributed by chronic CHL which lead to SNHL at later stage of the disease. Also patients with CDC category 3 most of them are on ART and treatment of opportunistic infection which increase the risk for SNHL due to ototoxicity effects to ototoxicity.

Study by Van der Westhuizen., *et al*. (2013) done in South Africa found that a significant increase (p <.05) in SNHL with disease progression however there was no statistically significant increase of HL with progression of the disease.

A study by De lange, (2007) done in South Africa and Sourcek and Micheals (1996) found that hearing loss defined at PTA > 25 dB display an increased prevalence with the progression of disease with 12%, 12% and 18% in CDC category 1, 2, 3 respectively. This increase was not statistically significant (P > 0.05, chi-square). The increase in SNHL was statistically significant with the progression of disease (P < 0.05, chi-square). However, the increase of CHL was not statistically significant with the progression of the disease (P > 0.05 chi-square). With the disease progression increase in the number of mild HL was also seen as well as an increased prevalence of bilateral SNHL.

With this study the findings were different from the previous studies which can be explained by the fact that the other studies used CDC classification which include both clinical and immunological staging which is slightly different compared to single classification. In this study most of the patients were on ART hence the increase in the prevalence as the increase in the CD4 can explain the ototoxic effect of some of the ART, neurological effect of HIV and the use of ototoxic drugs for the treatment of opportunistic infections.

Comparison on the prevalence of HL among those on ART and those not on ART

Out of 371 HIV/AIDS participants 80.6% were on ART, and 19.4% were not on ART. There was high prevalence of hearing loss in those not on ART 44.4% compared to in on those on ART. This finding was statistically significant (P < 0.05). SNHL was 20.8% conductive,15.6% and mixed 8.3% for those not on ART while SNHL was 18.7%, conductive 10.7% and mixed 1.0% for those on ART (P < 0.005). Mild hearing loss was high 23.5% with decrease in percentage as the degree of hearing loss increases. Among the two groups mild hearing loss was high 33.3% on those not on ART

compared to 21.1% for those on ART. With degree of hearing loss, the difference was not statistically significant (P > 0.05). The findings of this study were similar to the study done in Kenya and the ongoing study in Tanzania which found that use of ART improves hearing in HIV/AIDS patients.

A comparison study done in Kenya found that 34% of HIV positive patients not on ARVs had hearing loss compared to only 28% in patients who were on ARVs. SNHL was the most frequent hearing disorder in both groups. Majority of the patients had mild hearing loss. It was noted that HIV positive patients hearing level worsened on starting ARVs but this improved after six months of ARV treatment. In the ongoing cross-sectional study in Tanzania known as Dar-Dar program to establish the cause of hearing loss and site involved in the hearing system in HIV/AIDS patients preliminary results found that the prevalence of hearing loss was high among patients not on ART compared to the patients on ART. They also found that the effect of hearing loss was from the central rather than auditory nerve and cochlea. Thus, the use of ART improves the hearing although have some ototoxic effect in the ear.

Conclusion

The findings were corresponding well to certain findings that exist in the literature although some were different. This could be explained by different methodology used in some of the studies, different definitions of hearing loss, different tests used and the environments used to perform the test. Confounding factors such as noise exposure, use of ototoxic drugs, duration since onset of HIV and the duration of use of ART also may contribute to the difference compared to other studies. Such factors should be addressed in future studies so that clear correlation of the HIV and ART in the auditory system can be found.

Recommendation

- Further studies with objective tests such as (OAE, ABR, and BEPP) should be used with long time monitoring in the progress of HIV and auditory dysfunction so that we can be able to quantify further the effect and site involved with SNHL (central, neural, inner ear).

- A comparative study should be carried out to involve the pre-existing factors that may contribute to hearing loss such as noise exposure, age and use of ototoxic drugs. This will be able to provide information weather those factors are additive to hearing loss in patients with HIV.

- Serological staging (number of CD4) and clinical staging should be used together to predict the mechanisms of auditory dysfunction in HIV/AIDS patients and the effect of ART. Factors such as duration since the diagnosis of HIV and the duration of ART are also important factor in the effect of HIV or ART in the auditory system.

- Management of hearing loss aims in the rehabilitation by providing hearing aids, assistive hearing devices or cochlea implants. Thus, management of HIV/AIDS should involve the multidisciplinary team in the health system.

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