UNIVERSITY OF NAIROBI

PREVALENCE AND HANDICAP OF HEARING LOSS IN THE OLDER ADULT AT THE

KENYATTA NATIONAL HOSPITAL

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H58/68545/2011

Master of Medicine Otorhinolaryngology-Head and Neck Surgery

This dissertation is submitted in part fulfilment of the requirements for the award of the degree of Master of Medicine in Otorhinolaryngology-Head and Neck Surgery at the University of Nairobi.

STUDENT'S DECLARATION

I declare that this research dissertation is my own original work and has not been presented for a degree at any other university.

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ABBREVIATIONS

ABC –	Absolute Bone Conduction
dB-	decibel
ENT-	Ear, Nose and Throat
HHIE-S –	Hearing Handicap Index for the Elderly Screening version
HL –	Hearing level
HTN-	Hypertension
Hz –	Hertz
KHz -	Kilohertz
KNH-	Kenyatta National Hospital
NIHL –	Noise Induced Hearing Loss
PTA –	Pure Tone Audiometry
PTS –	Permanent Threshold Shifts
SPL –	Sound Pressure Level
TTS –	Temporary Threshold Shifts
UN-	United Nations
UON-	University of Nairobi
WHO-	World Health Organisation

ABSTRACT

Background

Hearing loss is the second most common chronic health problem in the older adult and a known to cause significant psychosocial embarrassment, stigma and a significant risk of environmental injury. It is an independent associated factor for early cognitive debility, Alzheimer's disease and dementia. Early identification of the condition may help preserve residual hearing, provide rehabilitation and psychosocial support.

Objective

To determine the prevalence and handicap of hearing loss in the older adult patient at the Kenyatta National Hospital (KNH).

Study Population and setting

Patients aged 60 years and above attending the outpatient clinics at KNH

Methodology

This was a cross-sectional study. Study subjects recruited from the adult outpatient clinics were informed of the study and consent was obtained. History and physical examination were undertaken followed by assessment with the Hearing Handicap Index for the Elderly Screening (HHIE-S). Finally, pure tone audiometry (PTA) was performed to evaluate the level of hearing loss. The data collected was analysed using SPSS version 22.

Results

There were 180 participants in the study, 60% were males and 40% were females with an age range from 60 years to 103 years. The prevalence of hearing loss was 80.6%. Majority of the hearing loss was sensorineural (58%), bilateral hearing loss was 66.7% and disabling hearing loss was 51.1%. Though most of the patients had significant hearing loss, only 22% reported mild to moderate handicap in the HHIE-S questionnaire. There was an increase in the threshold of hearing loss with increase in age.

Conclusion and recommendation

A large proportion of the elderly have disabling hearing loss that they are not aware of it. Routine PTA in the elderly would encourage early detection and intervention.

1.0 CHAPTER ONE: INTRODUCTION

Data from the World Health Organization (WHO) shows that 466 million people suffer from disabling hearing loss[1] of these 432 million are adults. Disabling hearing loss is characterised as hearing loss greater than 40 decibels (dB) in the better hearing ear in adults. Approximately one third of people over 65 years of age are affected by disabling hearing loss[1]. The prevalence of this type of hearing impairment in sub-Saharan Africa being 10.6%[1]. The most common causes of hearing loss in adults are encephalitis, chronic otitis media, presbycusis and otosclerosis[2].

The United Nations Project on Minimum Data Set for Ageing in Africa set the cut-off age for the older adult at 60 years[3]. Hearing loss is common in this population. Its prevalence as well as severity increases with age and it can affect one's quality of life and ability to function[2, 3]. There are a myriad of reasons for age-related hearing loss including presbycusis, ototoxicity and noise exposure. This creates a complex interaction of factors ranging from environmental to genetic which has made identifying the causes of hearing dysfunction in this age group difficult[4]. Initially thought to be incurable and unpreventable, new research has revealed that identification of cause(s), early care and even novel drugs may give protection and aid management of hearing dysfunction[5]. In the United States of America hearing loss affects approximately one third of adults between 61-70 years and in excess of 80% of those older than 85 years[6]. In Kenya the population above the age of 60 is estimated about 4.5% of total population[7]. The estimated hearing disability for those above 55 years of age was found to be 1.1%[8]

Persons with mild or moderate hearing loss may not notice the impairment due to its insidious onset. Only 20% of those above 65 years will self-report moderate to profound impairment[9].

Hearing loss in the older adult occurs insidiously and painlessly. This leads to a myriad of problems ranging from social characterised by withdrawal from social events and feeling of loneliness to psychological, manifested by paranoia, cognitive decline and dementia to life threatening situations such as inability to hear alarms, vehicles on the road or smoke alarms[10]. In 2013 Frank Lin et al[11] found that in elderly adults in Pittsburgh, Pennsylvania hearing loss was an independent associated factor for cognitive impairment. In the study, those with hearing loss had a 30-40% increase in cognitive impairment. Of these 24% had an increased risk of progression to early dementia and Alzheimer's disease.

1.1 Physiology of Hearing

The auditory system works to channel and convert sound pressure waves into electrical impulses that can be interpreted by the auditory centres in the brain (Figure 1). These interpretations are important not only in interpersonal communication but also as protective reflexes. The outer ear functions to collect and direct sound waves towards the middle ear. It also acts as an acoustic resonator for frequencies around 2-5 KHz, which are the most important in speech. The tympanic membrane and the ossicular chain serve not only to transmit sound but also to amplify the sound pressure with a net gain of a factor of seventeen.

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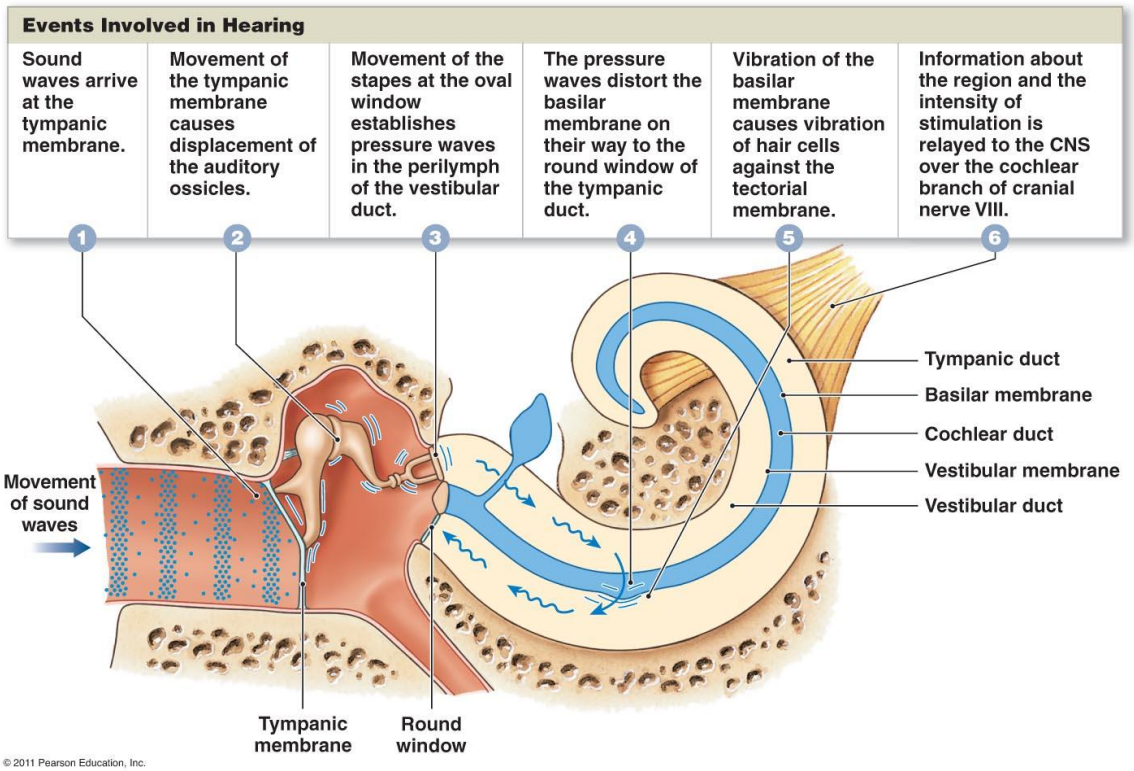


Figure 1: The physiology of hearing from the arrival of sound waves in the ear to their translation into information.

In the cochlear the sound pressure is converted to electrical impulse by the generation of action potentials. This is achieved by movement of hair cells within the cochlear. The electrical impulses are then conveyed to the brain by the cochlear nerve to its nuclei in the medulla. Afferent fibres from the nuclei carry information through the lateral lemniscus and inferior colliculi (midbrain) to the medial geniculate body and finally into the primary auditory cortex. Here the neural signal is converted to perceived sound and analysed by higher cortical areas to allow for understanding and association with memory.

1.2 Audiological Assessment

The aim of audiological testing is to:

a) Assess the state of hearing
b) Ascertain the degree, type and configuration of hearing loss
c) Screen patients for early and timely rehabilitation
d) Initiate appropriate intervention

There are simple bedside tests used for screening for hearing deficiencies. These include tuning fork tests such the Rinne, Weber, Schwabach, Gelle and absolute bone conduction (ABC) tests. Others such as the whisper test and watch tick test aid in detection of high or low frequency losses.

1.2.1 Rinne Test

This is a tuning fork test that is used to detect conductive defect. The preferred tuning fork frequency is 512 kilohertz (KHz) which has a specificity and sensitivity of 96% and 55% respectively[12].The 256KHz and 1024KHz tuning forks can also be used but have certain drawbacks. Tuning forks below 256 KHz are perceived as vibrations and those above 1024 KHz have a more rapid sound decay hence are less sensitive. Tuning fork test are limited in that in patients with moderately severe sensorineural loss and worse, sound produced from the tuning fork may not be perceived[13].

1.2.2 Weber Test

Weber test is a tuning fork test used as an adjunct to the Rinne test as patients with a profound sensorineural deafness may have a false Rinne negative. The way to distinguish

between a true and a false Rinne negative test is to perform Weber test. The latter is lateralised to the worst ear in conductive hearing loss, and the better in sensory neural loss. It has a lower sensitivity (60%) and specificity (69%) than the Rinne test[14].

A vibrating tuning fork is placed on the middle of the forehead or vertex or chin of the patient. The patient is instructed to specify which ear localises the sound better. In normal ear or bilateral equal hearing deficient there will be no difference between the two ears. This test is highly sensitive and identify unilateral hearing loss as low as a 5 dB difference between the ears[15].

1.2.3 Pure-tone Audiometry

Pure-tone audiometry (PTA) is a test used to measure hearing sensitivity. Pure-tone thresholds (PTTs) indicate the lowest sound audible to the subject in at least 50% of the time. PTA is the gold standard in screening for hearing loss[15] with a sensitivity of 50% and specificity of 78%[16]. It uses tonal sounds or clicks at different frequencies. The PTA test the dynamic human speech frequency ranges of 250-8000 Hz, although the human ear can make out sounds from 20-20,000 Hz. The presence of hearing loss is then graded using the WHO grading scale as seen in table 1

Table 1: WHO grading of hearing loss

Grade of hearing loss	Audiometric ISO level	Performance
0 (normal)	0-25 dBHL	Normal hearing
1 (mild)	26-40 dBHL	Trouble hearing soft speech
2 (moderate)	41-60 dBHL	Some difficulty hearing loud speech
3 (severe)	61-80 dBHL	Hears only loud speech and sounds
4 (profound)	>81 dBHL	Perceives sounds as vibrations

Disabling hearing loss is characterised as hearing loss of pure tone average of 40 decibels (dB) and above in the better hearing ear. The pure tone average is the average thresholds from the frequencies of 500Hz, 1000Hz, 2000Hz and 4000Hz. Deafness audiologically is when one is unable to comprehend speech in the presence of amplification of thresholds greater than 81dBHL (decibels Hearing Level) at 500Hz, 1000Hz, 2000Hz, and 4000Hz[17]. Total deafness is total lack of sound being heard, regardless of amplification or method of production.

1.3 Pathophysiology of the Ageing Ear

Changes with age may be seen throughout the auditory system, from the conductive to the sensory neural and even higher auditory centres. Conductive changes that occur with age include cartilaginous collapse of the external auditory canal[18], thickening of the tympanic membrane[19] and ossicular chain fixaton[20]. These though are thought to contribute little to hearing dysfunction. The sensory neural component – especially the cochlear – contribute the most to hearing impairment in the elderly[21, 22]. There are several mechanisms by which this occurs as seen in Table 2 below.

Table 2: Principal changes in the cochlea associated with age[18]

	Pathology	**Result**
Sensory	Loss of sensory cells in basal turn of cochlea	Abruptly sloping high frequency loss above the speech frequency range
Neural	Loss of cochlear neurons	Progressive loss of speech discrimination in the presence of stable pure tone thresholds
Strial	Metabolic and vascular changes within cochlea	Slowly progressive hearing loss with flattening of audiogram and good speech discrimination
Conductive	Changes in the conduction or resonance of the cochlear duct	Linear descending pattern on audiogram
Indeterminate	No pathological correlate identified. Possibly impaired cellular function	Flat and/or abrupt high tone hearing loss
Mixed	Combination of above	Mild to moderate high frequency loss

There exist numerous changes that affect the central auditory system. Physiological central neuronal loss seen with ageing coupled with the ageing peripheral auditory pathway leads to many older adults experiencing difficulties in speech recognition which are not proportional to the audiometric thresholds[23]. This is worsened when there is background noise requiring more complex auditory processing[24]. Cerebral cortical loss a physiological occurrence has also been associated with hearing loss at frequencies above 2000Hz[25].

1.4 Risk Factors for Hearing Loss in the Elderly

Additionally, adults are at greater risk of developing otologic diseases causing impairment such as Meniere's disease and otosclerosis, as well as systemic diseases such as hypertension[25], diabetes mellitus[26, 27], artherosclerosis[28] among others. The table below illustrates the myriad of factors that also contribute to hearing loss.

Table 3:Risk Factors for Age-Related Hearing Loss

RISK FACTOR	COMMENT
Alcohol	Occasional alcohol use may be protective vs. abuse possibly increases risk[4]
	Low or moderate alcohol consumption may interact with other nutritional elements, especially vitamin B_{12}
Family history	Genetic component in age of onset and severity[4,28]
Hormones	Oestrogen, aldosterone may be protective[4]
	Progesterone may increase risk of hearing loss[4]
Illicit drug use	Ecstasy (3,4-methylenedioxymethamphetamine) linked to ototoxicity
Industrial chemicals	Toluene, styrene shows increased risk of hearing loss[4]
Male	Younger age of onset and greater loss in men[4]
Comorbid conditions	Including diabetes, renal failure, atherosclerosis, immunosuppression, head injury
Medications	Salicylates, nonsteroidal anti-inflammatory drugs, acetaminophen, aminoglycosides, cisplatin, diuretics, topical preparations containing neomycin/polymixin B, quinine, tea tree oil, macrolides, vincristine, sildenafil
Noise	Occupational, leisure, military-related
Tobacco	Smoking history has minimal effect though may compound other associated factors, especially sex and occupational exposure[4]
Vitamin intake	No evidence for vitamins B_{12}, C, or E, or beta carotene reducing risk
	Some evidence for reduced risk with high folate intake[29]

1.5 Pathophysiology of Noise Induced Hearing Loss

Noise induced loss can occur as a one-time event or due continuous audiological insult of sound above 85dB. Acoustic trauma is exposure to sound of greater than 140dB sound pressure level (SPL) for less than 0.2 seconds. Within minutes of the exposure to loud noise oedema of the stria vascularis is noted. This progresses and is greatest at 24hrs post insult. This oedema may persist for days after the injury.

An inflammatory response within the cochlear is initiated in response to acoustic trauma leading to recruitment of leucocytes to the inner ear. These induce apoptosis and phagocytose the outer hair cells. Acoustic overstimulation can lead to damage of the cochlear microstructures to the stria vascularis. This leads to temporary (TTS) and permanent threshold shifts (PTS). Temporary threshold shifts are caused by decreased stiffness of the stereocillia of the outer hair cells as they become disorganised and flaccid. This is thought to be due to metabolic exhaustion resulting from continuous exposure but recovering if stimuli is removed. This also explains tinnitus after noise-induced hearing loss (NIHL). Permanent threshold shifts are associated with fusion of adjacent stereocillia and loss of stereocillia.

1.6 Pathophysiology of Hypertension Associated Hearing Loss

From the WHO World health report 2012[31] of every three people worldwide one has raised blood pressure. This vascular disorder affects hearing in several ways. High arterial pressures could lead to inner ear haemorrhage that may manifest as sudden or progressive hearing impairment[32]. Hypertension has been associated with raised blood viscosity which decreases blood flow at the capillaries thereby reducing oxygen levels leading to hypoxia in the inner ear[33]. Ionic changes occur in arterial hypertension altering cells potential thereby leading to hearing loss[34].

1.7 Pathophysiology of Diabetes Associated Hearing Loss

The high energy demands of the cochlear put it at risk for damage. Hyperglycaemia and hyperlipidaemia lead to increased blood viscosity which in turn reduces blood flow leading to hypoxia and metabolic derangement in the stria vascualris[35]. At the microvascular level there is a thickening of the capillary basement membrane leading to reduced vertex and basal flow and thereby ischaemia and hypoxia of the stria vascularis. The rate and size of thickening is directly related to the haemoglobin A1C (HbA1C) level.

2.0 CHAPTER TWO: LITERATURE REVIEW

Cruickshanks et al[6] undertook a study in the township Beaver Dam where a private census had been carried out for people aged 43-84 years for ocular and auditory screening. Of those who were screened prevalence of hearing loss was 45.9%. Mild hearing loss was present in 58.1% moderate in 30.6% and severe loss in 11.3% with HHIE score commensurate to the level of loss. Gates et al[33] undertook a similar study earlier in Framingham and auditory thresholds were similar to those in Beaver Dam. A more recent study by Lin et al[39] estimates hearing loss at 63.1% among Americans above the age of 65 with age, sex and race being the principal contributing factors.

In a review of age-related hearing loss prevalence in Europe by Roth et al[40] approximately 20% of women and 30% of men in Europe were found to have a hearing loss of 30 dBHL or more at age 70, and 45% of women and 55% men experience 30 dBHL hearing loss at age 80. These results were crudely averaged and interpolated. Due to differences in health service systems, classification of hearing loss and selection of population, neither developments over time nor geographic distribution could be extracted to a reasonable degree.

Among elderly in institutions, a study done by Ciurlia-Guy et al[41] at a veterans' chronic care facility found a prevalence of hearing loss at 69% and recommended conventional testing of all institutionalised elderly where possible.

There is a scarcity of studies on hearing loss in the older adult in Africa. In Nigeria Olaosun et al[42] studied 88 out of 526 patients who had reported for audiometric assessment. Of those studied 82% had an element of hearing loss. Of these, 8 out of 10 had disabling hearing loss. In this study of the elderly the median age was 72 years of age. This study however left out any patient with comorbidities that would be associated with hearing loss as well as having inconsistencies regarding recruitment of patients with wax impaction. In Cape Town Ramma L., Sebothoma B [43] studied a population of 2494 of whom 7.6% were above the age of 60 years. In this study 29% of males and 11.1% of females over 60 years were found to have debilitating hearing loss. Of those aged above 60, 38.9% had bilateral hearing loss.

Locally several studies have documented hearing loss due to occupational noise induced hearing loss[44], hypertension[45], renal disease[46], diabetes[27] and even autoimmune disease[47] but most these studies excluded the elderly patient.

The U.S. Preventive Services Task Force in its 2012 clinical considerations found a lack of evidence on screening approaches in respect to the type of test to be used, severity of hearing loss, age of the population to be screened, frequency and where screening should be

undertaken[48]. This was reported due to paucity of large studies and no standard in screening tools. Whereas the U.K. National Screening Committee in 2014 showed that screening tools did increase identification, some tests like the whisper test did not have high enough positive or negative predictive values while those that did such as the watch-tick test have not been sufficiently used in studies[49]. Boatman et al[50] showed that bedside hearing test had poor sensitivity but good specificity.

The hearing handicap inventory for the elderly was invented in 1982 by Ventry and Weinstein[50] who in the following year designed a Screening Version (HHIE-S), proposed as a screening tool find the degree of hearing deficiet[51]. In 2017 Servidoni and Oliveira[52] compared the HHIE-S with the standard of PTA in detecting hearing loss and found a 76.1% prevalence of hearing loss according to the questionnaire, compared to 79.7% using audiometry. They concluded that diagnostic accuracy was 86.2%, with a sensitivity of 89.1% and a specificity of 75.0%, with no gender predilection. The addition of the PTA to the HHIE-S by Calviti and Pereira[53] showed a better specificity at 63.4% and the best predictive value at 62.5%.

3.0 CHAPTER THREE: STUDY JUSTIFICATION

This study sought to ascertain the burden of hearing loss in the older adult patient in KNH. Hearing loss in the older adult has been associated with serious psychosocial problems such as depression and early onset dementia. Early identification and intervention have been found to be effective in staving off these problems. Locally there has been a paucity of data exclusively looking into the older adult and this study hopes to address that. Most studies done within KNH as earlier discussed have excluded those above 60 years old.

This is also in keeping with the Kenya Ministry of Health national strategy on ear and hearing care sections 2.2.6 and 2.2.7 on development and dissemination of health information and continued research into hearing health to reduce the paucity of data.

3.1 Study Objectives

3.1.1 Main Objective

- To determine the prevalence of hearing loss among the older adult patient in KNH

3.1.2 Specific Objective

- To determine the level of handicap due to hearing loss in the older adult patient
- To describe the pattern of hearing loss in the older adult patients
- To describe factors associated with hearing loss in the older adult patient

3.3 Study Methodology

3.3.1 Study Design

This was a hospital based cross sectional study.

3.3.2 Study Setting

The study was carried out in the adult outpatient clinics of KNH.

3.3.3 Study Population

The population included patients attending the surgical and medical clinics who were 60 years and above and met the inclusion criteria.

3.4 Sampling Procedure

Patients aged 60 years and above were referred by their attending doctors to the ENT clinic from the medical and surgical clinics through convenience sampling. Those who met the inclusion criteria were enrolled into the study. History was taken and physical examination carried out on each patient after which the HHIE was administered by the principle examiner and the research assistants. Once completed each patient in the study group underwent a PTA.

3.5 Participant Recruitment

3.5.1 Inclusion Criteria

Patients aged 60 years and above who could communicate and were willing to give consent

3.5.2 Exclusion Criteria

a) Patients who were unable to communicate

b) Patients who were unable or declined to give consent

3.6 Sample Size

Sample size calculation for finite population[54].

$$n = \frac{Nz^2pq}{E^2(N-1) + z^2pq}$$

n = Desired sample size

N = population size (number of patients above 60 years patients seen per week at most medical and surgical clinics in Kenyatta National Hospital per week is approximately 40, and for 2 months of the study duration the total will be approximately 320).

Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI)

p = expected true proportion (estimated at 50%)

$q = 1 - p$

E = desired precision (0.05)

$$n = \frac{320\ x\ 1.96^2\ x\ 0.50\ x\ 0.50}{0.05^2(320-1) + (1.96^2\ x\ 0.50\ x\ 0.50)} = 175$$

3.7 Data Collection Procedure

The research team consisted of the principal investigator and two research assistants who were senior registrars in the ENT department and a clinical audiologist whom the principal investigator had trained on the study protocols and parameters. Patients who met the above criteria were referred to the ENT clinic daily. Those who met the inclusion criteria underwent clerkship for history and physical examination which was augmented with the Weber and Rinne test. The hearing handicap index screening version for the elderly was administered. PTAs were performed using the modified Hughson-Westlake method[12] as recommended by the American Association on Hearing. Testing begun with the ear which the patient perceives to have better hearing. The tester presented a pure tone at a clearly audible level. After the

patient responded to the pure-tone signal, the tester decreased intensity by 10 dB and presented the tone again. If the patient responded to this tone, a "down 10" pattern was employed, with the tester decreasing the intensity of the tone by 10 dB and presenting a tone until the patient no longer responded[12]. The tester then increased tone intensity by 5 dB until the patient responded. This was performed at the following frequencies 250Hz, 500Hz, 1000Hz, 2000Hz, 4000Hz and 8000Hz. This method was used for both air conduction. For bone conduction testing the same method was used but at 500Hz, 1000Hz, 2000Hz and 4000Hz. The results were plotted on an audiogram and patients given their results. Patients who were found to have hearing loss were referred to the ENT clinic for routine follow-up and management as well as counselled on the importance of follow up and early rehabilitation.

3.8 Quality Control

Quality control was a continuous process to ensure results were reliable and could be replicated. A standard data collection tool was used by the principal investigator and research assistants to undertake the history and examination portion of data collection. The same 512Hz Heine tuning fork was used by all investigators as well as the same Heine otoscope for examination. The investigators undertook the administration of the HHIE-S which had been validated. The PTA was administered in the ENT department in the same testing room with the same PTA machine for all recruited patients. The PTA was carried out by a qualified audiologist on a calibrated PTA machine. The PTA machine used was an Interacoustic AC33 clinical audiometer.

3.9 Data Management

All data retrieved from completed questionnaires was stored using non-identifiers in a database using Microsoft excel to maintain confidentiality. The data was compiled, and cross checked for errors and rectified as per the questionnaires. The questionnaires were kept in a lockable cabinet with access restricted to the investigator and supervisors.

3.10 Data Analysis

The data collected was analysed using SPSS 22.0 statistical package. Descriptive analysis for continuous variables like age involved mean, standard deviation and range. The analysis of categorical data included calculation of percentages and frequency distributions. Correlation of variables was analysed using Fisher's exact test where statistical significance was determined by a p value of ≤ 0.05.

3.11 Ethical Considerations

The study was carried out after approval by the KNH/UON Ethics and Research Committee. Recruitment was by informed consent. The participants received full disclosure of the nature of the study. No extra cost was encountered by the patient. The cost for syringing and PTA was incurred by the principal researcher. Confidentiality was maintained by not using identifiers in biodata with codes and questionnaires locked and secured. At the end of the study the raw data was coded and backed up for further study. The results will be published in scientific journals and presented in medical conferences, regular print and electronic media where necessary for the benefit of the lay public. The study population was given their results and those found to have hearing impairment were recruited to the ENT clinic for rehabilitation and follow up. There were no conflicts of interest or otherwise in this study by the principal investigator, supervisors and the hospital. The patients had the right to withdraw from the study at any point without victimisation and without alteration of any treatment that they were undergoing.

4.0 CHAPTER FOUR: RESULTS

During the study a total of 180 patients were recruited and analysed from various clinics within Kenyatta National Hospital by convenience sampling.

4.1 Demographics

4.1.1 Age

There was a wide age range of 60yrs to 103yrs. The mean age of the sample population was 70.4yrs ±8.3yrs with the median of 69.5yrs. The frequency of the subjects was highest between the age of 60-69years at n= 90/180(50%), and only one patient who was 103 years of age as described in figure 2.

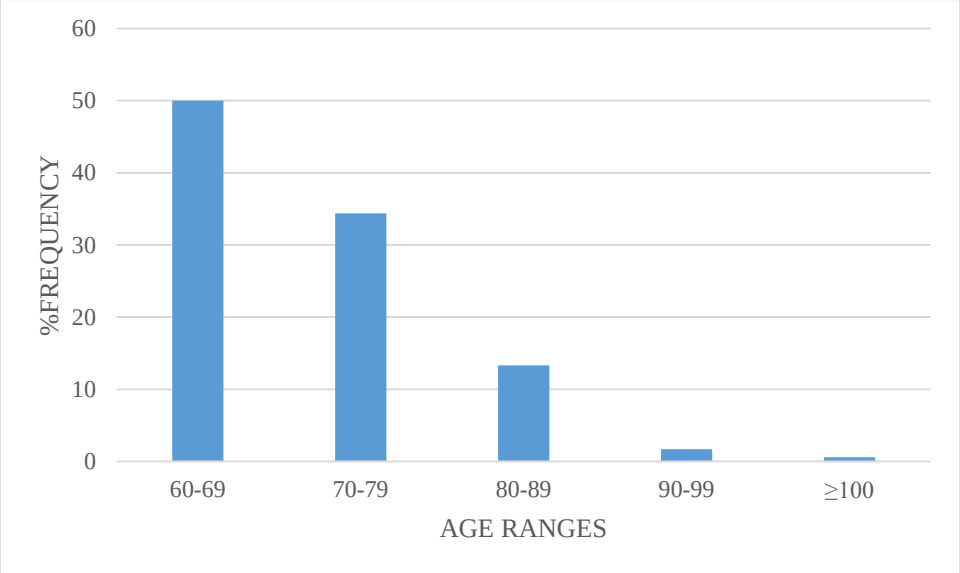


Figure 2: Age distribution

4.1.2 Gender

There was a total of 72 (40%) female subjects while the male were 108 (60%) with a Male: Female ratio of 1.5:1.

4.2 Hearing profile on Pure Tone Audiometry

After the history, examination and administration of the HHIE-S, PTA was performed on each of the subject population. These results were analysed to show pattern of loss, types of loss and compared with other study parameters as shown in the tables and graphs below.

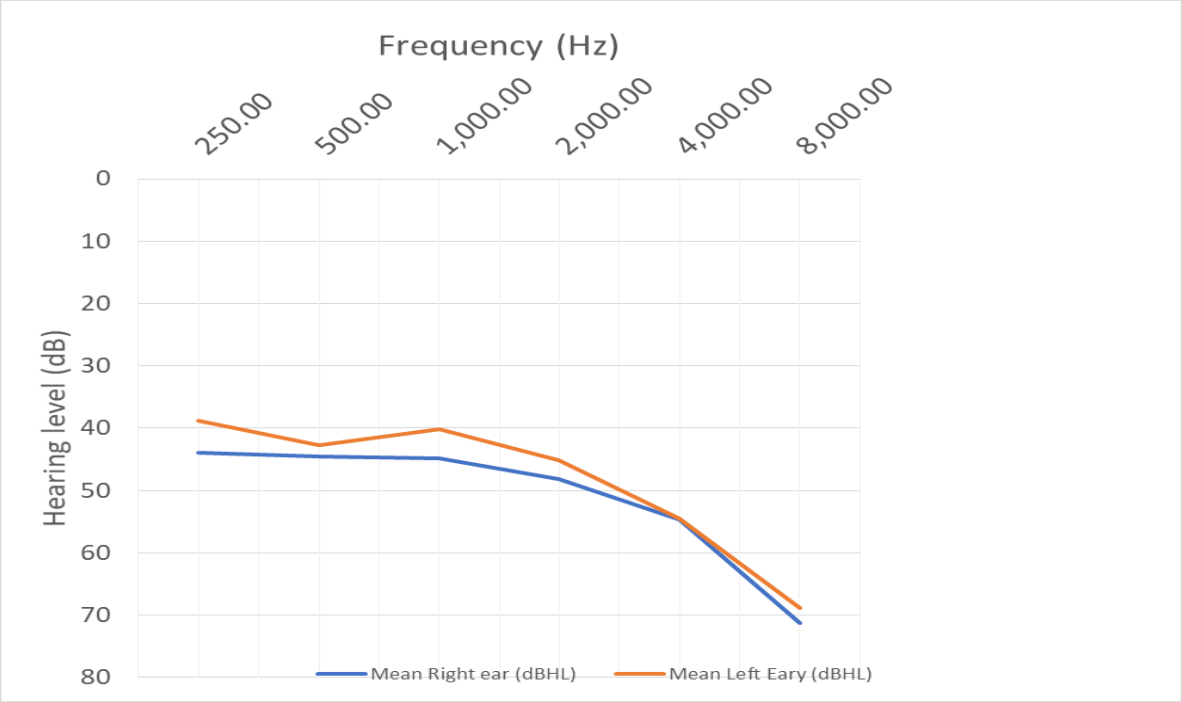


Figure 3: Audiometric averages and configuration

Figure 3 above shows the mean decibel hearing level at 250, 500, 1000, 2000, 4000, and 8000 hertz for the left and the right ear. The averages for the right and left ear were 48dbhl and 45.6dbhl respectively. The averages at 250Hz were 38.8dbhl on the left and 43.9dbhl in the right with a noted worsening of hearing as frequencies increased. There was a marked dip at 8000Hz with averages of 68.8dbhl on the left and 71.2dbhl on the right.

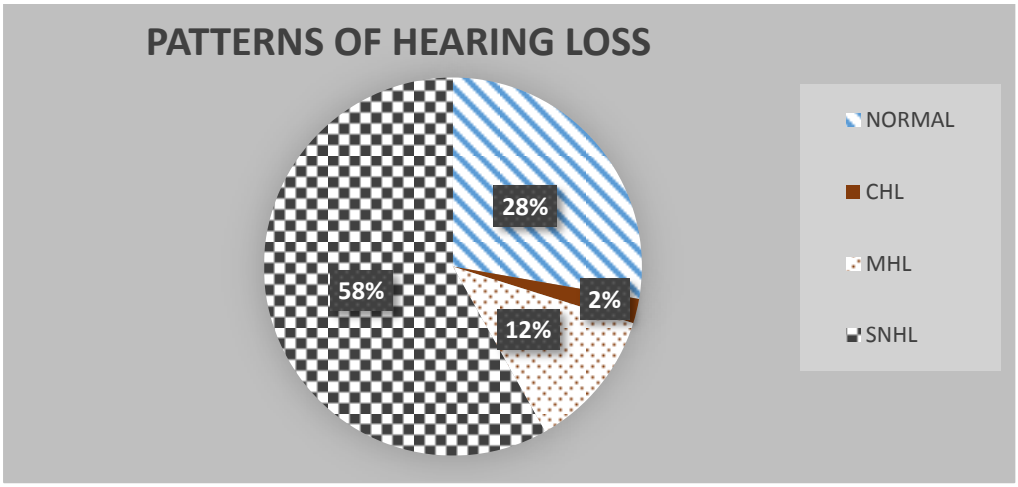
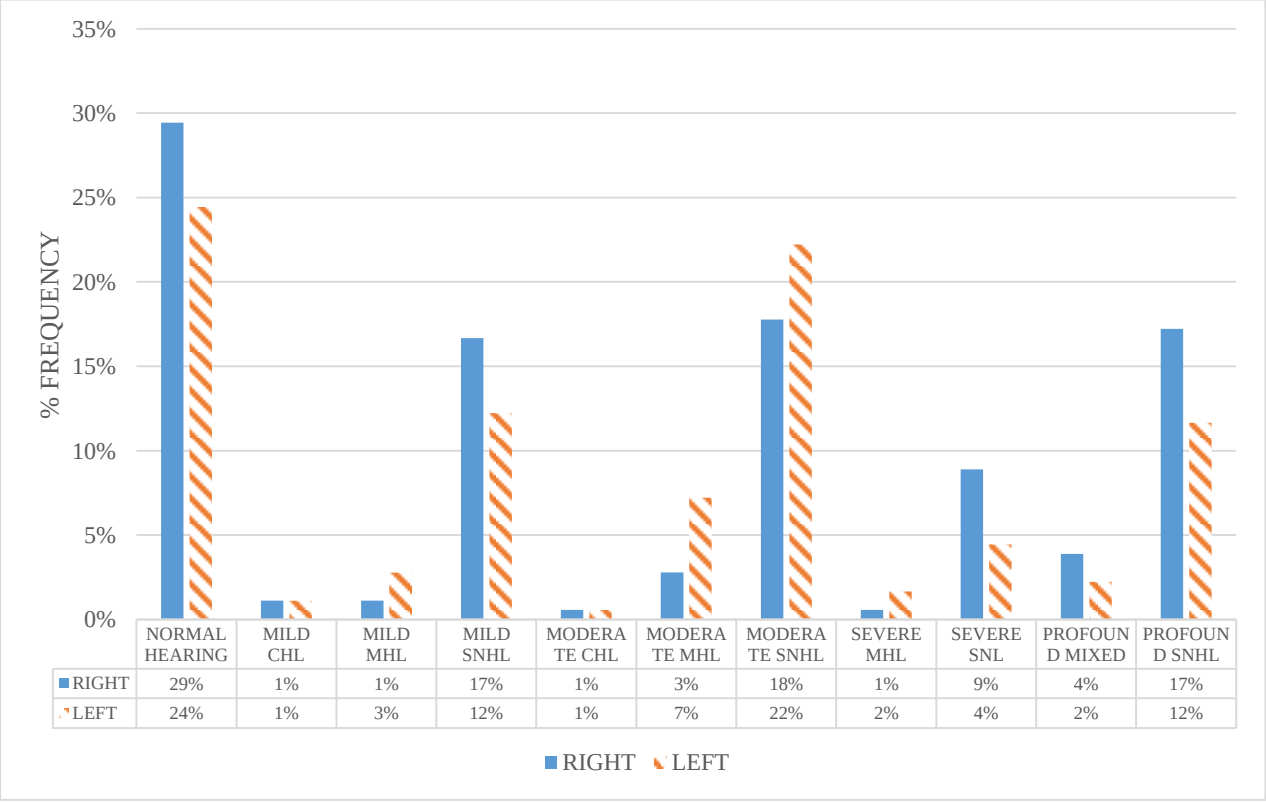


Figure 4: Distribution of patterns of hearing loss in the study population

Figure 4 shows the distribution of hearing loss among the entire study population. Normal hearing was noted in 28%, sensorineural hearing loss (SNHL) formed the majority of the cases at 58% while conductive hearing loss (CHL) had the least occurrence at 2%.



	NORMAL HEARING	MILD CHL	MILD MHL	MILD SNHL	MODERATE CHL	MODERATE MHL	MODERATE SNHL	SEVERE MHL	SEVERE SNL	PROFOUND MIXED	PROFOUND SNHL
RIGHT	29%	1%	1%	17%	1%	3%	18%	1%	9%	4%	17%
LEFT	24%	1%	3%	12%	1%	7%	22%	2%	4%	2%	12%

Figure 5: Pattern of hearing loss in the right and left ears

Figure 5 shows the pattern of hearing loss encountered in the patients recruited. Overall, sensorineural hearing loss was the most common form of hearing loss. No one side between the ears is seen to have more or less affliction.

4.3 Prevalence of hearing loss

Hearing loss in at least one ear was observed in n=145(80.6%) subjects. Prevalence of hearing loss in the right ear was 137(76.1%) and the left ear was 128(71.1%). Bilateral hearing loss was noted in n=120(66.7%) subjects and unilateral hearing loss in n=25(33.3%). The prevalence of disabling hearing loss was 51.1% (n=92). The mean duration of loss was 2.95yrs ± 4.38yrs with a median of 0.05yrs and a range of 0 to 20yrs.

Table 4: Presence of Hearing Loss According to Age

AGE GROUP	PRESENCE OF HEARING LOSS	NO HEARING LOSS	TOTAL	P-VALUE
60-69	61(67.8%)	29(32.2%)	**90**	<0.001
70-79	57(91.9%)	5(8.1%)	**62**	
80-89	23(95.8%)	1(4.2%)	**24**	
90-99	3(100%)	0	**3**	
>100	1(100%)	0	**1**	
TOTAL	**145(80.6%)**	**35(19.4%)**	**180(100%)**	

Table 4 shows demographic distribution of mean levels of hearing. There were higher levels of hearing loss with increase in age but no statistical difference between the two ears (p value 0.14)

Table 5: Hearing Loss in Relation to Gender

GENDER	PRESENCE OF HEARING LOSS	NO HEARING LOSS	TOTAL	P-VALUE
MALE	89(82.4%)	19(17.6%)	**108**	0.28
FEMALE	59(81.9%)	16(18.1)	**72**	
TOTAL	**145(80.6%)**	**35(19.4%)**	**180(100%)**	

Table 5 shows the distribution between the sexes. It was found that there was no statistically significant difference in hearing loss between males and females (*p*-value=0.28).

4.4 Hearing Handicap Index for the Elderly Screening Version

After the history and examination of the subject the HHIE-S was administered to the subject populace. The aim was to measure the level of handicap suffered from hearing loss. The results are displayed in table 6.

Table 6: Results of the Hearing Handicap Index

INDEX	FREQUENCY (%)
NO HANDICAP	137(77.8)
MILD TO MODERATE	39(22.2)
SEVERE HANDICAP	0(0)

Table 7 describes the results from the hearing handicap index for the elderly screening version results. It brought out that majority of the study population reported no handicap 77.8%, with 22.2% reporting mild to moderate handicap and no report of severe loss. Only 176 of the 180 were able to complete the HHIE-S questionnaire due to inability to adequately translate some of the questions into local languages

4.4.1 Hearing loss in relation to the hearing handicap index of the elderly

The HHIE-S results were compared with the PTA results and comparisons draw in the tables below.

Table 7:Hearing Handicap Index and Level of Hearing Loss

SEVERITY OF HEARING LOSS AS BY HHIE-S	Mean hearing level (dBHL)	N	SD
NO HANDICAP	33.9	137	19.2
MILD-MODERATE	69.8	39	20.6
TOTAL	41.8	176	24.5

Table 7 above shows the association between perception of handicap and the actual average of hearing loss. Average loss for the no handicap cohort was in the mild hearing loss range whereas the mild to moderate group was in severe hearing range. No patient reported severe handicap.

Table 8:Hearing Handicap Index and Type of Hearing Loss

HEARING LOSS	**HEARING HANDICAP SEVERITY INDEX**		**TOTAL**	**P-VALUE**
	NO HANDICAP	**MILD TO MODERATE**		
NORMAL HEARING	56	0	**56**	
MILD HEARING LOSS	34	1	**34**	
MODERATE HEARING LOSS	31	15	**36**	
SEVERE HEARING LOSS	12	9	**36**	
PROFOUND HEARING LOSS	4	14	**17**	
				<0.001
TOTAL	**137**	**39**	**176**	

Those with hearing loss and no reported handicap were 81 which was 46.0% of the subjects who underwent the HHIE-S.

4.5 Perception of Hearing Loss

Table 9 describes the self-reporting of hearing deficit among the study group. More than 54 % of the population reported no loss and a further 6.2 had been informed by others that they had hearing loss. 39.4 % perceived that they had hearing loss.

Table 9:Perception of Hearing Loss

PERCEPTION OF HEARING LOSS	N	%
NO HEARING LOSS	98	54.4
PERCEIVED HEARING LOSS	71	39.4
WAS TOLD BY OTHERS	11	6.2
TOTAL	180	100

4.5.1 Comparison between PTA and self-reporting of hearing loss

An analysis was performed on the correlation between the subjects' perception of their hearing status and audiometric results of their better hearing ear. Table 10 below shows the population frequency of the type of hearing and self-perception of hearing loss. We found that 45 out of 98(45.9%) had an element of hearing loss which they did not perceive.

Table 10:: Diagnosis of hearing loss in comparison to Perception of hearing loss

	DIAGNOSIS	NO HEARING LOSS	PERCEIVED HEARING LOSS	WAS TOLD BY OTHERS	TOTAL	P-VALUE
	NORMAL HEARING	53	3	0	**56**	
Mild	MHL	3	0	0	**3**	
	SNHL	24	6	2	**32**	
Moderate	MHL	0	9	1	**10**	
	SNHL	16	18	4	**38**	
Severe	MHL	0	1	0	**1**	
	SNHL	2	16	3	**21**	
Profound	MHL	0	1	0	**1**	
	SHNL	0	17	1	**18**	
						P<0.001
	TOTAL	**98**	**71**	**11**	**180**	**TOTAL**

4.6 Factors associated with hearing loss

4.6.1 Comorbidity

A small group of factors associated with hearing loss were identified in the history and the figure below shows their distribution.

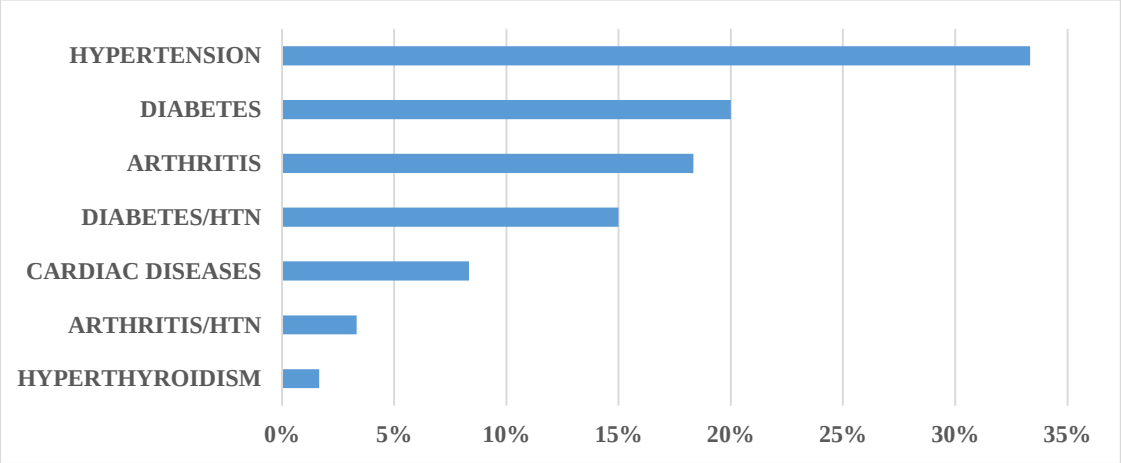


Figure 6: Demographics of the study population with Systemic Disease

Figure 6 describes comorbid factors that are associated with hearing loss at any age. In this study, 60 (33.3%) subjects were found to have comorbidities that are associated with hearing loss. Patient with existing comorbid conditions were analysed for hearing loss and compared with those without comorbid conditions.

Table 11: Presence of Co-morbidity and Hearing Loss

COMORBIDITY	HAD HEARING LOSS	HAD NO HEARING LOSS	P-VALUE
ARTHRITIS	10	1	
CARDIAC DISEASE	5	0	
DIABETES	11	1	
DIABETES/HTN	8	1	**0.25**
HYPERTENSION	13	7	
HYPERTENSION/ARTHRITS	2	0	
HYPERTHYROIDISM	0	1	
NO COMORBIDITY	96	24	

Table 11 above reveals that patients with comorbidities had a slightly higher prevalence of hearing loss of 81.7% (n=49/60) than those without comorbidities at 80% (n=96/120) but this wasn't statistically significant (*p*-value =0.25).

4.6.2 Occupational history

We polled the target population on their occupation. Most had multiple income generating activities not only throughout their careers but also at time of interview. None reported being exposure to loud noise. Those in occupations associated with high noise exposure like construction and police showed no increase in prevalence of hearing loss (p value 0.83).

4.6.3 History of Cigarette use

Each patient was asked about a history of cigarette use at any time in their life. This though was not quantified with duration and types of tobacco used.

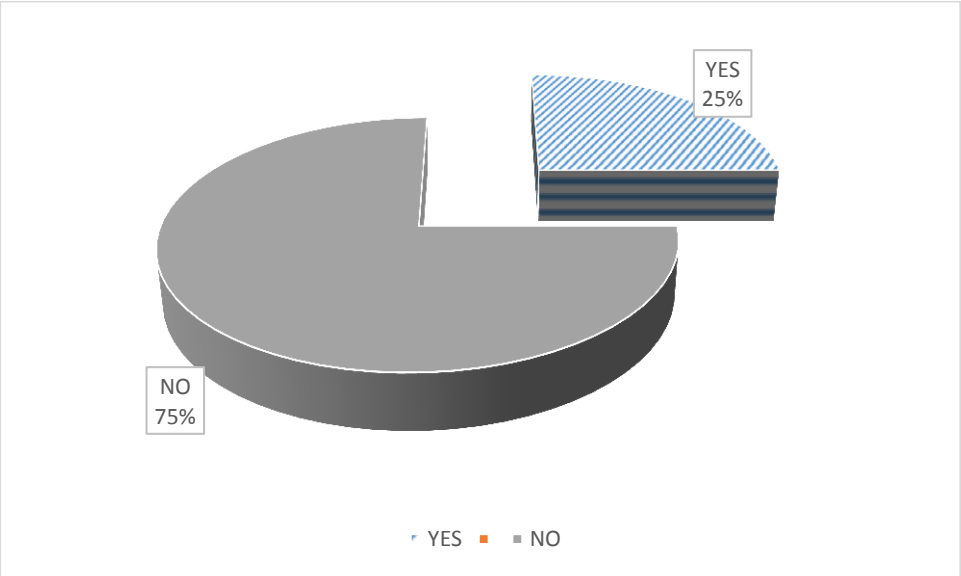


Figure 7: Distribution of history of cigarette smoking

Figure 7 shows that majority of our patients had no history of cigarette smoking

4.6.4 Hearing loss and cigarette use

We analysed the association between cigarette use and presence of hearing loss and found the results displayed in the table below

Table 12:Association between hearing loss and cigarette use

		PRESENCE OF HEARING LOSS		Total
		NO	YES	
CIGARETTE	**NO**	27	108	**135**
	YES	8	37	**45**
Total		**35**	**145**	**180**

Table 12 reveal that there was no statistical significance (p-value=0.83) in the association between the presence of hearing loss and use of cigarettes.

4.6.5 History of Alcohol use

We asked the target population about any history of alcohol consumption throughout their lives and the responses were charted below.

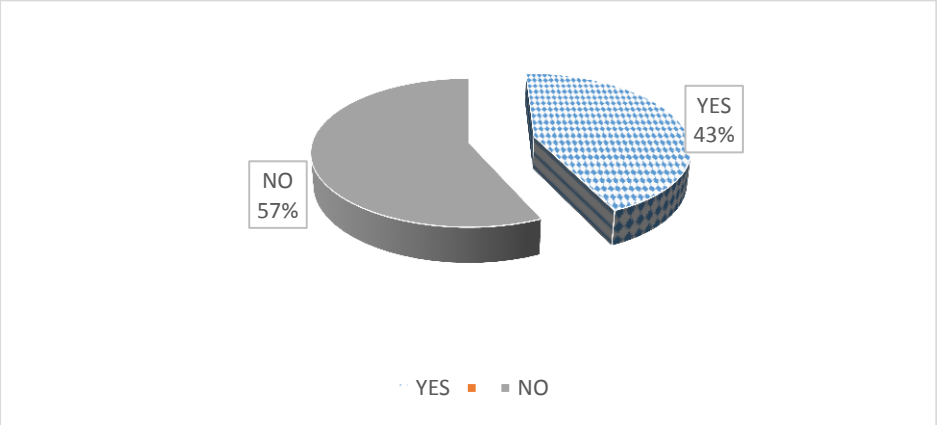


Figure 8; Distribution of population with history of alcohol intake

Figure 8 demonstrates that those subjects with no history of alcohol intake were the majority at 57%.

4.6.6 Hearing loss and alcohol use

Hearing loss and alcohol were correlated, and the results noted below.

Table 13:Association between hearing loss and alcohol use

		PRESENCE OF HEARING LOSS		TOTAL
		NO	**YES**	
ALCOHOL	**NO**	19	83	**102**
	YES	16	62	**78**
TOTAL		**35**	**145**	**180**

We also found that there also was no statistical significance (p-value=0.85) between the use of alcohol and presence of hearing loss.

5.0 CHAPTER FIVE: DISCUSSION

The purpose of this study was to quantify and qualify the hearing loss occurring in patients aged 60 years and above who are attending clinics in Kenyatta National Hospital. This is a population that generally has health concerns that lead them to attend various clinics within the institution thus it is important to conduct hearing screening in these patients. The study also hoped to form a basis for hearing loss protocols within the hospital and improve volume of scientific data on hearing loss in the elderly.

The study found that 80.6% of the study participants had an element of hearing loss. This is in keeping with the study done in Nigeria[41] but was higher than those done at Beaver Dam where they had lower ages[6] and Cape Town[42] which was a community-based study. It was noted that 120(66.7%) patients had bilateral hearing loss which is similar to the study done at the veterans chronic care facility[39].The averages at the frequencies used for diagnosis were higher than 40dBHL which WHO deems as disabling hearing loss[1] we found a prevalence of 51.1%. The male to female ratio in our study was 1.5:1 which had a higher male preponderance than the average ratio of adult clinic visits of male to female ratio of 1:2.3. We alluded this to the presence of a heavy attended antenatal and post-natal clinics. Lin et al[55] showed the exponential risk of developing dementia of 20% with every 10dB loss above 25dB HL thus, 145 of the patients are at risk of cognitive decline. This information should be conveyed to the patients and their families and that intervention is available. Early intervention with hearing aids, auditory rehabilitation or cochlear implants has been shown to improvement in memory, cognitive state and depression[59].

Majority of the study population with hearing loss has sensorineural hearing loss and with 66.7% bilateral. This is in keeping with features of an aging ear[23, 24,25,26,27]. With increase in age we found that there is a statistically significant increase in hearing loss severity consistent with Cruikshank's study[6]. It was noted that those with systemic illnesses had a higher prevalence of hearing loss though this was statistically insignificant when compared with those without co-morbid conditions. We want to infer that this may be because these conditions are under management hence, they have not severely affected hearing health

In 2014 Kenya was found to have the highest rate of cigarette smoking in Sub-Saharan Africa at 11.6% (2.5 million)[58]. Our prevalence was slightly higher at 25%. We investigated any association between cigarette smoking and hearing deficit and found no correlation between

the two. This was not in keeping with various studies showing that cigarette smoking was associated with hearing loss, even passive smoking[59,60].

Alcohol use yielded no statistical significance in the development of hearing loss. Piers et al[59] found that moderate alcohol intake(one to two drinks per day) was actually protective for development of hearing loss but more than this the protective factor was lost but there was no increase in the risk of developing hearing loss.

In the left ear 48 out of 98 subjects who reported no loss had some element of hearing loss. Conversely in the right ear 55 of these 98 had loss. This represents an average of 50% of the subjects regardless of the ear of deficit. This is in keeping with Fook and Morgan's review of hearing impairment in the older people[10]. For this reason, public health awareness should be geared at screening all persons above 60 years of age and should be driven by the health care professionals. Less than half (45.6%) of the patients included in this study reported hearing loss, either by self-awareness or being informed by others. This is higher than the study by Chou et al[9] but still shows that many older adults may have hearing loss. It is therefore important to catch these individuals at first contact.

In relation to the hearing handicap index for the elderly screening version (HHIE-S) we find that the averages of hearing loss level were on the lower spectrum of mild hearing loss for those who reported no handicap while those in mild to moderate handicap cohort this was in the range of severe hearing loss range. The tool only revealed hearing loss in 22.2% of the population in either the right or left ear. More studies into the utility of the tool may be required in our local set-up. Inference may be made that the tool may require to be amended to suit social and psychological profiles of our local region as most were not embarrassed by hearing loss and colloquially most did not attend any restaurants. It could be inferred that our population does not view hearing loss in the elderly as a handicap. The reason for use of this tool in the study was to find out if it could be used as an effective screening tool for detecting hearing loss in our older adult patients. Pure tone audiometry proved an easy diagnostic implement as all subjects had no difficulty in understanding the instructions provided and allowing for quick administration of the test. As earlier discussed, it is the gold standard in screening[12] and proved effective in detecting hearing loss.

5.1 Limitations

The HHIE-S was in English and had no version in local languages.

This was a hospital-based study not a community based study and may not give a true and accurate reflection of the national disease burden when it pertains to hearing loss in those above the age of 60yrs.

5.2 Conclusions

The prevalence of hearing loss in the older adult attending clinic at Kenyatta National Hospital is high. It is also noted that majority of patients do not perceive that they have hearing loss and a large proportion of those with hearing loss do not consider their loss as a handicap. It is also realised that the HHIE-S will show handicap in the population with severe to profound hearing loss.

5.3 Recommendations

Patients 60 years and above should have early screening for hearing loss on first contact in any clinic within the hospital. Patients of 60 years and above should be counselled on the availability and benefit of intervention for the hearing loss. More studies should be conducted on tailoring the HHIE-S tool to the local cultural and social practices.

Provide patients of 60 years and above and their families with the information from this paper and other studies that show the prevalence of hearing loss in the elderly as well as the benefits of early intervention and the options of intervention available to them.

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TIMELINE

PERIOD	ACTIVITY
September 2017- May 2018	Proposal writing
May 2018	Proposal presentation
June 2018-August 2018	Corrections
August 2018- September 2018	Ethics Approval
November 2018- December 2018	Data Collection
January 2019- February 2019	Report writing and submission of results

BUDGET

Stationery	40,000kes
Syringing	56,000kes
PTA	175,000kes
statistician	40,000kes
Research assistants	40,000kes
Miscellaneous	12,000kes
TOTAL	363,000kes

APPENDICES

Appendix I(a) Consent-General Information Sheet (English)

My name is Dr. Nicholas Ngugi Njuguna. I am a registrar doctor in the Otolaryngology Head and Neck Surgical Unit. I would like to seek consent from you to participate in a study aimed at determining the prevalence of hearing loss in patients above the age of 60 years old attending clinic in Kenyatta National Hospital. People above the 60 years of age are at a risk of developing hearing loss due to the natural ageing processes, systemic diseases such as hypertension, diabetes and renal failure or past insults such as high noise exposure and ototoxic medications.

The aim of this study is to find out how many of our older patient have hearing loss even if they cannot sense it. This will also allow us to identify those who are high risk for hearing impairment and implement early rehabilitation.

Your participation is completely voluntary and you may choose to opt out of the study at any point without fear of discrimination or victimisation. Secondly the participation in this study will not influence or interfere with the management of any other condition.

All information obtained in the course of the study shall be held in confidence. Your results shall be released to you at the end of the testing. No names or identifying characteristics shall be used to maintain confidentiality. All documentation shall be stored in a secure area and electronic data shall be password protected.

You will not be exposed to any risks if you consent to participate. Once consent is granted, a medical history will be taken and a thorough clinical examination performed. Thereafter a hearing handicap assessment will be performed and a hearing test know as a pure tone audiometry carried out.

The merit of this study will come in the early detection of any hearing loss and follow up in the Ear Nose and Throat clinic. Early intervention will mean return to most social activities as well as slow cognitive and psychosocial decline.

You will be given the opportunity to ask questions before you accept and you may talk to anyone you are comfortable with about the research before making your decision. You may seek any further clarification from me or my supervisors through the contacts given below.

If you agree to participate, you will be asked to provide some minimal information about you. Your name will not appear in any document. You will only be identified by a number and only the researchers can relate the number to you as a person. This information will not be

shared with anyone unless authorized by the Kenyatta National Hospital/University of Nairobi - Ethics and Research Committee (KNH/UoN-ERC).

Like all scientific information I will seek to share our findings with other people undertaking similar studies therefore we may publish our findings in scientific journals or present them in scientific meetings.

The results of this research will be beneficial in identifying those patients with hearing loss in the Kenyatta National Hospital setup.

There will be no extra cost incurred for participating in this study.

You will not be denied medical care in case you refuse to participate in the study. You may stop participating at any time with no consequences whatsoever.

Please feel free to seek additional information through the contacts given below;

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Appendix I(b) Consent-General Information Sheet (Swahili)

MWISHONI (a) IDHINI – Ukurasa wa ujumbe wa jumla NYONGEZA/ZIADA

Jina langu ni Daktari Ngugi Njuguna. Mimi ni daktari mkufunzi katika idara ya masikio, mapua na koo inayoshughulikia sehemu ya upasuaji wa Kichwa na shingo.

Ningependa kuomba idhini au ruhusa ya kufahamu kiwango au kiasi cha wagonjwa waliozidi umri wa miaka sitini (60) walio katika uwezo wa kusikia kufuatia hali ya uzee au kuzeeka au hali nyingine kama vile ugonjwa wa msongo wa roho na, ugonjwa wa kisukari na ugonjwa wa figo na madhara mengine kutokana na kilele kubwa na matibabu yanayoacha chembechembe za sumu mwilini.

Lengo la utafiti huu ni kuweza kutambua ni wangapi miongoni mwa wazee wetu ambao wanakabiliwa na tisho la kupoteza uwezo wa kusikia hata ingawa wenyewe hawafahamu kuwa wana tatizo hilo. Utafititi huu utatusaidia kutambua wale walio katika hatari ya kupoteza uwezo wao wa kusikia hili tuweze kurekebisha hali hiyo mapema kwa kuwapa matibabu mapema.

Kushiriki kwako ni kwa hiari kabisa na una Uhuru wa kujiondoa kwenye utafiti huu wakati wowote bila kuhofia kubaguliwa. Jambo la pili ni kuwa utafiti huu hautaathiri wala kuchochea matibabu ya ugonjwa mwingine wowote ambao unaugua.

Habari zote ambazo tutapata kutokana na utafiti huu zitahifadhiwa kwa njia ya faraga wa hali ya juu. Baada ya utafiti kumalizika utapewa matokeo au majibu yako. Ili kuhifadhi usiri wa habari hizi hazitawekwa majina au ithibati zozote za utambulishaji. Habari zote zilizoandikwa zitahifadhiwa vizuri mahali panapofungwa vyema na kwa njia ya kidijitali ambapo zitapewa nywila fiche au ya siri.

Ukikubali kushiriki katika utafiti huu hutajipata katika hatari yoyote punde tu utakapotoa idhini ya kufanyiwa utafiti utatoa historia yako ya matibabu kasha utafanyiwa uchunguzi wa kina/undani kabisa wa mwili mzima. Baada ya uchunguzi huu utafanyiwa ukaguzi wa kubaini uwezo wako wa kusikia na iwapo kuna vikwazo vyovyote vinavyosababisha kutosikia.

Ubora wa utafiti huu utaonekana katika kutambua kwa hali ya kutosikia na kuendeleza matibabu ya masikio, pua and koo kwenye kiliniki maalum. Tiba ya mapema itamaanisha kuwa hali ya uwezo wa kusikia itaimarishwa. Vilevile kasiya kudorora kwa uwezo wa kusikia itapungua. Wazee hawatapoteza uwezo wa kusikia haraka

Utapewa Fursa ya kuuliza maswali kabla ukubali kufanyiwa utafiti huu. Una uhuru wa kushauriana na mtu mwingine yeyote ambaye unapenda kuhusu utafiti huu kabla ufanye uamuzi wa mwisho

Una uhuru wa kniuliza maswali zaidi au ufafanuzi zaidi kuhusu utafiti huu au uwaulize walimu au wakaguzi wangu kwa kutumia anwani nilizotoa hapo mwishoni.

Ukikubali kushiriki katika utafiti huu utaombwa kutoa habari muhimu zinazokuhusu.Jina lako halitaandikwa popote kwenye habari hizi. Utatambulishwa kwa nambari ambapo watafiti watairejelea kama mtu. Habari hizi hazitapewa mtu mwingine yeyote ijapokuwa wale tu walioidhinishwa na hospitali kuu ya Kenyatta chuo cha kamati ya maadili na utafiti.

Kama ilivyo kawaida ya utafiti wowote wa kisayansi nitajadili matokeo ya utafiti huu na madaktari wenzangu wanaofanya utafiti sawa na huu kwa hivyo huenda tutachapisha matokeo haya katika majarida ya kisayansi au kayawasilisha katika mikutano ya kisayansi.

Matokeo ya utafiti huu yatasaidia katika kuwatambua wagonjwa wenye upungufu wa kusikia katika hospitali kuu ya Kenyatta yote.

Hutatozwa malipo yote ya kugharamia uchunguzi huu. Hutazuiliwa kupata matibabu yoyote ikiwa utakataa kushiriki katika utafiti huu.Waweza kukoma kuendelea na utafiti wakati wowote na hutaathirika kwa njia yoyote.

Tafadhali kuwa huru kutafuta habari zaidi kwa kuwasilianan name kupitia kwa anwani zifuatazo.

Au

Tafadhali jisikie huru kutafuta habari zaidi kwa kuwasiliana name kupitia kwa anwani zifuatazo

Sekretari – KNH/UON – ERC
S.L.P 20723,00202 KNH,
NAIROBI

Nambari ya simu 020 726 300-9
Barua pepe – uonknh-erc@uonbi.ac.ke
Tovuti – http://www.ercuonbi.ac.ke

Part I: Consent Certificate by the Patient/ Next-of-kin

I……..freely give consent for my kin (Name…….) to take part in the study conducted by Dr. Ngugi Nicholas Njuguna, the nature of which has been explained to me by him/ his research assistant. I have been informed and have understood that my participation is entirely voluntary and I understand that I am free to withdraw my consent at any time if I so wish and this will not in any way alter the care being given to me/ my kin. The results of the study may directly be of benefit to me, my kin and other patients.

……

Signature/ left thumb print (Self/ Next of kin)

Date……

Thumb print of participant if

Unable to sign due to illiteracy

Statement by the witness if patient/ kin is illiterate:

I have witnessed the accurate reading of the consent form to the participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness…….Signature of Witness…….Date……

Sehemu ya 1: Fomu ya makubaliano

Wanaojua kusoma na kuandika

Nimeelezewa utafiti huu kwa kina. Nimekubali kushiriki utafiti huu kwa hiari yangu. Nimepata wakati wa kuuliza maswali na nimeelewa kuwa iwaponina maswali zaidi, ninaweza kumuuliza mtafiti mkuu au watafiti waliotajwa hapo awali.

Jina la Mshiriki_____

Sahihiyamshiriki_____

Tarehe._____

Kwa wasioweza kusoma na kuandika:

Nimeshuhudia kusomewa na maelezo ya utafiti huu kwa mshiriki. Mshiriki amepewa nafasi ya kuuliza maswali. Nathibitisha kuwa mshiriki alipeana ruhusa ya kushiriki bila ya kulazimishwa.

Jina la shahidi_____

Alama ya kidole ya mshiriki

Sahihi la shahidi_____

Tarehe. _____

Appendix II (a): Data Collection Tool (English)

BIODATA

Initials: _____

Gender: ☐ ☐

Age: _____

Home County: _____

HISTORY

Do you have any difficulty hearing?

YES ☐ NO ☐

1. How did you know you had hearing difficulties?

I FEEL IT ☐ TOLD BY OTHERS ☐

2. Duration of hearing difficulty _____
3. Onset:

SUDDEN ☐ GRADUAL ☐

UNILATERAL ☐ BILATERAL ☐

4. Which ear has worse hearing?

RIGHT ☐ LEFT ☐ BOTH EQUAL ☐

5. What is your functioning capability?
    - Can you hear and understand? ☐

- Do you hear only loud noise? ☐
- Is hearing worse in crowds? ☐

6. Is hearing loss:

CONSTANT ☐ FLACTUATING ☐

7. Do you have any associated ear symptom?

VERTIGO ☐ TINNITUS ☐ OTALGIA ☐ OTORRHOEA ☐

8. Occupation_____
9. History of noise exposure:
10. Systemic diseases:
11. Alcohol use:
12. Cigarette use:
13. Past medical history (use of ototoxic drugs, chemotherapy and radiotherapy)
14. Familial history of hearing loss:

YES ☐ NO ☐

Examination

General examination: HR _____

BP _____

RR _____

Ear examination

Pinna:

NORMAL ☐ ABNORMAL ☐

Otoscopy:

EAC

CLEAR	CERUMEN IMPACTION	MASS IN EAC	CANAL STENOSIS
☐	☐	☐	☐

Tympanic membrane

NORMAL	SCLEROTIC	PERFORATED	RETRACTED
☐	☐	☐	☐

Rinne:

Ear tested	Positive	Negative
Left		
Right		

Weber:

Left laterising ☐

Right laterising ☐

☐

Central

(PTA results to be attached)

Appendix II (b): Data Collection Tool (Swahili)

MAELEZO YA BINAFSI

Herufi za jina lako _____

Jinsia:

Umri: _____

Kaunti yako: _____

Jimbo lako: _____

HISTORIA

1. Una matatizo yoyote ya kusikia?

   Ndio ☐ La/Hapana ☐

2. Ulijuaje kwamba una shida ya kusikia?

   Ninaihisi ☐ Kwa kuambiwa na wenzangu ☐

3. Umekuwa na hii shida ya kutosikia kwa muda gani? _____

4. Ilianzaje

   Ghafla ☐ Polepole ☐

   Sikio moja ☐ Masikio yote ☐

Appendix III: Questionnaire: Hearing Handicap Inventory for the Elderly–Screening Version

Part II: Questions from the Hearing Handicap Inventory for the Elderly–Screening Version

1. Does a hearing problem cause you to feel embarrassed when meeting new people?

YES | SOMETIMES | NO

2. Does a hearing problem cause you to feel frustrated when talking to members of your family?

YES | SOMETIMES | NO

3. Do you have difficulty hearing when someone speaks in a whisper?

YES | SOMETIMES | NO

4. Do you feel handicapped by a hearing problem?

YES | SOMETIMES | NO

5. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbours?

YES | SOMETIMES | NO

6. Does a hearing problem cause you to attend religious services less often than you would like?

YES | SOMETIMES | NO

7. Does a hearing problem cause you to have arguments with family members?

YES	SOMETIMES	NO

8. Does a hearing problem cause you difficulty when listening to the television or radio?

YES	SOMETIMES	NO

9. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?

YES	SOMETIMES	NO

10. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?

YES	SOMETIMES	NO

Note: *For each question, the scores are yes = 4 points; sometimes = 2 points; and no = 0 points. Scores range from 0-8 (no handicap), 10-24 (mild to moderate handicap) to 26-40 (severe handicap).*

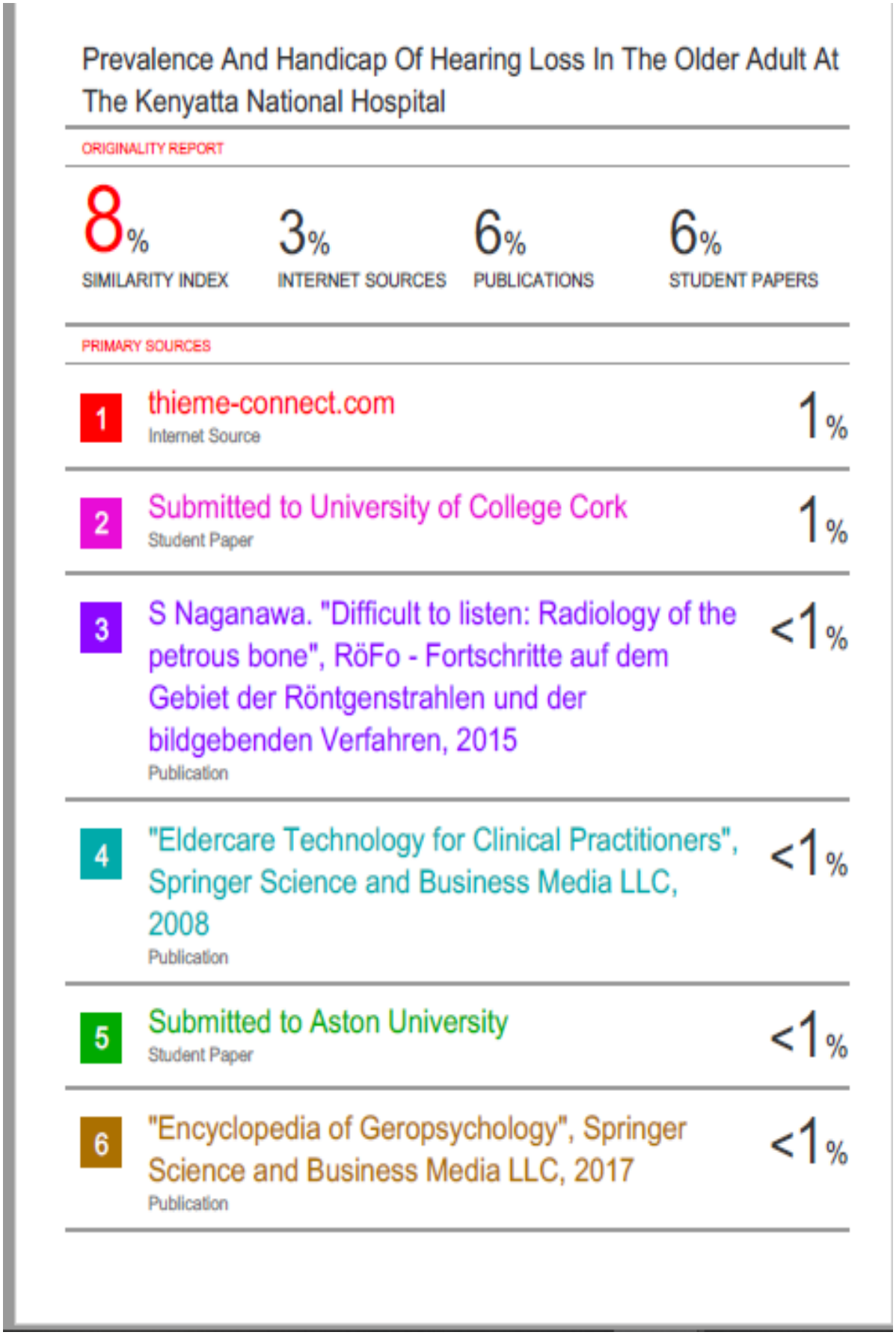
5. Ni sikio gani lenye shida zaidi?

Lakulia	La kushoto	yote mawili
☐	☐	☐

6. Uweo wako wa kusikia ni upi?
   i. Waweza kusikia na kuelewa ☐
   ii. Wewe husikia tu kelele kuu ☐
   iii. Kusikia huathirika zaidi palipo na ☐

Appendix IV: KNH/UON-ERC Letter of Approval

Appendix V: Certificate of Plagiarism



Prevalence And Handicap Of Hearing Loss In The Older Adult At The Kenyatta National Hospital

ORIGINALITY REPORT

8%	3%	6%	6%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	thieme-connect.com Internet Source	1%
2	Submitted to University of College Cork Student Paper	1%
3	S Naganawa. "Difficult to listen: Radiology of the petrous bone", RöFo - Fortschritte auf dem Gebiet der Röntgenstrahlen und der bildgebenden Verfahren, 2015 Publication	<1%
4	"Eldercare Technology for Clinical Practitioners", Springer Science and Business Media LLC, 2008 Publication	<1%
5	Submitted to Aston University Student Paper	<1%
6	"Encyclopedia of Geropsychology", Springer Science and Business Media LLC, 2017 Publication	<1%