TOWSON UNIVERSITY
OFFICE OF GRADUATE STUDIES

THE INFLUENCE OF HEARING AIDS ON THE QUALITY OF LIFE OF THE ELDERLY IN AN UNDERPRIVILEGED COMMUNITY: A PILOT STUDY

By

Bridget Niedermeyer

A Thesis

Presented to the faculty of

Towson University

In partial fulfillment

Of the requirements for the degree

Doctor of Audiology

Department of Audiology, Speech Pathology and Deaf Studies

Towson University
Towson, Maryland 21252

December 2013

TOWSON UNIVERSITY
OFFICE OF GRADUATE STUDIES

THESIS APPROVAL PAGE

This is to certify that the thesis prepared by Bridget Niedermeyer, B.S. entitled The Influence of Hearing Aids on the Quality of Life of the Elderly in an Underprivileged Community: A Pilot Study has been approved by the thesis committee as satisfactorily completing the thesis requirements for the degree, Doctor of Audiology (Au.D.).

Jennifer L. Smart Ph.D.
Chair, Thesis Committee

12/6/12
Date

Candace G. Robinson Au.D.
Committee Member

12/6/12
Date

Brian Kreisman Ph.D.
Committee Member

12/6/12
Date

Janet DeLany
Dean of Graduate Studies

12/17/12
Date

ACKNOWLEDGEMENTS

I would like to thank my thesis committee chair, Dr. Jennifer Smart, for all your support and guidance throughout this project and these past years. You have been a great advisor, mentor and friend. I would like to thank my committee members, Dr. Candace Robinson and Dr. Brian Kreisman, for all of your input and encouragement on this project. Without your knowledge and help, this thesis would not have been possible and I appreciate all of your time and effort. I would also like to thank Dr. Daniel Agley for his statistical guidance. Most importantly, I would like to thank my loving parents, sister, brother, boyfriend and many other family and friends for all of their encouragement, motivation and for reminding me to always BELIEVE in myself!

ABSTRACT

The Influence of Hearing Aids on the Quality of Life of the Elderly in an Underprivileged Community: A Pilot Study

Bridget Niedermeyer

The current study aimed to identify and treat hearing loss in an underprivileged community and evaluate the effect, if any, amplification had on quality of life. A total of 15 adults, between the ages of 67 and 89 years, completed a cognitive screening, using the Six-Item Screener (SIS) and a hearing handicap screening, using the Hearing Handicap Inventory for the Elderly-Screener (HHIE-S) and underwent a peripheral hearing assessment. Seven of these participants were excluded from the analysis, as they did not meet the criteria for this study (4-frequency PTA (.5, 1, 2, & 4 kHz) $\geq$ 26 dB HL, in at least one ear). Seven participants were fitted bilaterally. One participant, with a unilateral moderate to severe hearing loss, was fit with a contralateral routing of signals (CROS) hearing aid system. All participants fitted with hearing aids completed the HHIE-S questionnaire again, 4-5 weeks after their hearing aid fitting.

Improvement in HHIE-S scores (lower scores) indicating an improved quality of life (QOL) after 4-5 weeks of hearing aid use were observed; however, when analyzed it was not a significant finding. The results also revealed a strong positive correlation between right and left ear 4-frequency PTAs and pre-HHIE-S scores. The correlation revealed that the more severe the hearing loss the greater impact on emotional and social

quality of life as indicated by the HHIE-S scores. Results from this pilot study indicate that future studies should include more participants, use of the adaptation manager on the hearing aid(s) at the initial fitting, at least one follow-up appointment after the initial hearing aid fitting and before any follow-up questionnaires, and a longer duration between initial hearing aid fitting and administration of the second HHIE-S.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

ASHA…… American Speech Language and Hearing Association

ART…….. Acoustic Reflex Threshold

BTE…….. Behind the Ear

CID…….. Central Institute for the Deaf

CPHI…… Communication Profile for the Hearing Impaired

CROS……..Contralateral Routing of Signals

dB HL……..Decibel of Hearing Level

dB SPL…….. Decibel of Sound Pressure Level

DD……..Dichotic Digits

DPOAE……Distortion Product Otoacoustic Emissions

HAS……..Hearing Aid Scale

HAU…….. Hearing Aid Utilization

HHIE……..Hearing Handicap Inventory for the Elderly

HHIE-S……Hearing Handicap Inventory for the Elderly- Screening

IHS……Intelligent Hearing Systems

ITE……..In the Ear

IWB…….. Institute of Well Being

MCL……..Most Comfortable Listening Level

MMSE…….. Mini Mental State Exam

NAL-NL1…….National Acoustic Laboratories nonlinear fitting procedure, version 1

NU-6……..Northwestern University Auditory Test Number 6

OAE……..Otoacoustic Emissions

PTA…… Pure Tone Average

QOL…….. Quality of Life

REAR……Real Ear Aided Response

REM……Real Ear Measurement

SES……..Socioeconomic Status

SIS…….. Six-Item Screener

SLHC……..Speech, Language & Hearing Center

SNR…….. Signal-to-Noise Ratio

SRT…… Speech Reception Threshold

SSI-ICM……..Synthetic Sentence Identification-Ipsilateral Competing Message

SSW……..Staggered Spondaic Word

TSCS…… Tennessee Self Concept Scale

TU…….. Towson University

CHAPTER 1

INTRODUCTION

According to the World Health Organization's *Deafness and Hearing Impairment* report, it was estimated that over 275 million people worldwide are deaf or hard of hearing (WHO, 2012a). In the United States alone it was estimated that 37 million adults had some degree of hearing loss (Schoenborn & Heyman, 2008). Within the past 30 years the number of individuals with a hearing loss in the United States has almost doubled (American Speech-Language and Hearing Association (ASHA), 2012).

The rise of hearing loss has specifically been noted in the elderly population. Out of all age groups it is estimated that the elderly population, age 65 and older, account for most (37%) of the individuals with hearing loss (Desai, Pratt, Lentzner, & Robinson, 2001). In another, older, national report it was estimated that hearing loss in the elderly, 75 years and older, was as high as 40-50% (National Institute of Health, 1997). In almost all instances, the cause of hearing loss amongst the elderly is not preventable because of the age related changes that occur within the peripheral auditory system, known as presbycusis (Chisolm et al., 2003).

According to ASHA (2012), undiagnosed hearing loss can compromise communication, thus affecting quality of life (QOL). While individuals of all ages may be affected by hearing loss, some research has specifically focused on measuring the QOL or improving the QOL within the elderly population (Carabellese et al., 1993; Garstecki & Erler, 1998; Harless & McConnell, 1982; Lotfi, Mehrkian, Moossavi, & Faghih-Zadeh, 2009; Malinoff & Weinstein, 1989; Mulrow et al., 1990; Mulrow, Tuley, & Aguilar, 1992a; Stark and Hickson, 2004; Tesch-Römer, 1997; Vuorilho, Karinen, &

Sorri 2006). With the growing use of amplification (e.g., hearing aids) within the United States, elderly Americans may improve their communication and overall QOL through the use of hearing aid(s) (Carabellese et al., 1993; Garstecki & Erler, 1998; Harless & McConnell, 1982; Lotfi et al., 2009; Malinoff & Weinstein, 1989; Mulrow et al., 1990; Mulrow et al., 1992a; Stark and Hickson, 2004; Tesch-Römer, 1997; Vuorilho et al., 2006).

Unfortunately, due to the high cost of hearing aids, the use and thus benefit of amplification in low socioeconomic (SES) communities is often not attainable. Because hearing aids are essentially, not accessible, to people in low SES communities, research in this area is lacking. In addition to hearing loss, people in low SES communities are at greater risk for hyperthyroidism, hypertension, diabetes, hyperlipidemia, cerebrovascular disease, and audiological conditions (e.g., tinnitus and hyperacusis) (Agrawal, Platz, & Niparko 2008; Mathers, Smith, & Concha, 2000). All of these conditions have been linked to a higher prevalence of hearing loss (Agrawal et al., 2008; Mathers et al., 2000). Therefore it is important that audiologic services and amplification are accessible for people in low SES communities with hearing loss. Access to hearing aids would allow researchers to evaluate the benefit, or lack thereof, of hearing aids on the QOL of the elderly in a low SES community.

CHAPTER 2

REVIEW OF THE LITERATURE

Prevalence of Hearing Loss in the Elderly

Due to an increase of hearing loss seen within the elderly population several studies have contributed to prevalence estimates and population demographics to assist in further understanding this population. Moscicki, Elkins, Baum, & McNamara (1985) studied 2,293 participants involved in a large study called the Framingham heart study. One of the areas evaluated in this large study was hearing loss. Their study revealed that 83% of participants aged 57-89 years had some degree of hearing loss (Moscicki et al., 1985). It is important to note that in this study hearing loss was defined as air conduction thresholds > 20 decibel hearing level (dB HL) for at least one frequency from .5, 1, 2, & 4 kHz, in at least one ear (Moscicki et al., 1985).

This study found a much higher prevalence of hearing loss when compared to other studies due to their conservative definition of hearing loss (Moscicki et al., 1985). In other studies, a participant was considered to have hearing loss when their Pure Tone Average (PTA) at .5, 1, 2, 4 kHz was > 25 dB HL in at least one ear (Agrawal et al., 2008; Sindhusake et al., 2001). Therefore, Moscicki et al. (1985) re-analyzed their data using the stricter definition of hearing loss so that their results could be compared to other studies (Agrawal et al., 2008; Mosiciki et al., 2008; Sindhusake et al., 2001). After this analysis, a hearing loss prevalence of 47% was found.

In another large-scale study, the Blue Mountain Hearing Study, 2,015 Australian residents aged 55-100 years, received an audiological evaluation, completed the Hearing Handicap Inventory for the Elderly-Screening questionnaire (HHIE-S) and answered an

additional single question “Do you feel you have a hearing loss?”(Sindhusake et al., 2001). The HHIE-S was used to help the researchers compare the prevalence of participants that perceived a self-reported hearing handicap to the participant’s actual hearing status (Sindhusake et al., 2001). Participants were considered to have a hearing handicap if their HHIE-S score was > 8 (Sindhusake et al., 2001). When a participant’s PTA for .5, 1, 2, & 4 kHz was > 25 dB HL for at least one ear, they were considered to have a hearing loss (Sindhusake et al., 2001). A hearing loss prevalence of 39.4% was reported when using pure tone test results alone. The data from the single question, “Do you feel you have a hearing loss?” results revealed 11.4 % prevalence for mild hearing losses (> 25 dB HL), 37.3 % for moderate hearing losses (> 40 dB HL) and 48.7% for ‘marked’ hearing losses (> 60 dB HL). Finally, when looking at the HHIE-S data, results revealed a prevalence of 7.3%, 18.7 % and 29.7 % respectively. Overall, the HHIE-S was found to be more accurate at identifying individuals with moderate hearing losses (> 40 dB HL) than the single question alone. Of note, the single question had a higher specificity for identifying mild hearing losses (> 25 dB HL).

A larger sample of 5,742 people was analyzed from the 1999-2004 National Health and Nutrition Examination Survey (Agrawal et al., 2008). This sample was different from previous samples discussed because it included younger participants (20-60 years). A prevalence of 16.1% was revealed, when the participant’s PTA for .5, 1, 2, & 4 kHz was > 25 dB HL in either ear (Agrawal et al., 2008). However, relating this data to a prevalence estimate of hearing loss for the elderly is difficult due to the younger participants included in this sample (Moscicki et al., 1985; Sindhusake et al., 2001).

A longitudinal epidemiology hearing loss study completed in Beaver Dam, Wisconsin looked at the incidence and progression of hearing loss after a 5 year period. The researchers reported data from 2,721 people aged 48-92 years (Cruickshanks et al., 2003). Over the 5 year study period, the participants' hearing status was tested twice, once at the initial evaluation and once at the 5 year mark (Cruickshanks et al., 2003). The presence of hearing loss was defined when a PTA for .5, 1, 2, & 4 kHz was > 25 dB HL, in at least one ear (Cruickshanks et al., 2003). At the 5 year mark a decrease in hearing was identified when a participant's PTA for .5, 1, 2, & 4 kHz, was 5 dB HL higher (poorer) than their last PTA (Cruickshanks et al., 2003). The overall prevalence of hearing loss after 5 years was 21.4%. Just over half (53.3 %) of the participants that remained in the study were found to have a decrease in hearing status. Interestingly, the overall prevalence of hearing loss in this study at the 5 year mark was lower than the initial prevalence (46%) estimate but conclusions cannot be drawn from this change due to the large decrease in participant numbers from the beginning of the study (n = 3,753) to the end of the study (n = 2,721) (Cruickshanks et al., 1998; Cruickshanks et al., 2003).

Overall in the studies mentioned, the prevalence estimates of hearing loss within the elderly population range from 21.4% to 47% (Cruickshanks et al., 1998; Cruickshanks et al., 2003; Moscicki et al., 1985; Sindhusake et al., 2001). In addition to looking at the overall prevalence estimates of hearing loss in the elderly, it is important to also evaluate the role that gender plays in the prevalence estimates.

Prevalence of Hearing Loss in the Elderly Based on Gender

The study done by Moscicki et al. (1985) also looked at gender. The researchers found that women (16%) had a significantly lower prevalence of hearing loss, when

compared to the men (35%) for thresholds from 2-8 kHz (Moscicki et al., 1985). Because the Moscicki et al., (1985) participant population was limited to Framingham, Massachusetts, it is unknown if the same gender disparity would be seen in other areas.

Schoenborn & Heyman (2008) investigated the health disparities among adults with hearing loss in the United States using the National Health Interview Survey (NHIS). They found gender differences comparable to Moscicki et al., 1985, which revealed that men are 4.3 times more likely than women to have some degree of hearing loss.

Several other studies conducted in the United States also found higher prevalence of hearing loss among men than women (Agrawal et al., 2008; Cruickshanks et al., 2003; Desai et al., 2001; Gates, Cooper, Kannel, & Miller, 1990; Moscicki et al., 1985; NAAS, 1999; Wilson et al., 1999). The same results were revealed, when Hannula et al. (2011) investigated the prevalence of self- reported hearing problems in 850 Finnish participants, aged 54-66 years. Four questions were used to evaluate hearing problems:

> 1) "Do you have any difficulty with your hearing?; 2) Do you find it very difficult to follow conversation if there is background noise. e.g., TV, radio, children playing?; 3) Nowadays, do you ever get noises in your head or ears (tinnitus) which usually lasts longer than five minutes?; 4) Are you particularly sensitive to loud sounds?" (Hannula et al., 2011, p.552).

If a participant answered yes to any of these four questions, they were considered to have a self-reported hearing loss (Hannula et al., 2001). Additionally, when a participant's PTA at .5, 1, 2, & 4 kHz was > 20 dB HL in the better ear, they were considered to have a hearing loss (Hannula et al., 2011). Results revealed that the prevalence of self-reported

handicap was 60.8%, and of that, 66.6% were men (Hannula et al., 2001). These researchers concluded that men were more likely to report having a hearing loss than women (Hannula et al., 2011). Furthermore, the pure tone test results validated this finding (Hannula et al., 2011).

In a longitudinal study (conducted over 6 years), researchers compared measures of auditory performance (pure tone, immittance, word recognition testing) to participant's self-perceived hearing loss (Gates et al., 1990). Hearing loss was defined as a PTA at .5, 1, & 2 kHz > 26 dB HL in the better ear (Gates et al., 1990). Out of 1662 participants, 29% of participants, aged 57-89 years, reported having a hearing loss with the prevalence being slightly higher in men (33%) when compared to women (27%) (Gates et al., 1990). The results of this study also revealed that men were more likely to report having a hearing problem than women. However, the researchers noted that a majority of participants had a history of occupational and recreational noise exposure, which may have impacted their findings (Gates et al., 1990).

Gender differences seen in the literature are speculated to be due to the fact that men are almost twice as likely to be exposed to noise on a daily basis as compared to women (Moscicki et al., 1985). Helzner et al. (2005) found that occupational noise exposure was associated with a 55% increase of hearing loss. It is therefore queried if age or gender is a better hearing loss predictor among the elderly population.

Prevalence of Hearing Loss in the Elderly Based on Age and Gender

Looking at age and gender together, Gates et al. (1990) found increasing age to be a better predictor of hearing loss than gender. This study also revealed that after a person

turns 60 years of age the prevalence of self-reported hearing handicap increased for both men and women (Gates et al., 1990).

In another study previously discussed, researchers also found that after 70 + years of age, men have a higher incidence of hearing loss when compared to women with the average age of diagnosis for men being 72.9 years and 65.9 years for women (Cruickshanks et al., 2003). Additionally, in another previously discussed study, Moscicki et al. (1985) discovered that as a woman's age increases, the severity of hearing loss also increases; however, this result was not seen for the men as their thresholds remained the same with increasing age. In contrast, Schoenborn & Heyman (2008) found no gender differences in the prevalence and the severity of hearing loss with increasing age. Due to the conflicting results seen in several research studies and the variety of additional factors that can contribute to hearing loss, age and gender alone are not reliable predictors of hearing loss among the elderly population. Due to the fact that the elderly population often has more medical issues than younger generations it is important to identify if additional medical conditions increase the risk for hearing loss in the elderly (Schoenborn & Heyman, 2008).

Prevalence of Hearing Loss in the Elderly Based on Medical Conditions

Research has found that the inner ear changes as a person ages, causing a gradual hearing loss (NIDCD, 2010). This hearing loss due to aging is referred to as presbycusis (NIDCD, 2010). Schoenborn & Heyman (2008) revealed that adults who had hearing loss also had other health issues (e.g., diabetes and high blood pressure). Therefore, it is unknown if a large portion of the elderly population has a hearing loss specifically due to aging or if the hearing loss mimics the effects (audiometric configuration) of aging in

conjunction with other medical conditions (Agrawal et al., 2008; Mathers et al., 2000; Moscicki et al., 1985).

Some medical conditions, such as hyperthyroidism, hypertension, diabetes, hyperlipidemia, cerebrovascular disease, audiological conditions and tobacco use are risk factors that have been found to lead to higher prevalence of hearing loss (Agrawal et al., 2008; Mathers et al., 2000). Overall, it was also revealed that hearing loss prevalence decreases as age increases, in participants without these medical conditions (Agrawal et al., 2008) Specifically, smokers had a 68% higher risk of hearing loss when compared to non-smokers (Helzner et al., 2005). In addition, patients with audiological conditions, such as hyperacusis and tinnitus are known to have significantly poorer hearing thresholds compared to individuals who do not have these conditions (Hannula, Bloigu, Majamaa, Sorri, & Maki-Torkko, 2011). While it is known that an increase in medical conditions also increases the prevalence of hearing loss there are other factors that may play a role in the prevalence of hearing loss such as, ethnicity and SES, which should also be explored.

Prevalence of Hearing Loss in the Elderly based on Individual Differences

Ethnicity.

Ethnicity, SES, employment and level of education have also shown to increase the risk for hearing loss (Agrawal et al., 2008; Kochkin, 2009; Kochkin, 2005; NAAS, 1999; WHO, 2012a). In a study previously discussed in terms of age and gender, the researchers also found prevalence of hearing loss to be different across ethnic groups (Helzner et al., 2005). Specifically, Caucasian men and women had a higher prevalence (63%) of hearing loss when compared to African American men and women (Helzner et

al., 2005). However, this sample population consisted majority of Caucasian participants; therefore, this prevalence finding between ethnicities should be considered with caution (Helzner et al., 2005). Interestingly, when sample populations between ethnicities were divided more evenly, researchers have concluded the same results as Helzner et al., (2005), by identifying Caucasians to have a higher prevalence of hearing loss than African Americans (Desai et al., 2001; NAAS, 1999)**.** One explanation for this discrepancy in prevalence of hearing loss between ethnicities could be that African American men and women are less likely to *report* [emphasis added] difficulty hearing when compared to Caucasian men and women (Desai et al., 2001; NAAS, 1999). Even when a third ethnicity, Mexican Americans, was included in the sample, Caucasians remained to have a higher prevalence of hearing loss when compared to African Americans and Mexican Americans (Agrawal et al., 2008). More research regarding the prevalence of hearing loss between ethnic groups needs to be completed in order to gain a better understanding on why Caucasians tend to have a higher prevalence of hearing loss when compared to other ethnicities.

Socio-Economic Status.

Out of the 275 million people who have some degree of hearing loss, 80% of these people live in lower income countries (WHO, 2012a). Because of the low income status, one out of 40 people that need a hearing aid actually have one (WHO, 2012a). Additionally, in a survey given to approximately 40,000 members of the National Family Opinion group in the United States, income was negatively affected by both treated and untreated hearing loss (Kochkin, 2005).

The National Academy of Aging Society (1999) found that families with an income of < $20,000 are twice as likely to have hearing loss, than families with a higher family income ($50,000). However, recent research has revealed that household income and education levels were not reliable in predicting hearing loss prevalence (Helzner et al., 2005; Pratt, Kuller, Talbott, McHugh-Pemu, Buhari & Xu, 2009). Specifically, Helzner et al. (2005) analyzed data from 2,052 individuals from Pittsburgh, Pennsylvania and Memphis, Tennessee and found no significant results indicating that hearing loss and income (< $25,000) and education levels were not accurate predictors based on the results from the population studied. However, out of the 1,230 participants that had hearing loss only 409 participants had a low income; therefore the results may be different if a larger and more diverse sample was collected (Helzner et al., 2005).

Pleis and Lethbridge (2006) looked at a much larger participant population of adults throughout the United States by administering a national health interview. Interestingly researchers found that out of the 37,622 thousand participants who reported having a low income (< $20,000), 7, 735 (21%) of those participants also had a hearing loss. The overall findings reveal that people with lower incomes were more likely to report hearing difficulties than adults who had an income of > $75,000 (Pleis & Lethbridge, 2006).

In a more recent study the effects of hearing loss on QOL were evaluated (Kochkin, 2010). After analyzing surveys from 46,843 individuals, results indicated that there is a strong relationship between degree of hearing loss and unemployment for participants that were unaided (Kochkin, 2010). Results from this study also revealed an income differences between individuals with mild hearing loss and individuals with more

severe hearing loss; the more severe the degree of hearing loss the lower the overall amount of income (Kochkin, 2010).

Etiology of Hearing Loss within the Elderly

Moscicki et al. (1985) found that 59% of elderly individuals have sensorineural hearing loss, which is the most common type of hearing loss seen amongst the elderly population. This type of hearing loss is most often due to damage within the inner ear (Moscicki et al., 1985). Chisolm, Willott, & Lister (2003) reported that the age related changes that are within the outer ear and middle ear, minimally affect the transmission of sounds to the inner ear (Chisolm et al., 2003). Most age related changes that occur in the peripheral system happen in the inner ear (Chisolm et al., 2003). The age related changes occurring in the inner ear were classified into six different categories: sensory, neural, strial, cochlear conductive, mixed and intermediate (Chisolm, et al., 2003). These categories, known as Schucknect's types of presbycusis, were developed to further understand and predict the best treatment options needed based on the anatomic and physiologic changes that occur within the peripheral auditory system as a person ages (Chisolm et al., 2003). In addition to peripheral changes that occur in the auditory system, there are several changes that occur beyond the cochlea (Fitzgibbons & Gordon-Salant, 1996; Kirikae et al., 1964; Rodriguez, DiSarno, & Hardiman, 1990).

Rodriguez, DiSarno, & Hardiman (1990) studied the auditory processing abilities of 85 elderly individuals aged 60-85 years. The monosyllabic word list, Synthetic Sentence Identification-Ipsilateral Competing Message (SSI-ICM), Staggered Spondaic Word (SSW) and Dichotic Digits (DD) were used to evaluate the central system and they found that central auditory changes can occur without a decline in peripheral hearing loss

(Rodriguez et al., 1990). In another study, which used various temporal processing tests to assess auditory processing abilities found that as age increases the ability for the central auditory nervous system to complete temporal processing tasks, becomes more difficult (Fitzgibbons & Gordon-Salant, 1996). Age related processing difficulties were found to effect central auditory dysfunction; however, the specific site of central dysfunction was unknown (Fitzgibbons & Gordon-Salant, 1996).

It has been concluded that as a person ages the peripheral and/or central auditory nervous system also changes; with these changes there has shown to be an increase in the prevalence of hearing loss among the elderly (Chisolm, Willott, & Lister, 2003; Fitzgibbons & Gordon-Salant, 1996; Gates et al., 1990; Kirikae, Sato, Shirara, 1964; Pichora-Fuller & Souza, 2003). Therefore, with the many changes occurring within the peripheral and central auditory nervous system, it is important to consider an interdisciplinary approach to meet the rehabilitative needs of all elderly individuals with a main goal of improving the QOL for elderly individuals (Chisolm et al., 2003).

Influence of Hearing Aids on the Quality of Life of the Elderly

As previously stated, aging can cause presbycusis, which may compromise communication, thus affecting QOL. Carabellese et al. (1993) investigated the effect hearing loss has on QOL in elderly individuals. Carabellese et al. (1993) used multiple questionnaires to look at the QOL in 1,332 Italians, aged 70-75 years, and living at home. Several measurements (Beck's Depression Inventory, Mental Status Questionnaire, Activities of Daily Living scale, and Linn's SELF scale) were used to look at the social, affective, cognitive and physical domains of each participant (Carabellese et al., 1993). Each participant underwent a visual and hearing examination and was categorized into

one of four groups: good hearing and vision, hearing impairment only, vision impairment only, and hearing and vision impairment (Carabellese et al., 1993). However, diagnostic hearing and vision testing was not completed (Carabellese et al., 1993). Hearing was evaluated by how well the participant could understand a person talking at a normal volume, without hearing aids. A score of 1 to 4 was assigned to participants indicating their level of hearing difficulty, with a score of 1 indicating no difficulties hearing and a score of 4 indicating significant difficulty hearing (Carabellese et al., 1993). Seventy-three percent of the participants had a hearing score of 1, 21% had a hearing score of 2, 3.5% had a hearing score of 3 and 2.7% had a hearing score of 4 (Carabellese et al., 1993). Using these results and the measurements mentioned previously, the findings suggest that a deficit in hearing has shown to negatively affect individuals' functional and social QOL (Carabellese et al., 1993).

Multiple researchers have found hearing aids to be an effective rehabilitation tool in enhancing elderly individuals QOL by decreasing depression, increasing ego, increasing internal locus of control, decreasing self-perceived hearing handicap and improving psychosocial function, specifically as it relates to social, mental and communication abilities (Carabellese et al., 1993; Garstecki & Erler, 1998; Harless & McConnell, 1982; Lotfi et al., 2009; Malinoff & Weinstein, 1989; Mulrow et al., 1990; Mulrow et al., 1992a; Stark and Hickson, 2004; Tesch-Römer, 1997; Vuorilho et al., 2006).

Influence of Hearing aid Use within the Elderly Population

The Communication Profile for the Hearing Impaired (CPHI), The Hearing Aid Management, Rotter's Internal-External scale, and Minnesota Multiphasic Personality

Inventor questionnaire, were used to investigate demographic and compare the benefit (or lack thereof) of hearing aids among adults who used hearing aids to individuals who did not use hearing aids (Garstecki and Erler, 1998). One hundred and thirty one participants, aged 65 years and older, were put into one of four groups: the females with hearing aids; females without hearing aids (despite displaying a clear need for them); males with hearing aids; and males without hearing aids (despite displaying a clear need for them) (Garstecki & Erler, 1998). Results indicated that female hearing aid users were more successful in communicating in social situations when compared to the other three groups (Garstecki & Erler, 1998). Coincidentally, the female hearing aid users, as well as the male hearing aid users had more education, higher income, and better social support when compared to the non-hearing aid user groups (Garstecki & Erler, 1998). Most importantly results revealed participants' not wearing hearing aids were more likely to experience depression and have a lower ego (Garstecki & Erler, 1998).

Harless and McConnell (1982) used the Tennessee Self Concept Scale (TSCS), and the Speech Intelligibility Questionnaire (SIQ) to identify if hearing aids improved the self-image within the elderly population. Researchers compared 43 elderly individuals, aged 60 years and older, who have a hearing loss and have worn hearing aids for at least 4 months for at least 5 hours per day to 43 elderly individuals age 60 years and older, who have a hearing loss but did not wear hearing aids (nor had any experience with them). The mean age in years and gender between groups were very similar (Harless & McConnell, 1982). The TSCS revealed that individuals who had adjusted to their hearing aids had more positive self-concept when compared to individuals who had hearing loss and did not wear amplification (Harless & McConnell, 1982). The researchers concluded

that hearing aids are a good rehabilitation option for improving an elderly person's self-image, if they are willing to wear them for at least 4 months, 5 hours a day (Harless & McConnell, 1982).

Tesch-Römer (1997) investigated the psychological effects of hearing aid use in elderly individuals. A group referred to as the aural rehabilitation group, consisted of 70 hearing aid users, with a mean age 71.8 was analyzed and compared to two control groups (Tesch-Römer, 1997). The first control group consisted of 42 participants, with a mean age of 71.5 years, had a hearing loss but did not wear hearing aids (Tesch-Römer, 1997). The second control group consisted of 28 participants, with a mean age 69.4 years and had normal hearing (Tesch-Römer, 1997). However, the guidelines that were used to determine if a participant had a hearing loss was based on the participant having a hearing threshold > 30 dB HL in at least one frequency, .5, 1, 2, & 3 kHz, in the better ear or hearing thresholds > 30 dB HL in at least two frequencies, in the poorer ear (Tesch-Römer, 1997).

Comparing the socio-demographics of the three groups, it was revealed that the normal hearing group had a higher education level and a lower Mini Mental State Exam (MMSE) score, which is a screening test for dementia (Tesch-Römer, 1997). At baseline, all participants completed pure tone audiometry and speech testing (Tesch-Römer, 1997). In addition, various tests and questionnaires were given at baseline and 6 months later to evaluate participant's communication problems, social activities, psychosomatic well-being and cognition (Tesch-Römer, 1997). Even though there was a high variation in hearing aid use in the aural rehabilitation group 30 minutes to 16 hours per day, hearing aid use was found to be helpful in communication and social interaction by reducing their

self-perceived communication problems. However, the researchers found that social activity, satisfaction with social relations, general well-being and cognition were not improved by hearing aid use according to their test measures and the population they evaluated (Tesch-Römer, 1997). The researchers speculated that if the study was conducted over a longer period then a perceived improvement in psychological functioning may have be seen (Tesch-Römer, 1997).

Hearing Handicap Inventory for the Elderly- Screening (HHIE-S)

To evaluate the benefit hearing aids have on the QOL in the elderly, the Hearing Handicap Inventory for the Elderly (HHIE) and Hearing Handicap Inventory for the Elderly- Screening Version (HHIE-S) questionnaires developed by Ventry and Weinstein (1982, 1983) are most commonly used among researchers. The HHIE is composed of a 13 item emotional subscale and a 12-item social/ emotional scale. The emotional questions addressed the attitude and emotional response to the hearing loss as well as the reaction of others about the participants hearing loss. The social questions addressed the perceived effects of hearing loss in various situations.

However, due to time constraints the, HHIE was not used clinically as it took too long to complete (Ventry & Weinstein, 1982). Therefore, Ventry and Weinstein (1983) developed the HHIE-S to use as a tool to identify hearing loss within the elderly population. This questionnaire consisted of 10 questions used to assess perceived emotional and social problems associated with hearing loss (Ventry and Weinstein, 1983). The American Speech Language and Hearing Association (ASHA) and American Academy of Audiology (AAA), have supported the HHIE-S to be used to provide additional information to a diagnostic audiological evaluation and hearing aid fitting

(Katz, 2009). The HHIE and the HHIE-S are inexpensive tools, as use of them does not require specialized training or equipment to administer, benefitting both the clinical practice and the patient (Weinstein, 1986).

Malinoff and Weinstein (1989) used the HHIE as their measurement tool in a sample of 45 adults aged from 55 to 90 years. All participants were new hearing aid users, and were fit based on their PTA at .5, 1, & 2 kHz and their Central Institute for the Deaf (CID) W-22 score (Malinoff & Weinstein, 1989). To objectively measure changes in participants self-perceived handicap and behavior, the HHIE was administered prior to the hearing aid fitting and again at 3 weeks post hearing aid fitting (Malinoff & Weinstein, 1989). On average, 34.3% of participants prior to their hearing aid fitting indicated having a self-perceived handicap (HHIE score was > 18%) (Malinoff & Weinstein, 1989). Three weeks after the hearing aid fitting, the average score significantly decreased to 6.73%, signifying that the hearing aids decreased the amount of self-perceived handicap caused by hearing loss (Malinoff & Weinstein, 1989). The results of this study identified that after 3 weeks of hearing aid use the HHIE is a reliable measure for hearing aid benefit (Malinoff & Weinstein, 1989).

Mulrow et al. (1990) investigated the social, emotional, mental and communication benefits hearing aids have on the elderly QOL. Eighty-seven participants were given a hearing screening and were diagnosed with a hearing loss, if their threshold at 2 kHz was > 40 dB HL (Mulrow et al., 1990). Due to cost associated with purchasing two hearing aids, the majority of the participants were fit with a hearing aid monaurally in the poorer ear (Mulrow et al., 1990). The psychosocial benefit of hearing aid(s) were evaluated at the initial fit, 6 weeks and 4 months post- hearing aid(s) fitting using the

HHIE, the Quantified Denver Scale of Communication Function, the Short Portable Mental Status Questionnaire, and the Geriatric Depression Scale (Mulrow et al., 1990). Looking at all the measurements, significant improvements in social, emotional, mental, and communication scores were seen at 6 weeks post- hearing aid fitting and the scores remained stable at 4 months post- hearing aid fitting (Mulrow et al., 1990). Specifically the HHIE found significant improvements in social and emotional abilities at baseline to 6 week follow up when looking at the participants wearing hearing aids. After the 6 week follow up, the social and emotional scores remained stable. Results indicate that the greatest improvement in amount of perceived social and emotional handicap is seen 6 weeks after hearing aid fitting (Mulrow et al., 1990).

In a 1-year longitudinal study, Mulrow et al., (1992a) investigated the psychosocial benefits of hearing aids in 192 men, with a mean age of 72 years. Hearing screening, diagnosis, monaural hearing aid fitting and measurements given were the same as the previous study by Mulrow et al., 1990; however, the measurements were given at the initial fit, 4, 8, and 12 months post- hearing aid fitting. Again, a significant QOL improvement was seen from baseline as compared to 4 months post- hearing aid fitting and the scores plateaued at 8 and 12 months (Mulrow et al., 1992a). Based on the findings from these measures the researchers reported that hearing aids improved the psychosocial function (specifically in areas of social, emotional and communication function) as soon as 4 months post- hearing aid fitting and remained the same even after 12 months post- hearing aid fitting (Mulrow et al., 1992a).

Moreover, in a study completed in Finland, Vuorialho et al., (2006), also found hearing aids to be a beneficial treatment option for elderly individuals with hearing loss.

Results from the HHIE-S given pre- and 6 months post- monaural hearing aid fitting, revealed significant improvements in elderly individual's social and emotional QOL scores. The mean HHIE-S score for 98 participants, aged 61-87 years, was 28.7 before the hearing aid fitting and 12.7, 6 months post-hearing aid fitting (a lower score indicates an improvement) (Vuorilho et al., 2006). This study again, indicates the benefits of hearing aids on first time users. Of note, based on Finnish standards, a hearing aid was fitted when the participant's PTA at .5- 2 kHz was > 30 dB HL in at least one ear (Vuorilho et al., 2006).

Finally, another study by Lotfi et al., (2009), assessed the QOL changes seen within the Iranian elderly population after being fit with hearing aids for the first time (Lotfi et al., 2009). Two hundred and seven participants aged 60 years and older completed pure tone audiometry, tympanometry, speech testing and the HHIE before being fit with hearing aids (Lotfi et al., 2009). Two-hundred and seven participants had a PTA at .5, 1, 2, & 4 kHz that was > 40 dB HL in the better ear (Lotfi et al., 2009). Three months after the hearing aid fitting, participants had to complete the HHIE questionnaire again (Lotfi et al., 2009). Researchers concluded that hearing aids improved the social and emotional QOL in elderly individuals based on pre- (23.14- 65.88) and post- (22.1-28.13) HHIE scores (Lotfi et al., 2009). Interestingly, the researchers also compared the HHIE scores of 47 males to the 63 females. The effect of hearing aids on the QOL did affect one gender more than the other (Lotfi et al., 2009). Based upon the research in this section, it can be concluded that significant improvement of social and emotional QOL can be seen when hearing aids are used as a rehabilitation option for hearing loss caused

by presbycusis (Lotfi et al., 2009; Malinoff and Weinstein, 1989; Mulrow et al., 1990; Mulrow et al., 1992a; 1992b; Vuorialho et al., 2006).

All of these studies documented the efficacy of the HHIE or the HHIE-S as a tool to evaluate hearing handicap in the elderly population. Even though the studies differed in sample size, hearing aid selection, period of follow-up and modes of administering the HHIE, all studies found significant reduction in perceived handicap and showed that the HHIE and the HHIE-S is a reliable measurement tool for documenting QOL changes pre- and post- hearing aid fitting (Lotfi et al., 2009; Malinoff and Weinstein, 1989; Mulrow et al., 1990; Mulrow et al., 1992a; 1992b; Stark and Hickson, 2004; Vuorialho et al., 2006). Despite the benefits seen with hearing aids increasing the QOL in elderly individuals with hearing loss, unrealistic expectations may limit the benefit seen with hearing aid devices as an effective rehabilitation tool.

Factors Affecting the Influence of Hearing Aid Use in the Elderly Population

Patient expectations.

Surr and Hawkings (1988) investigated the expectations, first time hearing aid users had on the benefit of hearing aids. The researchers used a questionnaire, which consisted of 19 questions; 10 questions were based on what the participant thinks people will think of their hearing loss and nine questions were based on what the participants thinks about their own hearing loss. The questionnaire measured each participant's expectations before receiving hearing aids and their experience 6 months post- hearing aid fitting. Eighty- six military men, aged 42-82 years were given the choice of style of hearing aid and whether they wanted monaural or binaural hearing aid fitting (Surr & Hawkings, 1988). Seventy-three percent choose an in-the-ear (ITE) hearing aid and of

that, 54% choose a binaural fitting (Surr & Hawkings, 1988). Of the 27 % of participants that chose a behind-the-ear (BTE) hearing aid, 41% chose a binaural fitting (Surr & Hawkings, 1988). Prior to the hearing aid fitting, 26% of the participants were afraid hearing aids would make them appear older (Surr & Hawkings, 1988). However this number decreased after 6 months with only 11% continued to view themselves as older wearing hearing aids (Surr & Hawkings, 1988).

This study also revealed that only 59% participants indicated that other individuals noticed an improvement in their hearing abilities. In addition, the results showed that the participant's expectations of people noticing a change in their hearing abilities were much higher than what was actually found (Surr & Hawkings, 1988). Surprisingly, results showed that 70% of participants aged < 65 years, felt that their hearing loss was noticed by others and had higher hearing aid expectations when compared to participants aged > 64 years (Surr & Hawkings, 1988). Overall, participants' > 64 years were less concerned about the cosmetic appearance of the hearing aid when compared to participants' < 65 years (Surr & Hawkings, 1988). Interestingly the participants, who chose an ITE device, felt it was more noticeable than those who chose a BTE device (Surr & Hawkins, 1988). This study also found that hearing aid user's expectations of their peers noticing they have received hearing aid (s) was too high (Surr & Hawkings, 1988).

Using a larger scale questionnaire consisting of 48 items, Kricos, Lesner, and Sandridge (1991) also investigated the elderly population's expectations regarding the use of hearing aids. Researchers administered the questionnaire to 100 adults aged 55 to 92 years. The questionnaire focused on seven factors regarding hearing aid use and

benefit: cosmetics, acoustics, communication benefits, comfort, ease of use, and cost (Kricos et al., 1991). Twenty-nine percent of the participants felt that size and visibility of the hearing aid would affect their decision to acquire a hearing aid (Kricos et al., 1991). Overall, this study showed the lack of knowledge the elderly population has regarding the use, cost and benefit of hearing aids. Specifically, the study revealed that the elderly population has high expectations regarding the natural sound quality and amount of communication benefits hearing aids provide (Kricos et al., 1991). Moreover, 62% of the participants thought changing the battery would be difficult to complete due to their poor vision (Kricos et al., 1991). Therefore it is not surprising that 45% of the elderly participants in this study had positive attitudes regarding hearing aid benefits (Kricos et al., 1991).

Both of these studies emphasize the importance of educating and counseling patients on their expectations, benefit and adjustment period of hearing aids. If the patient's expectations are too high, they may not feel they are benefiting from the hearing aids and therefore will not use the devices thus hearing loss will continue to negatively affect their QOL (Kricos et al., 1991; Surr & Hawkins, 1988). The role that individual factors play on determining success with a hearing aid is also important to consider.

Patient personality.

Factors such as personality may contribute to lack of hearing aid use, since hearing loss most often occurs within the elderly population. At the same time hearing loss is occurring within the elderly, it has well been documented, that frequently an increase in memory loss and chronic illnesses are also present (Garstecki & Erler, 1998).

Therefore Garstecki and Erler (1998) investigated the psychological effects of elderly individuals who had hearing aids to those who do not have hearing aids.

After analyzing the CPHI and the Rotter's internal-external scale from 131 individuals aged 65 years and older (Garstecki & Erler, 1998). Based on their findings, researchers concluded that females not wearing hearing aids demonstrated less internal control, lower egos and were more likely to suffer from depression, due to their hearing loss (Garstecki & Erler, 1998). Female hearing aid users had better communication abilities and were more likely to use communication strategies when compared to female non hearing aid users and male hearing aid users. Overall this study reveals that the amount of perceived hearing aid benefit, in terms of degree of hearing loss, comfort, use, expectation of hearing aid and amount of social support differs between genders (Garstecki & Erler, 1998).

General patient factors.

Another study looked at individual patient factors to see if a factor could determine amount of hearing aid benefit (Mulrow, Tuley & Aguilar, 1992b). Patient factors such as age, education, functional handicap, degree of hearing loss, amount of hearing and speech recognition gain achieved with hearing aid, locus of control, visual acuity, manual dexterity, number of morbid diseases and number of medications were evaluated in 87 patients aged 71-75 years (Mulrow et al., 1992b). The HHIE was given to patients before they received their hearing aids (Mulrow et al., 1992b). They were then re-administered the HHIE and Hearing Aid Scale (HAS) 4 months after receiving their hearing aids (Mulrow et al., 1992b). The Hearing Aid Utilization (HAU) was also given

to assess amount of time the patient used the hearing aids every week (Mulrow et al., 1992b).

Ultimately, a standardized summary score was calculated and given to each patient based on their HHIE, HAS and HAU scores (Mulrow et al., 1992b). A high-standardized score meant the patient's handicap scores improved, as they had high satisfaction with the hearing aids and utilized the hearing aids for all waking hours (Mulrow et al., 1992b). Greater hearing aid success was seen in patients that had a greater self-perceived handicap, took minimal amounts of medications were younger in age and were higher educated (Mulrow et al., 1992b). However, there was no single factor or group of factors that was clinically useful in guaranteeing hearing aid success in elderly individuals (Mulrow et al., 1992b). Results must be interpreted with caution, as the majority of the subjects were retired male veterans, who were fit with monaural amplification when considered a candidate for bilateral amplification (Mulrow et al., 1992b).

Quality of Life in Low Socioeconomic Elderly Population

Although the literature is limited in this area, when looking at the general QOL in low SES individuals, they are most affected by hearing loss due to the lack of income and access (e.g., too expensive) to hearing aids (Pleis & Lethbridge-Cejku, 2006; Pratt et al., 2009). Further individuals that had a hearing loss and did not obtain hearing aids were more likely to be unemployed causing a decreased in overall QOL (Kochkin, 2010). As many researchers have found, undiagnosed hearing loss affects the QOL of elderly individuals and hearing aids have shown to be an effective rehabilitation tool by increasing QOL by decreasing depression, increasing ego, increasing internal locus of

control, decreasing self-perceived hearing handicap and improving psychosocial function, specifically social, mental and communication abilities (Carabellese et al., 1993; Garstecki & Erler, 1998; Harless & McConnell, 1982; Lotfi et al., 2009; Malinoff & Weinstein, 1989; Mulrow et al., 1990; Mulrow et al., 1992a; Tesch-Römer, 1997; Vuorilho et al., 2006). Therefore, the main aim of this study is to identify and treat hearing loss in a low SES community and to evaluate the effect, if any, amplification has on QOL. The second aim of this study was to evaluate the benefit, or lack thereof, of having graduate students participate in a project involving an underprivileged community.

CHAPTER 3

METHODS AND MATERIALS

Participants

According to the World Health Organization (WHO) (2012b) there are commonly used definitions of what age is considered elderly; however, there is no agreement on one specific age a person is considered "elderly." The lower limits of the definition of elderly ranges from 55 years to 65 years of age (WHO, 2012b). Therefore, this study will define elderly as 55 years and older, which incorporated all definitions of elderly. In this pilot study, (15 adults, 1 male and 14 females ranging in age from 64 to 89 years with a mean age of 74.4 years (SD 8.7) volunteered to participate in this study. Participants were recruited through the use of a flyer via a Towson University (TU) – Cherry Hill (Baltimore City) community liaison. The Cherry Hill, Baltimore community was targeted for recruitment because it is a low SES area that has ties to TU therefore the residents were more likely to volunteer to participate in the program due to the trust that had already been established between the two communities. The pilot study was conducted at the TU Speech, Language & Hearing Center (SLHC) on campus and at TU SLHC, Institute of Well Being (IWB). Participants were not financially compensated for their time but they did get to keep their new digital hearing aids following their participation in the study. Participants signed the inform consent, request for services and authorization form prior to beginning any of the testing (See Appendix A, B, & C). The request for services and authorization forms are documents required by the TU-SHLC. There were no charges for their assessments or their hearing aids. This research was funded by the

Kendell Discretionary Grant. All of the hearing aids were unconditionally donated by the hearing aid companies, Phonak and Widex.

Procedures

Data collection was conducted in two parts. Part I of the assessment consisted of a baseline measure of hearing status, and a screening of the participant's hearing handicap and cognitive abilities. If the patient met the requirements of a hearing loss defined by this study, PTA (.5, 1, 2, & 4 kHz) ≥ 26 dB HL in at least one ear then the participant proceeded with the last part of Part I of the pilot study (hearing aid fitting). Participants were transported to and from TU for their appointment(s) at no cost to them. Part II consisted of a follow-up evaluation, in Cherry Hill, of the participants' perceived handicap after their 4–5 week trial period with new digital hearing aids. Both parts of the pilot study are described in detail below.

Part I.

The case history form was obtained in a one-on-one interview format (See Appendix D). The participants answered questions about their audiological history, family history, as well as medical and surgical history. An otoscopic examination was completed prior to obtaining any objective or subjective test results.

Cognitive screening.

The Six-Item Screener (SIS) was administered in order to identify individuals at risk for cognitive impairment (Callahan, Unverzagt, Hui, Perkins, & Hendrie, 2002) (See Appendix E). This test was derived from the MMSE and measured each participant's orientation to year, month, and day of the week and recalls three words after a 3-minute break, for a total of 6 points (Callahan et al., 2002). Each item missed resulted in a point,

therefore the higher the number the poorer the score. The tester asked each of the six questions, verbally, in a quiet room. According to Callahan et al., (2002), a SIS score of 2-3 indicates further diagnostic testing for cognitive impairment. For the purposes of this study, any participant with a score ≥ 3 would be excluded and referred for further psychological testing.

Quality of life screening.

The Hearing Handicap Inventory for the Elderly-Screener (HHIE-S) was administered to each of the participants to screen any perceived emotional and social problems associated with their hearing difficulties (Ventry and Weinstein, 1983) (See Appendix F). The tester asked the participants each of the 10 test items verbally in a quiet room. Participants also had a copy of the questionnaire in front of them so that they could follow along as the questions were read to them. The answer options to each question were yes, sometimes, or no. Each of the items was scored as 4, 2, or 0, respectively. Scores for the total scale ranged from 0 to 40. According to ASHA (1997), HHIE-S scores > 8 are defined as indicating the presence of a hearing handicap; these guidelines are based on data obtained from Lichtenstein, Bess and Logan (1988).

Peripheral hearing Assessment.

Immittance.

Immittance testing was performed in a quiet room using the GSI Tympstar or the AT 235 Interacoustics systems for right and left ears. Tympanometry was conducted prior to obtaining contralateral acoustic reflex thresholds. Contralateral acoustic reflex thresholds (ARTs) at .5, 1, 2, & 4 kHz were obtained. If contralateral ARTs were absent or abnormal, ipsilateral ARTs were obtained at the specific frequency that was absent or

abnormal. Contralateral ART results were compared to Gelfand, Schwander, and Silman (1990) norms. Distortion Product Otoacoustic Emissions (DPOAE) testing was also completed in a quiet room. DPOAEs were obtained using the Otodynamic ILOv6 and Intelligent Hearing Systems (IHS), SmartOAE for right and left ears. The primary tones of L1= 65 dB SPL and L2 = 55 dB SPL were used. An SNR of 6 dB was considered present per each frequency tested.

Air and Bone Conduction Testing.

Audiological testing was conducted in a double wall sound-proof test suite using a two-channel Grason-Stadler Incorporated (GSI) 61 or a Madsen Astera audiometer with EAR-TONE ER 3A insert earphones for air conduction and a Radioear B-71 bone conduction vibrator with headband for bone conduction. Air conduction testing was obtained from octaves 250-8 kHz. Inter-octaves were assessed if there was a difference of 20 dB HL or more between octaves. Bone conduction testing was obtained for frequencies .5, 1, 2, and 4 kHz. Thresholds for both air conduction and bone conduction, were obtained using the modified Hughson Westlake procedure. The categories used to describe the degree of hearing loss in this study were based on 4-frequency PTA at .5, 1, 2 and 4 kHz (Agrawal et al., 2008; Hannula et al., 2011; Lotfi et al., 2009; Malinoff & Weinstein, 1989; Mosciki et al., 1985; Sindhusake et al., 2001). A 4-frequency PTA $\leq$ 25 dB HL was considered normal hearing, 26-40 dB HL a mild hearing loss, 41-55 a moderate hearing loss, 56-70 a moderately-severe hearing loss, > 70 dB HL a severe hearing loss (Ventry & Weinstein, 1982; Ventry & Weinstein, 1983).

Speech Audiometry.

Speech audiometry was also completed to verify pure tone test results and to obtain more information about the participant's auditory system and speech understanding abilities. Speech recognition thresholds (SRTs) were obtained using spondee words presented via monitored live voice for both the right and left ears (ASHA, 1988). Next, word recognition testing was presented at 40 dB SL re: SRT or at most comfortable listening levels (MCL) via compact disc (CD) using the Northwestern University Auditory Test Number 6 (NU-6), test ordered by difficulty (Tillman & Carhart, 1966). Participants were given 25 words per ear regardless of performance. Following completion of the audiometric testing, participants were counseled on their hearing status based on the results obtained from subjective and objective testing.

It is important to note that the peripheral hearing testing was completed in one test session but the testing of all participants was conducted over two separate dates. Participants were seen in two groups, the groups were divided based on convenience of scheduling for the participants. There were two locations for the testing due to a previously scheduled move for the TU-SLHC but all equipment was the same at both locations and all equipment was in calibration for all test sessions.

Hearing aid fitting.

All participants' with a 4-frequency PTA (.5, 1, 2, & 4 kHz) $\geq$ 26 dB HL in at least one ear proceeded to the last part of the Part I of the study. All participants were fit binaurally with new digital hearing aids that were donated from two different hearing aid companies. Four participants were fit the same day as their peripheral hearing assessment because their hearing loss only required open fitted hearing aids and medical clearance

was not warranted based on their audiological test results. These participants signed a medical waiver form prior to the hearing aid fittings. The rest of the participants returned to the TU SLHC at the IWB building to be fit with their hearing aids on a separate date.

Hearing aids were selected based from the donations received and based on the participant's degree and configuration of hearing loss. Prior to their hearing aid fitting, otoscopy was performed and all ears were required to be free of excessive cerumen. If excessive cerumen was found the participant was referred to their general physician or an Ear Nose & Throat physician to have it safely removed. Additionally, if there were any retrocochlear concerns or other medical concerns based on the test results then the patient was referred to a physician for medical clearance. All participants signed a medical clearance waiver form or had a medical clearance form signed prior to hearing aid fitting (See Appendix G & H).

Using the participant's pure tone data, hearing aids were programmed based on manufacturer software fitting formulas. Due to the variability between hearing aid manufactures' adaptation managers for "first fit", all participant's hearing aids were set to 100% at the manufacturers proprietary settings to avoid additional variables being introduced to the hearing aid fitting protocol. Feedback manager was completed for all bilateral fittings. All push buttons and/or volume controls were de-activated to eliminate patient variables and minimize confusion following their first fitting. Real ear measurements (REM) were obtained using the AudioScan Verifit system. A hearing aid was considered a good fit for the participant when the Real Ear Aided Response (REAR) via speechmapping stimuli, matched the prescribed National Acoustic Laboratories' nonlinear fitting procedure, version 1 (NAL-NL1) targets at 55, 65, and 75 decibel sound

pressure level (dB SPL) input levels. It is important to note that small adjustments were also made based on participant's comfort level and perceived quality of sound at the initial fitting. Counseling regarding use and care of hearing aid(s) was completed in a one-on-one setting. After counseling a written hearing aid maintenance form, covering care and use of hearing aids, as well as a 4-pack of hearing aid batteries was given to each participant to take home.

Au.D. student survey.

Fourteen, first year Au.D. students were recruited via e-mail, to collect data and reflect on their experience which was documented in a survey. After each volunteer completed their time slot they completed the "Au.D. Student Survey" (see Appendix I). The survey consisted of a total of six questions related to their perception and/or willingness to serve an underprivileged community with a closed set of five answer choices for each question. The goal for this questionnaire was to evaluate the benefit, or lack there of, having students participate in a project involving an underprivileged community. The closed-set answer choices were: strongly agree, agree, disagree, strongly disagree and non-applicable. To perform statistical analysis each answer choice was given a point value with strongly agree being the highest point value, 2, and strongly disagree being the lowest point value, -2. The score sheet is located in Appendix J. A total score was given to each of the surveys with 12 points being the highest possible total score. The scores were then converted to a total score value and a score between 9-12 indicated that the experience strongly impacted their awareness and willingness to serve an underprivileged community, 5-8 indicated that the experience impacted the student while a score of 0-4 revealed no impact at all.

Part II.

The researchers contacted each of the participants via telephone and/or postal mail and scheduled a personal one-on-one interview in a quiet room at St. Veronica's Church in Cherry Hill to ask the questions from the HHIE-S after 4-5weeks of their hearing aid trial. Participants were familiar with this location and it was convenient to the Senior Apartments where a majority of the participants lived. Each participant was again given a copy of the HHIE-S while the HHIE-S questions were read aloud to him or her.

Statistical Analysis

Once all data were collected various statistical analyses were performed to evaluate the data. Descriptive statistics were performed on Microsoft Excel 2010 to evaluate means and standard deviations. A paired sample *t*-test was performed on IBM SPSS Statistics version 19 to evaluate significance between pre- and post- HHIE-S scores after using hearing aids for 4–5 weeks. Lastly, a Spearmans Correlation Coefficent was computed using IBM SPSS Statistics version 19 to identify if the 4-frequency PTAs were correlated with the pre- HHIE-S scores.

CHAPTER 4

RESULTS

A total of 15 adults (14 African American females, 1 Caucasian male) between the ages of 64 and 89 years (M = 74.40, SD = 8.68) participated in this study. Seven of these participants (all females) were excluded from the analysis because they did not meet the criteria for this study (4-frequency PTA (.5, 1, 2, & 4 kHz) ≥ 26 dB HL, in at least one ear). The age range for the eight participants ranged from 67 to 89 years old (M = 78.13, SD = 9.40). Four participants (50%) had a history of noise exposure. Otologic history included tinnitus (n = 7; 87.5%), ear pain (n = 1; 12.5%), aural fullness (n = 2; 25%), and vertigo (dizziness) (n = 4; 50%). Other reported medical conditions consisted of headaches (n = 4; 50%), diabetes (n = 4, 50%), and hypertension (n = 7, 87.5%). One participant (participant 4) had a unilateral hearing loss. This participant was included in the study, as she met the criteria for a hearing loss for one ear (left), but due to the fact that her hearing loss falls into a different category than the other seven participants (unilateral hearing loss, no benefit from amplification bilaterally, therefore fitted with CROS system) she was excluded from further statistical analyses beyond descriptive statistics for hearing thresholds. Therefore data for the remaining seven participants (six African-American females, one Caucasian male) were analyzed using Microsoft Excel 2010 and IBM SPSS Statistics version 19.

Part I

Peripheral hearing assessment.

The raw data and means and standard deviations for hearing loss with all eight participants (16 ears) can be seen below in Table 1. Participant four was excluded from

further data analyses. The means and standard deviations for the final set of seven participants (14 ears) can be seen in Table 2.

Table 1

4-Frequency Pure Tone Averages (PTA) for Right and Left Ears for Each Participant

Participant	Right Ear	Left Ear
1	33.75	37.50
2	42.50	42.50
3	62.50	60.00
4	13.80*	80.00*
7	30.00	27.50
8	33.75	33.25
10	38.70	36.20
11	38.75	42.50
Mean	36.72	44.93
SD	10.75	17.07

Note: 4-Frequency PTA for right and left ears for each participant that qualified for the study. PTA and means are reported in dB HL. Asterisk (*) denotes the participant that had a unilateral hearing loss. Total participants, n = 8.

Table 2

4-Frequency Pure Tone Averages (PTA) for Right and Left Ears for Seven Participants

Participant	Right Ear	Left Ear
1	33.75	37.50
2	42.50	42.50
3	62.50	60.00
7	30.00	27.50
8	33.75	33.25
10	38.70	36.20
11	38.75	42.50
Mean	39.99	39.92
SD	10.75	10.29

Note: 4-Frequency PTA for right and left ears for seven participants. PTA and means are reported in dB HL. Total participants, n = 7.

All seven participants had a sensorineural hearing loss in both ears across all octave frequencies from 250 Hz to 8 kHz. The average speech recognition thresholds (SRT) for all participants were 32.50 dB HL (12.16) for the right ears and 33.93 dB HL (11.71) for the left ears. The average word recognition scores (WRS) for all participants were 83.43% (14.13) and 81.14% (8.55) for the right and left ears respectively. All participants (100%) had Jerger Type A tympanograms, bilaterally. Means and standard deviations for each ART stimulus condition are found in Table 3 (contralateral ARTs) and Table 4 (ipsilateral ARTs). Figure 1 (contralateral ARTs) and Figure 2 (ipsilateral ARTs) show mean comparisons for ARTs. Means and standard deviations for DPOAEs for right and left ears could not be analyzed, because data was not saved and not recorded for six of the seven participants.

Table 3

Mean Contralateral Acoustic Reflex Thresholds

	Stimulus Right Ear				Stimulus Left Ear			
	500 Hz	1kHz	2kHz	4kHz	500 Hz	1kHz	2kHz	4kHz
Mean	101.43	95.43	99.29	102.14	98.57	92.86	95.00	105.71
SD	13.76	18.42	17.18	13.80	12.49	13.50	11.55	12.39

Note: Mean contralateral acoustic reflex thresholds for right and left ears at each test frequency. Means are reported in dB HL. SD = standard deviation. Total participants, n = 7.

Table 4

Mean Ipsilateral Acoustic Reflex Thresholds

	Right Ear (n = 4)				Left Ear (n = 3)			
	500 Hz	1kHz	2kHz	4kHz	500 Hz	1kHz	2kHz	4kHz
Mean	104.00	98.80	100.00	115.00	103.30	105.00	105.00	105.00
SD	15.97	14.36	12.25	0.00	20.21	17.32	17.32	17.32

Note: Mean ipsilateral acoustic reflex thresholds for right and left ears at each test frequency. Means are reported in dB HL. SD = standard deviation. Total participants, n = 4 right ears, n = 3 left ears.

Figure 1.

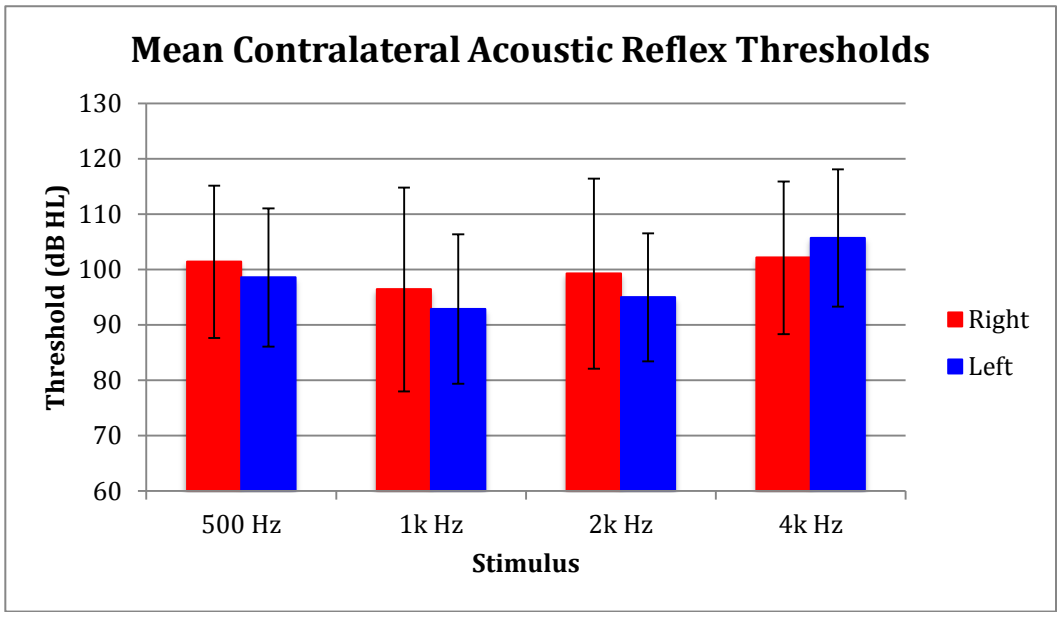

Figure 1. Mean contralateral acoustic reflex thresholds for right and left ears at each test frequency. Error bars represent one standard deviation above and below mean. Total participants, n = 7.

Figure 2.

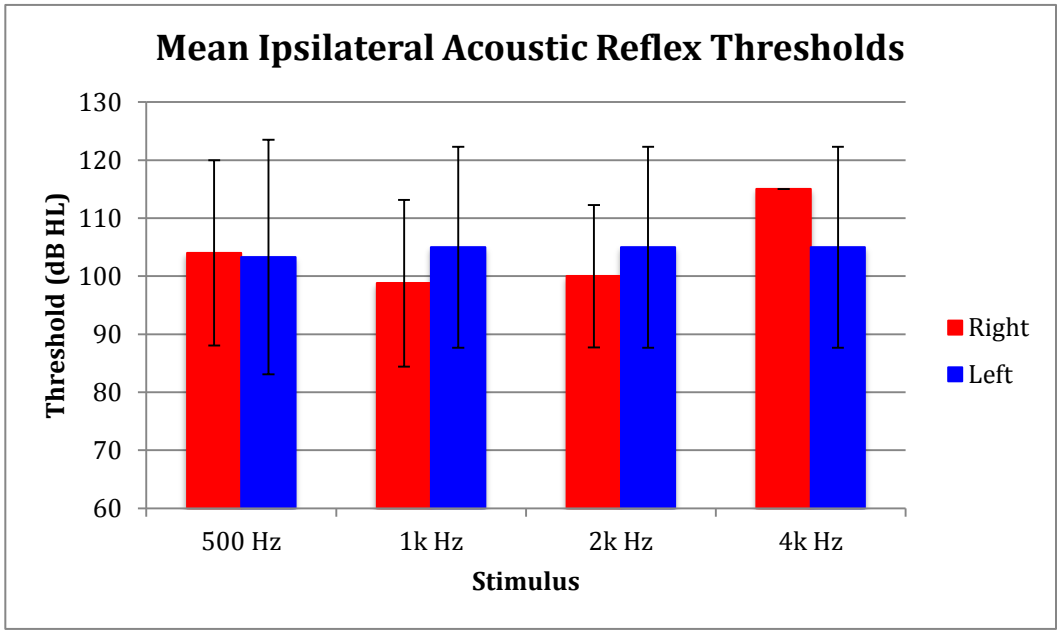

Figure 2. Mean ipsilateral acoustic reflex thresholds for right and left ears at each test frequency. Error bars represent one SD above and below mean. Total participants, n = 4 right ears; n = 3 left ears.

Six-item screener (SIS) cognitive screener.

The Six-Item Screener (SIS) was also completed prior to hearing aid fitting. Of the participants that qualified for this study, six participants' had a score of 0 and one participant had an SIS score of 2 (M = .30; SD = .76).

HHIE-S quality of life screener.

All participants completed the HHIE-S questionnaire prior to being fitted with hearing aids. Mean and standard deviation results for each condition evaluated (Emotional, Social and Total) can be seen in Table 5.

Table 5

Pre- Hearing Aid Fitting HHIE-S Mean Scores

	Pre-Hearing Aid Fitting		
HHIE-S	Emotional	Social	Total
Mean	9.14	8.57	17.71
SD	8.40	5.50	12.83

Note: Pre- hearing aid fitting HHIE-S (Hearing Handicap Inventory for the Elderly-Screening) mean scores and standard deviations for each condition evaluated. The lower the score the better the perceived QOL (Quality of Life). Total participants, n = 7.

Hearing aid fittings.

Four participants were fit with Widex RE-9, one participant was fit with Widex RE-19, two participants were fit with Phonak Dalia Micro P and one participant was fit with a Phonak CROS system, which was fitted with a Phonak Cassia hearing aid as seen in Table 6. As previously noted, the participant that received the CROS system was excluded from further data analysis.

Table 6.

Hearing Aids Fitted

Hearing Aids	Number of Ears Fit
Phonak Dalia Micro P	4
*Phonak CROS	1
Phonak Cassia	1
Widex RE-9	2
Widex RE-19	8

Note: Types of hearing aids that were donated and fitted to each of the participants' that qualified for the study. Asterisk (*) denotes that the participant was excluded from further data analysis due to moderate to severe unilateral hearing loss. Total participants, n = 8.

Au.D. student survey.

A total of 13 Au.D. students responded to the email and volunteered their time to help gather data for this pilot study. On the first test date of data collection, eight Au.D. students volunteered their time assist with hearing testing. On the second test date, five Au.D. students volunteered their time to assist with hearing testing and fit hearing aids. Before each test date the students were given written and verbal instructions on all test procedures. The mean total score for the 13 surveys completed was 7 (SD = 3.28). Based on the mean total score, the impact of this experience based on the student's perception can be reported as this experience impacted their awareness and willingness to serve an underprivileged community. The individual scores can be seen in Figure 3.

Figure 3.

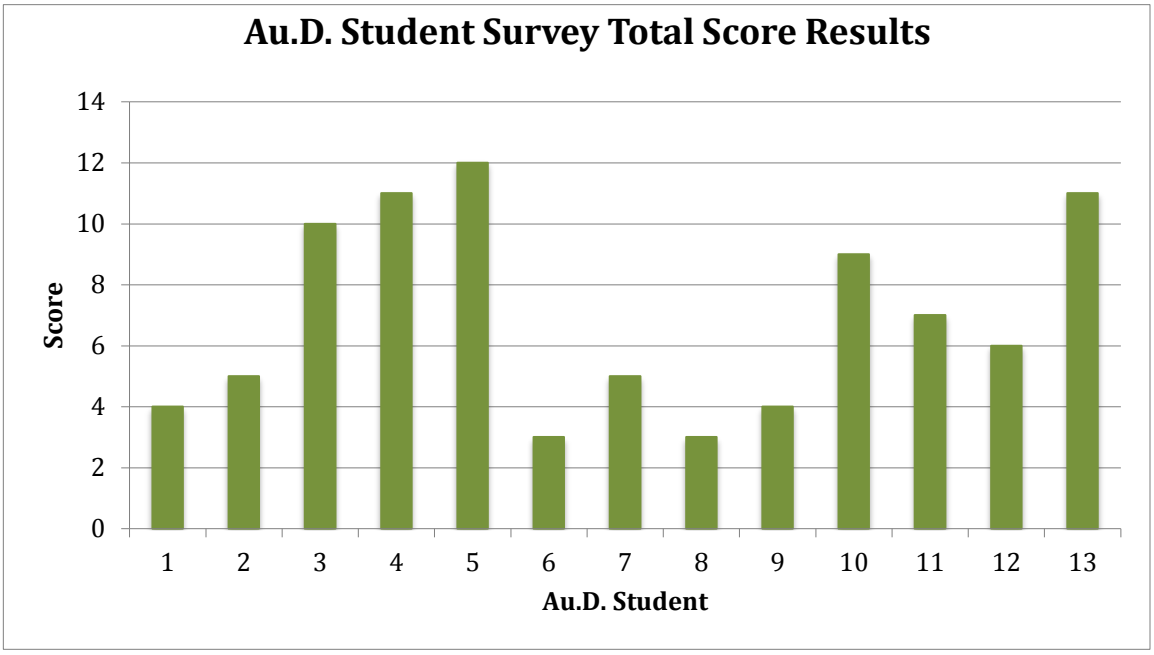

*Figure 3.*Au.D. student survey total score results for each student who volunteered their time in this pilot study. Mean = 7. Standard Deviation = 3.28. Total Au.D. students volunteered, n = 13.

Part II

Post-HHIE-S.

All participants completed the HHIE-S questionnaire 4-5 weeks following their hearing aid fitting. Post-HHIE-S mean and standard deviation results for each condition evaluated (Emotional, Social and Total) can be seen in Table 7. Figure 3 compares both the pre- and post-HHIE-S mean scores for each condition evaluated. Figure 4 compares both pre- and post-HHIE-S total scores for each participant fit with hearing aids.

A two-tailed paired sample *t*-test was completed using IBM SPSS Statistics version 19 to determine if statistically significant differences existed between HHIE-S scores pre- and 4-5 weeks post-hearing aid fitting. Results revealed there were no significant differences between HHIE-S scores pre- and post-hearing aid fitting ($t = 1.49$; $df = 6$; $p = .186$).

Table 7

Post- Hearing Aid Fitting (4-5 weeks) HHIE-S Mean Scores

	4 to 5 Weeks Post- Hearing Aid Fitting		
HHIE-S	Emotional	Social	Total
Mean	4.29	5.71	10.00
SD	6.47	5.94	11.78

Note: Post-hearing aid fitting (4-5 weeks) HHIE-S (Hearing Handicap Inventory for the Elderly- Screening) mean scores and standard deviations for each condition evaluated. The lower the score the better the perceived QOL (Quality of Life). Total participants, n = 7.

Figure 4.

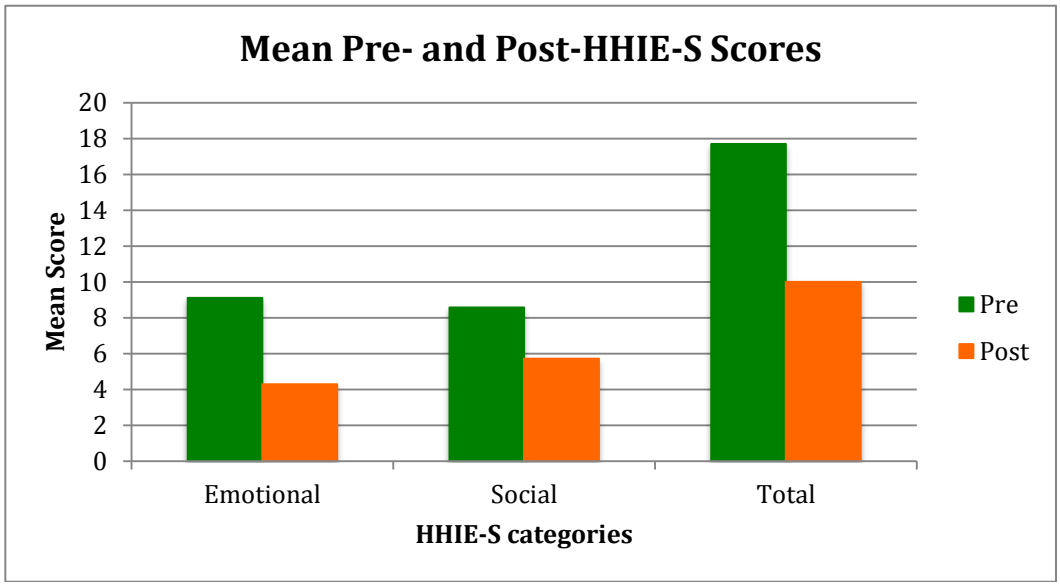

Figure 4. Mean pre- and post- (4-5 weeks) HHIE-S (Hearing Handicap Inventory for the Elderly- Screening) scores for each condition on all participants fit with hearing aids. Note: The lower the score the better the perceived QOL. Total participants, n = 7.

Figure 5.

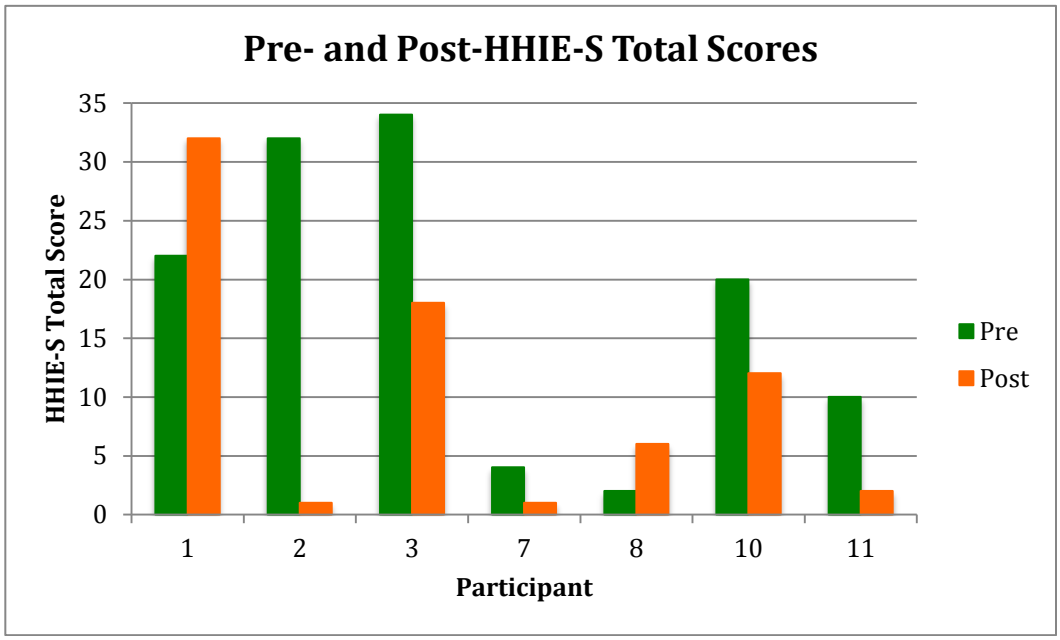

Figure 5. Pre- and post-HHIE-S total scores for each participant fit with hearing aids. Note: The lower the score the better the perceived QOL. Total participants, n = 7.

A Spearmans Correlation Coefficient was computed using IBM SPSS Statistics version 19 to assess the relationship between the participants' 4-frequency PTA score and the participants' pre-hearing aid fitting HHIE-S total score, using a two-tailed significance. A strong positive correlation between the left ear PTA and pre-HHIE-S total score ($r = .811$, $n = 7$, $p = .027$) as well as between the right ear PTA and pre-HHIE-S total score ($r = .757$, $n = 7$, $p = .049$). Both correlations were significant ($p < .05$). Overall, the poorer the PTA, in the higher the HHIE-S scores (lower perceived QOL).

Self-reported daily hours of hearing aid use.

At 4-5 weeks post-hearing aid fitting the following hearing aid use was reported: one participant reported using his hearing aids for 10 hours a day, one participant wore reported wearing her hearing aids for 6 hours a day, one participant reported wearing her hearing aids for 5 hours a day, two participants reported using their hearing aids 4 hours a day, one participant reported wearing her hearing aids for 2 days and one participant reported wearing her hearing aids for 1 day, which was the day of the hearing aid fitting.

Six participants reported that their hearing aids were too loud and were having difficulty inserting the hearing aids in their ears. The two participants that wore their hearing aids 6 hours a day had no difficulties with their hearing aids. All participants were wearing both hearing aids except participant three. She has been wearing her right hearing aid for 5 hours per day, but only wore her left hearing aid for 2 weeks. She indicated her left hearing aid was too loud. Interestingly, there was no pattern seen between amount of hearing aid use and amount of improvement in HHIE-S scores (lower scores) indicating an improved QOL.

CHAPTER 5

DISCUSSION

The main purpose of this study was to evaluate the effect amplification has on QOL in an elderly population living in a low SES community. The second aim of this study was to evaluate the benefit, or lack thereof of having graduate students participate in a project involving an under privileged community.

Participants

A requirement for inclusion in part I of the current pilot study was elderly individual's aged 55 years and older that lived in a low SES community, such as Cherry Hill in Baltimore, Maryland. The mean age for the participants was 74.40 years. Of the 15 participants, 14 of them were African American females, and one was a Caucasian male. It been suggested in the literature that men most often report hearing difficulties; however, women are more likely to visit a doctor when compared to men (Argrawal et al., 2008; Cruickshanks et al., 2003; Desai et al., 2001; Gates et al., 1990; Kirzinger, Cohen, & Gindi, 2012; Moscicki et al., 1985; Schoenborn & Heyman, 2008; Wilson et al., 1999). Participants were self-selected for this study meaning that if they perceived a hearing loss they could have a comprehensive audiological evaluation therefore gender balance could not be controlled. The amount of self-reported hearing loss based on gender was unable to be analyzed in the current study, due to the small sample size and the sample consisting primarily of females. Future research with a larger sample size and a balanced gender distribution is warranted.

Interestingly, studies have found Caucasians to have a higher prevalence of hearing loss than African Americans (Agrawal et al., 2008; Desai et al., 2001; Helzner et

al., 2005; NAAS, 1999). The Cherry Hill community in Baltimore is 97.5% African American therefore just drawing a random sample would not allow us to evaluate ethnicity and hearing loss in this community due to the lack of diversity (Ames et al., 2011). A study recruiting participants from various low SES communities may result in a more diverse sampling.

Otologic and Medical History

Scheoenborn and Heyman (2008) found that elderly adults that had hearing loss also had other health issues; therefore, questions regarding otologic and medical history were included for the current study. Of the participants that qualified for the study, the most commonly reported medical conditions reported were hypertension (87.5%) and diabetes (50%). Researchers have found a relationship between medical conditions (specifically, hypertension and diabetes) and a higher prevalence of hearing loss (Agrawal, et al., 2008; Mathers et al., 2000). The most commonly reported otologic conditions that the participants reported were tinnitus (87.5%) and dizziness (50%). In a study by Hannula et al. (2001) there was a link between tinnitus and hearing loss. There is no clear relationship between "dizziness" and hearing loss but that may be due to the various causes for dizziness and the variable presentation of individuals with reports of "dizziness."

Peripheral Hearing Assessment

Research has found that the elderly individuals with hearing loss often have a sensorineural hearing loss, due to the age related changes that occur in the inner ear this is commonly referred to as presbycusis (Chisolm et al., 2003; Moscicki et al., 1985). A majority of the participants in this study had bilateral sensorineural hearing loss. Most of

the participants' hearing loss was unknown in origin but may be due to, at least in part, presbycusis. Seven participants had a sensorinerural hearing loss, bilaterally.

HHIE-S

To evaluate the benefit of hearing aids on QOL, the HHIE-S was administered to each participant at the initial peripheral hearing evaluation (before being fitted with hearing aids) and again 4-5 weeks after their hearing aid fitting. All participants came to the post-HHIE-S interview, except one participant who was too ill to come to the interview session. This participant completed the post-HHIE-S interview over the telephone. This participant's data was included in the analysis, as this was not considered an exclusionary criterion and there were no indications that the participant did not understand the questions or the task.

A comparison of pre- and post-HHIE-S scores did not reveal significant benefit from hearing aids. Several participants subjectively reported that they did not wear (or rarely wore) their hearing aids between the fitting appointment and the follow-up appointment because their hearing aid was "too loud." It is likely that decreasing the overall gain of the hearing aids may have increased hearing aid use, resulting in similar findings as Vuorialho et al. (2006); which found hearing aids to be highly beneficial and effective in decreasing emotional and social handicap caused by hearing loss by using the HHIE-S pre- and six months post-hearing aid fitting. Vuorialho et al. (2006) also used a longer pre- and post- assessment period between administration of the HHIE-S and therefore it may have given their participants time to adjust to their hearing aids (and have their hearing aids adjusted to their listening preference) which may have contributed to their significant finding. Additionally, a follow-up appointment conducted one week

after the initial fitting may have identified the participants' complaints regarding sound quality and therefore it could have been addressed sooner which may have resulted in a better, more accurate, HHIE-S score. Unfortunately, TU is not physically close to the Cherry Hill community therefore transportation was provided to all participants to and from their diagnostic audiological evaluation appointments and hearing aid fittings. While we would prefer to see the participants after 1-2 weeks of wearing their hearing aids it was not physically or financially feasible. Future studies should consider this limitation when developing protocols and/or seeking grant support to work with low SES communities. Lastly, the small sample size may have contributed to the non-significant finding.

The relationship between the participants' 4-frequency PTA and the participants' pre-HHIE-S total score revealed a strong positive correlation between left and right ears in this study. Ventry & Weinstein (1982) also found high correlations ($r > .87$); however, they compared the 3-frequency PTA (.5, 1, & 2 kHz) to the post-HHIE questionnaire. This indicates the need for further research and data collection in this area. Additionally, a larger sample size is warranted to ensure there is enough power in the data analysis to generalize to other populations.

Self-Reported Hours of Hearing Aid Use

There was a wide variability in the amount of reported hearing aid use in the current study, ranging from 8-10 hours a day to 1 day out of the entire 4-5 week period. Mulrow et al. (1990) noted that the participants that reported the highest number of hearing aid use also had the greatest improvement in post-HHIE-S scores; however, this was not seen in the current study. The variability in use may have been due to the fact

that many participants had difficulty with inserting the hearing aids and changing the batteries due to tactile or physical difficulties. The participants did not let the researchers know about their difficulties despite having contact phone numbers and receiving follow-up phone calls. All participants with complaints or problems waited until the face-to-face follow-up appointment to report their difficulties. Future research should consider amending the fitting protocol to use the adaptation manager and to include a one-on-one appointment within the first 1-2 weeks following the fitting to increase routine daily use. Additionally, the use of data logging, when possible could be used to document when the hearing aids are on to provide an objective measure of use in conjunction with subjective self-reported use.

Au.D. Student Survey

The second aim of this study was to evaluate the impact this experience had on Au.D. students' perception and willingness to serve an underprivileged community. The results indicated that this experience strongly impacted their perception and willingness to serve an underprivileged community. Students that interacted with the participants on average had a higher total score than students who helped with paperwork and did not get to interact with the participants. Written comments from the students were all positive. Some of the direct quotes received were:

- "Great attitude and positive atmosphere throughout both Cherry Hill days."
- "Such a great experience-all the participants were happy to be there and clearly grateful for our time and services. Would do it again in a heartbeat!"

- "From what I could tell the whole day was a success and the participants were fantastic. I could tell how much they appreciated what we were doing as well as how much fun they had with one another."
- "I hope this program continues and that we as students get to offer our services to the Cherry Hill community."

Future Directions

The aim of this pilot study was to identify and treat hearing loss in a low SES community and to evaluate the effect, if any, amplification had on the QOL. The lack of significance seen in the results for pre- and post-HHIE-S scores (main test to evaluate QOL changes) highlighted several areas for future studies to consider amending to obtain an accurate evaluation of QOL. First, a larger sample size and improved gender distribution is needed. This would have given the data more power and with a more equal gender distribution would have allowed a comparison of males to females. Second, unilateral hearing losses should either a) be excluded from group recruitment or b) be targeted and analyzed as a separate group. Third, the hearing aid fitting protocol used should be amended to provide the participants with more auditory comfort and an earlier opportunity for changes. It would be of interest to know whether a follow-up appointment after the hearing aid fitting would have increased hearing aid use and/or participant satisfaction. Lastly, consideration should be given for a longer time between pre- and post- HHIE-S questionnaire. Future research should consider having follow-up appointments 1-2 weeks after initial hearing aid fitting for all participants. And a QOL survey, like the HHIE-S should be administered later, possibly 8-12 weeks after the

initial fitting to see if a longer time to adapt impacts actual perception of QOL (Vuorialho et al. (2006).

Conclusion

Based on the results of this study, the benefit of hearing aids after a month of use on QOL is potentially influenced by the initial gain of hearing aids, ability to manipulate the hearing aids (insert, remove and change the battery), and daily use of the hearing aids. Overall this study found a general trend indicating an improvement in HHIE-S scores (lower scores) indicating an improved QOL after 4-5 weeks of hearing aid use; however, it was not a significant finding. This result should be interpreted with caution due the small sample size and lack of consistent use of hearing aids by participants. Furthermore, this study also found a strong positive correlation between PTA and pre-HHIE-S scores. Indicating, the more severe the hearing loss, the greater impact it has on emotional and social QOL. This is an important finding for clinical practice and for future studies. Clinicians should consider administering a QOL questionnaire (e.g., HHIE-S) to provide additional information to a diagnostic audiological evaluation and hearing aid fitting. Finally, the study also revealed that having Au.D. students involved in the current study impacted their perception and willingness to serve an underprivileged community in the future. In the current economy and health insurance coverage declining (Medicare and private insurance policies) the importance for volunteers in health related fields cannot be minimized, especially in low SES communities. Therefore, having Au.D. students involved in the program highlighted the students' willingness to serve when exposed to communities in need and therefore students should be included in hands-on projects for outreach programs when possible. Combined, these results support the need for a larger

scale study on QOL of people living in a low SES community with hearing loss and further studies to support (or contradict) the effect that volunteering may have Au.D. students' future willingness to serve.

APPENDICES

Appendix A

Informed Consent Form

TOWSON UNIVERSITY

Department of Audiology, Speech-Language Pathology,
and Deaf Studies

INFORMED CONSENT FORM
Project title: Influence of Hearing Aid Use on the Quality of Life of the Elderly in an Underprivaleged Community: A Piolt Study

Principal Investigator:
Jennifer L. Smart, Ph.D.
Towson University
Dept. of ASLD
8000 York Road
Towson, MD 21252
(410) 704-3105
JSmart@towson.edu

Purpose of the Study:

The purpose of this project to identify the hearing status and quality of life both before and after a bilateral hearing aid fitting, for adults living in an underprivileged community. .

Procedures:

If you take part in this study, a peripheral hearing test will be performed to evaluate your outer, middle and inner ears. This will involve one session lasting approximately one-two hours. During the session you will participate in a number of different hearing tests. For some tests you will be asked to report back what you hear through earphones. There are no right or wrong answers for these tests. For other tests, such as immittance, acoustic reflexes and otoacoustic emissions, a small rubber tip probe rests in the ear canal. For these tests, you will be asked to sit quietly in a comfortable chair. You will be asked to complete a questionnaire following your hearing test.

If a hearing loss is found then new digital hearing aids will be fitted and programmed according to your hearing test results. This session will take place at Towson University Speech-Language and Hearing Clinic (TUSLHC), lunch and transportation will be provided to you. Some of the assessments may be familiar to you while others will be new but all are a part of routine clinical practice.

Risks/Discomfort:

There are no known risks for participating in this study. The tests included in this study are a part of routine clinical assessments.

Benefits:

You will receive a comprehensive audiological evaluation, and if warranted, a pair of new digital hearing aids at no cost.

Alternatives to Participation:

Participation in this study is voluntary. You are free to withdraw or discontinue participation at any time.

Cost Compensation:

Participation in this study will incur no charge.

Confidentiality:

All information collected during the study period will be kept strictly confidential and will be located in a locked cabinet in a locked office or laboratory. You will be identified through identification numbers. No publications or reports from this project will include identifying information on any participant. If you agree to join this study, please sign your name below.

_____ I have read and understood the information on this form.

_____ I have had the information on this form explained to me.

_____
Participant's Name (printed)

_____ _____
Participant's Signature Date

_____ _____
Principal Investigator Date

If you have any questions regarding this study please contact the Principal Investigator, Dr. Jennifer L. Smart, phone: (410) 704-3105 or email: JSmart@towson.edu or the Institutional Review Board Chairperson, Dr. Debi Gartland, Office of University Research Services, 8000 York Road, Towson University, Towson, Maryland 21252; phone (410) 704-2236.

Appendix B

Request For Services Form

Speech-Language & Hearing Center
Towson University-8000 York Road-Towson, MD 21252-0001
Voice or TDD: 410-704-3095 - Fax: 410-704-6303

TOWSON UNIVERSITY

REQUEST FOR SERVICES

Dear Client:

The Speech-Language-Hearing Clinic welcomes the opportunity to provide our services to you. Our full range of clinical services is provided at reduced cost by staff or graduate and senior undergraduate student clinicians under the direct supervision of our clinic staff. Every clinic staff member is nationally certified by the American Speech-Language-Hearing Association and licensed by the State of Maryland which ensures that you will receive quality service.

This Clinic is a very important part of the Speech-Language Pathology and Audiology program of Towson University. Some aspects of your clinic evaluation or treatment may be used for instructional and demonstration purposes because we are a university training program. There may be observations by students from Towson University and affiliated training programs; confidential use of audio and video tape recording and clinic records; and/or review of clinical records for research purposes. If clinical records are used for research purposes, client names and identifying information will be omitted. If any specific research project involving your direct participation is contemplated you will be given information about the project and asked to participate. Our student clinicians are trained to abide by all state and federal laws and regulations governing the security and confidentiality of client records.

Each client is responsible for Clinic service fees. In regard to insurance billing, obtaining referrals, pre-authorization, or special forms necessary for reimbursement is the responsibility of the client. Insurance membership cards must be presented at time of appointment or on first day of treatment. If your insurance is billed for service and insurance company denies payment, you are responsible for payment. Any balance due for speech-language treatment or training must be paid by client prior to continuation of services in the following semester.

I hereby acknowledge that as of this date, I have read the above information and I have received the Towson University Speech-Language-Hearing Clinic Notice of Privacy Practices. This notice is available on our clinic website and is posted in our clinic. If desired, we will provide you with a paper copy.

_____ _____
Client, Parent\Guardian Signature Date
(I wish to use the services of the Towson University Clinic and I understand and agree to the above information)

_____ _____
Staff Supervisor Signature Date

A:shared/FORMS/clients/REQUEST4SERV04\01\03

Appendix C

Authorization Form

Speech-Language & Hearing Center
Towson University-8000 York Road-Towson, MD 21252-0001
Voice or TDD: 410-704-3095 - Fax: 410-704-6303

TOWSON UNIVERSITY

AUTHORIZATION FORM

I, _____, hereby authorize ***Towson University Speech-Language-Hearing Clinic***
Name of individual authorizing use/disclosure
to use/disclose the following information from the speech/language or audiology record(s) of :

Name: _____ SSN: _____ Birthdate: _____

Address: _____ Home phone: _____ Work phone: _____

_____ Cell phone: _____

Information to be used/disclosed:
☐ Diagnostic Report performed on Date: _____
☐ Progress Report covering the period from: Date: _____ to Date: _____
☐ Other: _____

Purpose of disclosure of information: ☐ At patient's request ☐ Assist health care providers in care of patient
☐ Verification of services provided for insurance payment purposes ☐ Research purposes
☐ Other: _____

Person/institution to whom information is to be disclosed:

☐ Name/Address:	☐ Name/Address:	☐ Name/Address:
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

A message may be left: ☐ at home ☐ at work ☐ do not leave a message

Expiration date (may not exceed one year)_____

The University may not condition its provision of treatment, payment, enrollment or eligibility for benefits on your signing this authorization. However, there are two exceptions:
1. If you refuse to sign this authorization to use or disclose protected health information for research, it may refuse to provide treatment related to that research and:
2. If you refuse to sign this authorization to disclose information to a third party, it may refuse to provide health care that is solely for the purpose of disclosure to that third party.

You may revoke this authorization at any time, by writing to the Clinic Administrator of the Speech-Language-Hearing Clinic. The revocation will become effective on the day the University receives it, except to the extent that: (a) the University has made a disclosure before the effective date of the revocation; or (b) if the authorization was obtained as a condition of obtaining health insurance coverage, other law provides the insurer with the right to contest a claim under the policy or the policy itself.

You should be aware that information disclosed pursuant to this authorization could possibly be disclosed by the recipient and thus no longer be protected by the Health Insurance Portability and Accountability Act and its implementing regulations.

Signature of Client, Parent/Guardian: _____ Date: _____

Signature of Personal Representative if applicable*: _____
* Describe authority to act for the client: _____

Signature of Witness_____ Date:_____

HIPAA/Authorization for use/disclosure 3/03

Appendix D

Case History Form

Speech, Language & Hearing Center
Towson University-8000 York Road-Towson, MD 21252-0001
Voice or TTY: 410-704-3095 – Fax: 410-704-6303

TOWSON UNIVERSITY
Cherry Hill Hearing Healthcare Initiative

Name: _____

Date of Birth: _____ Age: _____ Gender: Male / Female

Preferred Mailing Address (for future appointments):

_____
Street

_____ _____ _____
City State Zip Code

Phone Number (for future appointments):_____

Brief case history:

Have you ever experienced: (please check all that apply)

- ☐ Tinnitus (ringing in your ears)
- ☐ Vertigo (dizziness)
- ☐ Headaches
- ☐ Ear infections
- ☐ Ear pain
- ☐ Other:_____

Medical history:

Medications:_____

Surgeries:_____

Additional History:

Occupation: _____

Noise Exposure (e.g., military, industrial (machinery), etc.):_____

Any Family members with history of hearing loss? _____

Appendix E

Six-Item Screener

Six-Item Screener to Identify Cognitive Impairment*

Script:

I would like to ask you some questions that use your memory. I am going to name 3 objects. Please wait until I say all 3 words, then you repeat them. Remember what the 3 objects are because I am going to ask you to name them again later.

1. APPLE	Recall:	Yes ☐	No ☐
2. TABLE	Recall:	Yes ☐	No ☐
3. CAR	Recall:	Yes ☐	No ☐

Now I'm going to ask you a few basic questions.

• What is the year?	Correct:	Yes ☐	No ☐
• What is the month?	Correct:	Yes ☐	No ☐
• What is the day of the week?	Correct:	Yes ☐	No ☐

* Use an additional set of questions, such as verifying name, address and phone number a distractor. Allow 3 minutes to pass before asking for recall.

What were the 3 objects I asked you to remember?

4. APPLE	Recall:	Yes ☐	No ☐
5. TABLE	Recall:	Yes ☐	No ☐
6. CAR	Recall:	Yes ☐	No ☐

6 Item Recall Summary: Number of objects missed (only choose one).

1. ☐ 2. ☐ 3. ☐ 4. ☐ 5. ☐ 6. ☐

Do responses indicate cognitive impairment?

Scoring: A score of 2-3 missed indicates a need for further screening and diagnostic testing.

Reference: Christopher M. Callahan, MD, Frederick W. Unverzagt, PHD, Siu L. Hui, PHD, Anthony J. Perkins, Ms, And Hugh C. Hendrie, Mb, Chb: Medical Care: Volume 40, Number 9, Pp 771–781©2002 Lippincott Williams & Wilkins, Inc.

Appendix F

Hearing Handicap Inventory for the Elderly- Screener

Hearing Handicap Inventory for the Elderly- Screening (HHIE-S)

		Yes	Sometimes	No
E	1. Does a hearing problem cause you to feel embarrassed when you meet new people?			
E	2. Does a hearing problem cause you to feel frustrated when talking to members of your family?			
S	3. Do you have difficulty hearing when someone speaks in a whisper?			
E	4. Do you feel handicapped by a hearing problem?			
S	5. Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?			
S	6. Does a hearing problem cause you to attend religious services less often than you would like?			
E	7. Does a hearing problem cause you to have arguments with family members?			
S	8. Does a hearing problem cause you difficulty when listening to TV or radio?			
E	9. Do you feel that any difficulty with your hearing limits or hampers your personal or social life?			
S	10. Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?			
Score _____				

Retrieved From: http://www.asha.org/docs/html/GL1997-00199-T19.html

Ventry, I. J. & Weinstein, B. (1983). Identification of elderly people with hearing problems. American Speech-Language and Hearing Association, 37-42.

Appendix G

Medical Clearance Waiver Form

Speech-Language & Hearing Center
Towson University-8000 York Road-Towson, MD 21252-0001
Voice or TDD: 410-704-3095 - Fax: 410-704-6303

TOWSON UNIVERSITY

WAIVER OF MEDICAL EVALUATION FOR HEARING AID USE

I have been advised that the Food and Drug Administration has determined that my best interest would be served if I had a medical evaluation by a licensed physician (preferably a physician who specialized in diseases of the ear) before purchasing a hearing aid(s). I do not wish to receive a medical evaluation before purchasing a hearing aid(s).

_____ _____
Signature Date

_____ _____
Witness Date

O:\ student\AUD Graduate Assistant\Forms\"Waiver of Medical Evaluation For Hearing Aids"

Appendix H

Medical Clearance Form

Speech-Language & Hearing Center
Towson University-8000 York Road-Towson, MD 21252-0001
Voice or TDD: 410-704-3095 - Fax: 410-704-6303

TOWSON UNIVERSITY

MEDICAL CLEARANCE FOR THE USE OF AMPLIFICATION

Name: _____ DOB: _____

There are no medical contraindications for the use of amplification (i.e., hearing aids) on:

the right ear ☐ the left ear ☐ both ears ☐

_____
Physician's Name (Print or Stamp)

_____ _____
Physician's Signature Date

O:student/AUD Graduate Assistant/Audiology Clinic Manual 2003/ "Medical Clearance for Use of Amplification"

Appendix I

Au. D. Student Survey

CHERRY HILL HEARING HEALTHCARE INITIATIVE
AU.D. STUDENT SURVEY

Thank you for providing hearing services to the participants of Cherry Hill! We would like to know how your experiences with participants of Cherry Hill have impacted your views on caring for the low SES population. Please circle the response that indicates your degree of agreement with the following statements:

As a result of my experiences caring for Cherry Hill participants:

My perception of adults living in low SES communities has changed.	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**
I am more inclined to care for adults living in low SES communities	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**
I am more sensitive to the needs of adults living in low SES communities	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**
I would consider volunteering my professional services to promote hearing in low SES communities	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**
I plan to advocate for the hearing needs of adults living in low SES communities	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**
I would consider working in settings that provide care to adults living in low SES communities	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**	**N/A**

COMMENTS:

Thank you for completing this survey!

Appendix J

Au. D. Student Survey Score Sheet

CHERRY HILL HEARING HEALTHCARE INITIATIVE
Au.D. STUDENT SURVEY

Thank you for providing hearing services to the participants of Cherry Hill! We would like to know how your experiences with participants of Cherry Hill have impacted your views on caring for the low SES population. Please circle the response that indicates your degree of agreement with the following statements:

As a result of my experiences caring for Cherry Hill participants:

	Score: Strongly Impacted ←		Impacted	→ No Impact	
	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
My perception of adults living in low SES communities has changed.	(2)	(1)	(-1)	(-2)	(0)
I am more inclined to care for adults living in low SES communities	(2)	(1)	(-1)	(-2)	(0)
I am more sensitive to the needs of adults living in low SES communities	(2)	(1)	(-1)	(-2)	(0)
I would consider volunteering my professional services to promote hearing in low SES communities	(2)	(1)	(-1)	(-2)	(0)
I plan to advocate for the hearing needs of adults living in low SES communities	(2)	(1)	(-1)	(-2)	(0)
I would consider working in settings that provide care to adults living in low SES communities	(2)	(1)	(-1)	(-2)	(0)

COMMENTS:

Total Score	_____
Strongly Impacted	**9-12**
Impacted	**5-8**
No Impact	**0-4**

Thank you for completing this survey!

Appendix K

IRB Approval

TOWSON
UNIVERSITY

APPROVAL NUMBER: 12-A072

APPROVED
JUN 12 2012
TOWSON IRB

To: Jennifer Smart
8000 York Road
Towson MD 21252

From: Institutional Review Board for the Proctection of Human Subjects, Patricia Alt, Member

Date: Monday, June 11, 2012

RE: Application for Approval of Research Involving the Use of Human Participants

Office of University
Research Services

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2236
f. 410 704-4494

Thank you for submitting an Application for Approval of Research Involving the Use of Human Participants to the Institutional Review Board for the Protection of Human Participants (IRB) at Towson University. The IRB hereby approves your proposal titled:

Benefits of Hearing Aid Use on the Quality of Life of the Elderly in an Underprivileged Community

If you should encounter any new risks, reactions, or injuries while conducting your research, please notify the IRB. Should your research extend beyond one year in duration, or should there be substantive changes in your research protocol, you will need to submit another application for approval at that time.
We wish you every success in your research project. If you have any questions, please call me at (410) 704-2236.

CC: C. Robinson
File

TOWSON UNIVERSITY

Date: Monday, June 11, 2012

NOTICE OF APPROVAL

TO: Jennifer Smart **DEPT:** ASLD

PROJECT TITLE: *Benefits of Hearing Aid Use on the Quality of Life of the Elderly in an Underprivileged Community*

SPONSORING AGENCY:

APPROVAL NUMBER: 12-A072

The Institutional Review Board for the Protection of Human Participants has approved the project described above. Approval was based on the descriptive material and procedures you submitted for review. Should any changes be made in your procedures, or if you should encounter any new risks, reactions, injuries, or deaths of persons as participants, you must notify the Board.

A consent form: [✓] is [ ] is not required of each participant

Assent: [ ] is [ ] is not required of each participant

This protocol was first approved on: 11-Jun-2012
This research will be reviewed every year from the date of first approval.

Patricia Alt

Patricia Alt, Member
Towson University Institutional Review Board

References

Ames, A., Evans, M., Mlam, A., Petteway, R. & Rutledge, R. (2011). *Neighborhood health profile: Cherry Hill.* Baltimore City Health Department, December 2011. Retrieved from http://www.baltimorehealth.org/dataresearch.html

Agrawal, Y., Platz, E. A., & Niparko, J. K. (2008). Prevalence of hearing loss and differences by demographic characteristics among US adults. Arch Intern Med, 168 (14), 1522-1530.

American Speech-Language-Hearing Association. (1988). Guidelines for *determining threshold level for speech* [Guidelines]. Retrieved from www. asha.org/policy. doi: 10.1044/policy.GL1988-00008

American Speech-Language-Hearing Association. (1997). Guidelines for *audiological screening* [Guidelines]. Retrieved from www. asha.org/policy. doi: 10.1044/policy.GL1997-00199.

American Speech-Language-Hearing Association. (2005). *Guidelines for manual pure-tone threshold audiometry* [Guidelines]. Retrieved from http://www.asha.org/docs/html/GL2005-00014.html#sec1.5

American Speech-Language- Hearing Association (2012). The prevalence and incidence of hearing loss in adults. Retrieved From http://www.asha.org/public/hearing/disorders/prevalence_adults.htm

Callahan, C. M., Unverzagt, F. W., Hui, S. L. Perkins, A. J., & Hendrie, H. C. (2002). Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Medical Care, 40*(9), 771-781.

Carabellese, C., Appollonio, I., Rozzini, R., Bianchetti, A., Frisoni, G. B., Frattola, L., & Trbucchi, M. (1993). Sensory impairment and QOL in a community elderly population. *Journal of the American Geriatrics Society, 41*, 401-407.

Chisolm, T. H., Willott, J. F., & Kister, J. J. (2003). The Aging auditory system: Anatomic and physiologic changes and implications for rehabilitation. *International Journal of Audiology, 42*, 2S3-2S10.

Cruickshanks, K. J., Wiley, T. L., Tweed, T. S., Klein, B. E. K., Klein, R., Mares-Periman, J. A., & Nondahl, D. M. (1998). Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin: The epidemiology of hearing loss study. *American Journal of Epidemiology, 148*(9), 878-886.

Cruickshanks, K. J., Tweed, T. S., Wiley, T. L., Klein, B. E., Klein, R., Chappell, R., . . . Dalton, D. S. (2003). The 5-year incidence and progression of hearing loss. *Archives Otolaryngology - Head & Neck Surgery, 129*, 1041-1046.

Desai, M., Pratt, L. A., Lentzner, H., & Robinson, K. N. Trends in Vision and Hearing Among Older Americans. Aging Trends; No. 2. Hyattsville, Maryland: National Center for Health Statistics. 2001. Retrieved from http://www.cdc.gov/nchs/data/ahcd/agingtrends/02vision.pdf

Fitzgibbons, P. J., & Gordon-Salant, S. (1996). Auditory temporal processing in elderly listeners. *Journal of the American Academy of Audiology, 7*, 183-189.

Garstecki, D. C., & Erler, S. F. (1998). Hearing loss, control, and demographic factors influencing hearing aid use among older adults. *Journal of Speech, Language, and Hearing Research, 41*, 527- 537.

Gates, G. A., Cooper, J. C., Kannel, W. B., & Miller, N. J. (1990). Hearing in the Elderly: The Framingham cohort, 1983-1985. *Ear and Hearing, 11*(4), 247-256.

Gelfand, S.A. (2001). *Essentials of Audiology* (2nd ed., pp. 257-290). New York: Thieme.

Gelfand, S. A., Schwander, T. & Silman, S. (1990). Acoustic reflex thresholds in normal and cochlear-impaired ears: Effects of no-response rates on 90th percentiles in a large sample. *Journal of Speech and Hearing Disorders, 55*, 198-205.

Hannula, S. H., Bloigu, R., Majamaa, K., Sorri, M., & Maki-Torkko, E. (2011). Self-reported hearing problems among older adults: Prevalence and comparison to measured hearing impairment. *Journal of the American Academy of Audiology, 22*, 550-559.

Harless, E. L., & McConnell, F. M. (1982). Effects of hearing aid use on self concept in older persons. *Journal of Speech and Hearing Disorders, 47,* 305-309.

Helzner, E. P., Cauley, J. A., Pratt, S. R., Wisniewski, S. R., Zmuda, J. M., Talbott, E. O., . . . Newman, A. B. (2005). Race and sex differences in age-related hearing loss: The health, aging and body composition study. *American Geriatrics Society, 53*, 2119-2127.

ILO V6 User Manual. (2009). *ILO V6 clinical OAE software manual, 12:* Otodynamics Ltd.

Jerger, J. (1970). Clinical experience with impedance audiometry. *Archives Otolaryngology - Head & Neck Surgery*, *92,* 311-324.

Katz, J., Medwetsky, L., Burkard, R., & Hood, L. (Eds.). (2009). *Handbook of Clinical Audiology* (6th ed.). Philadelphia: Lippincott, Williams & Wilkins.

Kirikae, I., Sato, T., & Shitara, T. (1964). A study of hearing in advanced age. *Laryngoscope, 74*, 205-220.

Kirzinger, W. K., Cohen, R. A., & Gindi, R. M. Healthcare access and utilization among young adults aged 19-25: Early release of estimated from the National Health Interview Survey, January – September 2001. National Health Center for Health Statistics. May 2012. Retrieved from http://www.cdc.gov/nchs/nhis/releases.htm.

Kochkin, S. (2009). Marke trak VIII: 25-year trends in the hearing health market. *The Hearing Review, 16*(11), 12-31.

Kochkin, S. (2010). Marke trak VIII: The efficacy of hearing aids in achieving compensation equity in the workplace. *The Hearing Journal, 63*(10), 19-26.

Kricos, P. B., Lesner, S. A., & Sandridge, S. A. (1991). Expectations of older Americans regarding the use of hearing aids. *The Journal of the American Academy of Audiology*, *2*, 129-133.

Lichtenstein, M. J., Bess, F. H., & Logan, S. A. (1988). Diagnostic performance of the Hearing Handicap Inventory for the Elderly (Screening version) against differing definitions of hearing loss. *Ear and Hearing*, *9*, 209–211.

Lotfi, Y., Mehrkian, S., Moossavi, A., & Faghih-Zadeh, S. (2009). Quality of life improvement in hearing-impaired elderly people after wearing a hearing aid. *Arch Iranian Medicine, 12(*4), 365-370.

Malinoff, R. L., & Weinstein, B. E. (1989). Measurement of hearing aid benefit in elderly. *Ear and Hearing, 10*(6), 354-356.

Mathers, C., Smith, A., & Concha, M. (2000). Global burden of hearing loss in the year 2000. *Population English Edition, 18*(4), 1-30. Retrieved From http://www.who.int/entity/healthinfo/statistics/bod_hearingloss.pdf

Moscicki, E. K., Elkins, E. F., Baum, H. M., & McNamara, P. M. (1985). Hearing loss in the elderly: An epidemiologic study of the Framingham heart study cohort. *Ear and Hearing, 6*(4), 184-190.

Mulrow, C. D., Aguilar, C., Endicott., J. E., Tuley, M. R., Velez, R., Charlip, W. S., . . . DeNino, L. A. (1990). Quality-of-life changes and hearing impairment. *Annals of Internal Medicine, 113,* 188-194.

Mulrow, C. D., Tuley, M. R., & Aguilar, C. (1992a). Correlates of successful hearing aid use in older adults. *Ear and Hearing, 13*(2), 108-113.

Mulrow, C. D., Tuley, M. R., Aguilar, C. (1992b). Sustained benefits of hearing aids. *Journal of Speech and Hearing Research, 35,* 1402-1405.

National Academy on an Aging Society. (1999). *Hearing loss: A growing problem affects quality of life.* Retrieved from http://ihcrp.georgetown.edu/agingsociety/pdfs/hearing.pdf

National Institute of Health, National Institute on Deafness and Other Communication Disorders. (1997). *Presybycusis* (NIH Publication No. 97-4235). Retrieved from http://www.nidcd.nih.gov/health/hearing/pages/presbycusis.aspx

Pichora-Fuller, M. K., & Souza, P. E. (2003). Effects of aging on auditory processing of speech. *International Journal of Audiology, 42*(2), 2S11-2S16.

Pleis, J. R., & Lethbridge-Cejku, M. (2006). Summary health statistics for U.S. adults: National health interview survey, 2005. *Vital and Health Statistics, 10*(232), Hyattsville, MD: National Center for Health Statistics.

Pratt, S. R., Kuller, L., Talbott,E. O., McHugh-Pemu,K., Buhari,A. M., & Xu, X. (2009). Prevalence of hearing loss in black and white elders: Results of the cardiovascular health study. *Journal of Speech, Language, and Hearing Research, 52*, 973-989.

Rodriguez, G. P., DiSarno, N. J., & Hardiman, C. J. (1990). Central Auditory Processing in Normal-hearing elderly adults. *Audiology, 29*, 85-92.

Schoenborn, C. A., & Heyman, K. *Health disparities among adults with hearing loss: United States, 2000-2006.* National Center for Health Statistics, 2008. Retrieved from http://198.246.98.21/nchs/data/hestat/hearing00-06/hearing00-06.pdf

Sindhusake, D., Mitchell, P., Smith, W., Golding, M., Newall, P., Hartley, D., & Rubin, G. (2001). Validation of self-reported hearing loss. The blue mountains hearing study. International Journal of Epidemiology, 30, 1371-1378.

Stark, P., & Hickson, L. (2004). Outcomes of hearing aid fitting for older people with hearing impairment and their significant others. *International Journal of Audiology, 43*, 390-398.

Surr, R. K., & Hawkins, D. B. (1988). New hearing aid users' perception of the "hearing aid effect". *Ear and Hearing, 9*(3), 113-132.

Tesch-Römer, C. (1997). Psychological effects of hearing aid use in older adults. *Journal of Gerontology: Psychological Sciences, 52B*, P127-P138.

Tillman, T. W., & Carhart, R. (1966). An expanded test for speech discrimination utilizing CNC monosyllabic words: Northwestern university auditory test no. 6. (USAF School of Aerospace Medicine Technical Report) Texas: Brooks Air Force Base.

Ventry, I. J. & Weinstein, B. (1982). The hearing handicap inventory for the elderly: A new tool. *Ear and Hearing, 3,* 128-134.

Ventry, I. J. & Weinstein, B. (1983). Identification of elderly people with hearing problems. *American Speech-Language and Hearing Association, 25,* 37-42.

Vuorialho, A., Karinen, P., & Sorri, M. (2006). Effect of hearing aids on hearing disability and quality of life in the elderly. *International Journal of Audiology, 45,* 400-405.

Weinstein, B. E. (1986). Validity of a screening protocol for identifying elderly people with hearing problems. *American Speech-Language Hearing Association, 25*, 27-42.

Wilson, C., & Stephens, D. (2003). Reasons for referral and attitudes toward hearing aids: Do they affect outcome?. *Clinical Otolaryngology, 28*, 81-84.

World Health Organization: Deafness and hearing impairment. (2012a) Retrieved From http://www.who.int/mediacentre/factsheets/fs300/en/index.html

World Health Organization: Definition of an older or elderly person. (2012b) Retrieved From http://www.who.int/healthinfo/survey/ageingdefnolder/en/index.html

CURRICULUM VITA

Bridget M. Niedermeyer

6303 Banbury Road,
Baltimore, Maryland 21239
bniede1@students.towson.edu

EDUCATION

Expected December 2013	**Doctor of Audiology,** Towson University, Towson, MD
May 2008	**B.S.,** Speech-Language Pathology and Audiology, and Deaf Studies Towson University, Towson, MD

AUDIOLOGIC EXPERIENCE

September 2011- December 2012	**ENTAA Care,** Graduate Intern Glen Bernie, MD / Columbia, MD / & Piney Orchard, MD Experience working in a fast pace setting with: Adult and pediatric diagnostic audiological evaluations, Immittance testing, otoacoustic emissions testing, adult Auditory Brainstem Responses (ABR), Electronystagmography (ENG) testing, fitting, programming and repairing hearing aids.
January 2012 – August 2012	**Cochlear Implant Center at GBMC,** Graduate Intern Baltimore, MD Experience with adult and pediatric cochlear implant candidacy evaluations, which includes: diagnostic audiological evaluations, Immittance testing, otoacoustic emissions testing, AzBio testing, HINT testing, and CNC testing. As well as experience with device counseling, troubleshooting and mapping both Cochlear Americas and Advanced Bionics products. In addition to programming and repairing hearing aids and working with FM system
May 2011- August 2011	**Hearing and Speech Agency (HASA)**, Graduate Intern Baltimore, MD Experience with: Adult and pediatric diagnostic audiological evaluations, Immittance testing, otoacoustic emissions testing, Pediatric Auditory Brainstem Responses (ABR), fitting, programming and repairing hearing aids, and FM systems.

January - May 2011	**York Learning Center, (LIU #12)**, Graduate Intern York, PA Experience with: Pediatric diagnostic audiological evaluations, Immittance testing, otoacoustic emissions testing, Auditory Processing Disorder (APD) testing and working with FM systems.
January 2009 - December 2010	**Speech, Language & Hearing Center,** Graduate clinician Towson, MD Experience with: Fitting and programming hearing aids, diagnostic audiological evaluations for adults and pediatrics, immittance testing, otoacoustic emissions testing, Auditory Processing Disorder (APD) testing and working with FM systems.
August 2008 - May 2009	**Research Assistantship** for a Deaf Studies professor, Dr. Jody Cripps at Towson University, Department of Speech-Language Pathology and Audiology, and Deaf Studies

PROFESSIONAL ORGANIZATIONS

- American Academy of Audiology (December 2006-2012)
- Maryland Academy of Audiology (September 2008- 2010)
- Student Academy of Audiology, Towson University Chapter (September 2008-2011)
- Cochlear Americas Advocate (volunteer) (June 2007- Present)