The Impact of Untreated Hearing Loss on Socio-Emotional Well-being and Life Satisfaction in older Maltese Adults

Raisa Borg

Department of Human Communication Sciences and Disorders, University of Malta,

Master of Science in Audiology

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Dr. Ritienne Grima and Dr. Pasquale Balzan

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Abstract

This study explores the impact of untreated hearing loss (HL) on socio-emotional well-being (SEWB) and life satisfaction (LS) in older Maltese adults. While prior research has primarily focused on specific mental health conditions such as depression and anxiety, less attention has been given to broader constructs like SEWB and LS, particularly in individuals with untreated HL. The Hearing Handicap Inventory for the Elderly – Screening Version (HHIE-S) and the Satisfaction with Life Scale (SWLS) were used to assess SEWB and LS in individuals with untreated HL. The study also sought to compare these outcomes with those of a control group without HL, examine the influence of demographic and hearing-related variables, and explore the relationship between SEWB and LS.

A total of 92 participants aged 65 years and over were included, comprising 73 older adults with untreated HL (target group) and 19 without HL (control group), as determined through hearing screenings. Inferential analysis revealed that individuals with untreated HL perceived their SEWB to be significantly lower than those without HL. However, no statistically significant difference was found between the two groups in terms of overall LS, suggesting that LS may remain stable despite reduced socio-emotional well-being. Notably, around half of the participants with untreated HL (n = 33, 45.2%) were found to be highly satisfied with their life.

These findings highlight the socio-emotional impact of untreated HL while showing the relative independence of life satisfaction from socio-emotional decline. This study highlights the importance of examining untreated HL as a distinct factor influencing older adults' well-being

Keywords: untreated HL, older adults, SEWB, LS

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Dedication

To those who face the unseen, the unspoken, the untold struggles, and for the strength to carry on through them.

&

To those who believed in me, even when I did not believe in myself.

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Glossary

These terms are italicised the first time they appear in the text.

1. ***Activity limitation***

An individual's functional capacity, which includes the challenges faced in everyday life due to hearing loss, including impairments, activity limitations, and participation restrictions (WHO, 2001).

2. ***Binaural hearing loss***

HL in both ears (Huttunen et al., 2019)

3. ***Confounding variables***

Factors that could distort the association between the independent (untreated hearing loss) and the dependent variables (socio-emotional well-being and life satisfaction) (Thomas, 2023)

4. ***Impairment***

Body-level function or shape (World Health Organisation [WHO], 2001)

5. ***Monaural hearing loss***

HL in one ear (Huttunen et al., 2019)

6. ***Ototoxic medications***

Ototoxic medications are drugs that can damage the inner ear, potentially causing hearing loss, tinnitus, or balance issues (Joo et al., 2019)

7. ***Order effect***

The impact that the order in which tasks or conditions are presented to participants can have on their responses or behaviour. Essentially, the sequence in which participants experience different parts of the study (e.g., tests or questionnaires) may

influence the results. For example, fatigue may cause participants' performance to decline as they progress through multiple tasks (Bobbitt, 2020)

8. ***Presbycusis***

Age-related HL (Parham et al., 2011)

9. ***Participation restriction***

Psychosocial function (WHO, 2001)

10. ***Quality of life [QOL]***

A person’s perceived state of wellness or contentment at a given moment. shaped by their cultural values, beliefs, concerns, expectations, goals, and standards (WHO, 2012)

11. ***Research instruments***

Instruments used to collect data (Dawson, 2019)

List of Abbreviations

Abbreviation	Full name
AACC	Active Ageing and Community Care
AC	Air Conduction
ARHL	Age-Related Hearing Loss
ASHA	American Speech-Language-Hearing Association
BAHA	Bone Anchored Hearing Aid
BHF	Binaural High Frequency
BLF	Binaural Low Frequency
BC	Bone Conduction
CDT	Clock Drawing Test
CEO	Chief Executive Officer
CHL	Conductive Hearing Loss
DASS	Depression, Anxiety, and Stress Scale
EBSCO	Electronic Bibliographic System Company
ENT	Ear Nose and Throat
FREC	Faculty of Health Sciences Research Ethics Committee
GP	General Practitioner
HHIE - S	Hearing Handicap Inventory for the Elderly (Screening Version)
HL	Hearing Loss
HRQoL	Health-Related Quality of Life
ICF	International Classification of Functioning, Disability, and Health

LS	Life Satisfaction
M	Mean
MDN	Median
MMSE	Mini-Mental State Examination
NIDCD	National Institute on Deafness and Other Communication Disorders
NIOSH	National Institute for Occupational Safety and Health
NHANES	National Health and Nutrition Examination Survey
NSO	National Statistics Office
OAE	Otoacoustic emissions
P	P- value
PTA	Pure Tone Audiometry
QOL	Quality of Life
SD	Standard Deviation
SEWB	Socio-Emotional Well-Being
SF36	Short Form 36
SNHL	Sensorineural Hearing Loss
SPSS	Statistical Package for the Social Sciences
SWLS	Satisfaction with Life Scale
WHO	World Health Organization

Chapter 1: Introduction

Globally, hearing loss [HL] is a common condition affecting many individuals and according to the World Health Organization [WHO] (2021) it may affect up to 2.5 billion individuals by 2050. Similarly, the National Institute on Deafness and Other Communication Disorders [NIDCD] (2023) highlights HL as a widespread health concern across populations. In fact, approximately one in three individuals aged between of 65 and 74 years experiences HL, and the prevalence increases with age, affecting about half of those over 75 (WHO, 2021).

Locally, the aging population is increasing rapidly and older adults are living a longer life. In fact, the life expectancy in Malta increased from 80.9 years in 2012 to 82.3 years in 2022 (National Statistics Office [NSO], 2022). This highlights the need of addressing untreated HL, in light of various contributing factors such as chronic illnesses, prolonged exposure to loud noise and *presbycusis* (Parham et al., 2011).

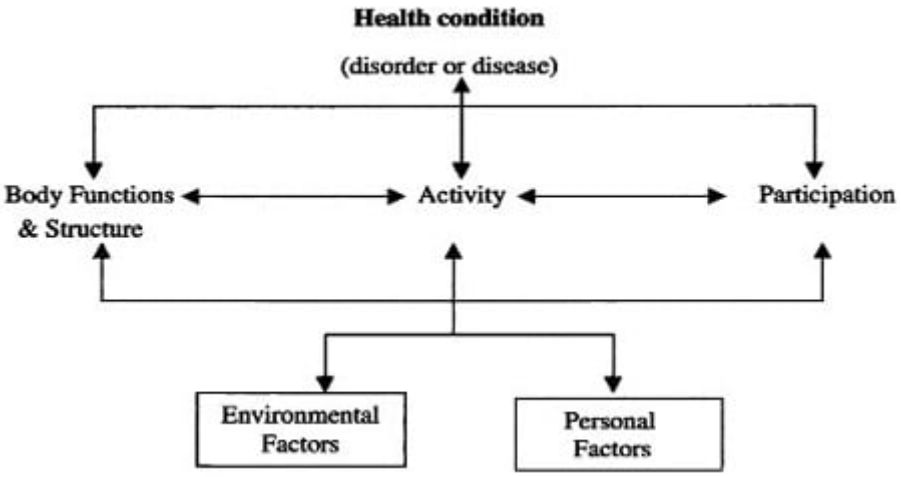
As HL becomes increasingly prevalent worldwide, it is essential to understand its influence on the well-being of older adults. HL can affect communication, which may lead to social isolation, cognitive decline, and increased chance of depression (Parham et al., 2011). Due to the invisible nature of the disorder, HL may not be easily recognised in its early stages (Pike et al., 2022). Despite the importance of early hearing intervention, shown to improve communication and overall outcomes (Barbee et al., 2018; Johnson, 2018), many older adults may take up to four years after the onset of HL to acknowledge the difficulty, due to various contributing factors, namely denial, stigma, and lack of awareness (Contrera et al., 2016; Powers & Carr, 2022).

HL affects both individuals and their significant others, often leading to a reduced overall *quality of life* [QOL], emotional stress and communication problems. An untreated HL may exacerbate these issues, with individuals often withdrawing from social interactions (Monahan & Sieminski, 2014). Moreover, significant others may experience added caregiving responsibilities, emotional burden, and strain, especially when the individual is in denial about their condition (Hamrah et al., 2024).

The International Classification of Functioning, Disability and Health [ICF] framework (WHO, 2001), shown in Figure 1, addresses these challenges by accounting for the individual's physical, social and emotional factors. This ensures holistic planning, which promotes better outcomes for both individuals with HL and their significant others (Gagné, 2016; Grenness, 2016).

Figure 1

ICF Framework



Note. Reprinted from *International Classification of Functioning, Disability, and Health*, by World Health Organization, 2001, Geneva: World Health Organization. Copyright 2001 by World Health Organization.

Untreated HL may have significant financial and social implications for the individual and the state. Financially, it can contribute to increased healthcare costs associated with comorbid conditions such as cognitive decline, depression, and increased risk of falls (Stiepan, 2024). Socially, it affects productivity, due to reduced job performance and higher unemployment rates (Livingston, 2017). Since untreated HL may lead to social isolation and reduces QOL, demands on social services and public health resources may also increase (Stiepan, 2024). Hence, addressing untreated HL through early intervention and treatment can mitigate these effects (Lovato, 2020).

Unaddressed HL can influence the individual's socio-emotional well-being [SEWB] and overall life satisfaction [LS].

SEWB includes the mental, emotional, and social aspects of health, including emotional regulation, the ability to develop and sustain healthy relationships, and the sense of connection and support from others (Borre et al., 2023). HL can interfere with communication, leading to social isolation, cognitive decline, and, depression (Parham et al., 2011). When left unaddressed, these effects may worsen and be accompanied by emotional distress and reduced functional ability (Borre et al., 2023; Cudjoe et al., 2020; De Raedemaeker et al., 2022; Gordon et al., 2014). Individuals may avoid social situations due to difficulty understanding conversations, further exacerbating these issues (Hay-McCutcheon et al., 2018). Furthermore, studies by Livingston (2020) and Mukadam (2019), highlight that untreated HL is the most adjustable risk factor linked to age-related dementia.

LS depends on both social and emotional well-being and it is an indicator of a person's general QOL (Gee et al., 2014). Personality traits can significantly influence an individual's LS, reflecting the personal evaluation of their overall well-being, however, LS is influenced by other numerous factors (Ashton, 2023). On one hand, individuals with HL who perceive their lives as lacking meaning, may experience diminished LS. Health and social relationships can also influence LS, namely external events, such as, a serious illness diagnosis, or job loss, which can significantly decrease one's sense of fulfillment. On the other hand, positive experiences like social interaction can enhance LS (Lopez-Gomez et al., 2021). Additionally, QOL represents a person's general well-being across different areas of life, whereas subjective well-being focuses on emotional experiences and personal evaluations. LS plays a crucial role in showing how well personal standards and expectations are being fulfilled.

Although terms like "well-being," "happiness," and "LS" are often used interchangeably, they differ in scope and stability. LS is more stable and reflects long-term fulfillment, happiness is transient and influenced by external factors (Bień et al., 2017), while well-being is multidimensional, encompassing aspects such as depression and LS (Bautista et al., 2023).

Various local and international studies have been carried out to explore the effects of HL in adults (Borre et al., 2023; Grech, 2017; Hallberg et al., 2008; Hamrah et al., 2024; Heffernan et al., 2016; Ndreko, 2017). Nevertheless, to the researcher's knowledge, no studies have explored how older Maltese adults' SEWB and LS are affected by untreated HL. HL in older adults has become an increasing concern, not only due to its physical implications and economic challenges, but also its impact on SEWB and LS. However, despite the well-documented repercussions, there remains a lack of focused research on how untreated HL specifically influences the SEWB and LS of older adults in smaller or less-studied

populations, such as in Malta. This unaddressed area in research highlights a significant gap that could potentially provide valuable insights. Therefore, the aims and objectives of this study are as follows:

Aims & Objectives

Aims

The purpose of this study is to explore how untreated hearing loss affects socio-emotional well-being and life satisfaction in older Maltese adults. Secondly, this study aims to investigate the interaction between socio-emotional well-being and life satisfaction in untreated hearing-impaired individuals.

Objectives

1. To explore how older Maltese adults with untreated hearing loss perceive their socio-emotional well-being.

2. To explore how older Maltese adults with untreated HL perceive their satisfaction with life.

3. To compare the socio-emotional well-being and life satisfaction of older Maltese adults with untreated HL to those without hearing loss.

4. To investigate the influence of demographic variables, such as age, years of education and gender, on scores related to socio-emotional factors, and LS in older adults with untreated HL.

5. To explore how hearing-related variables, including type, unilateral/bilateral nature, and degree of untreated HL, impact scores on socio-emotional factors, and LS in older adults with untreated HL.

6. The explore the relationship between measures of socio-emotional factors, and LS specifically among older Maltese adults with untreated HL.

Chapter 2: Literature review

This chapter will present a critical appraisal of available literature on HL and its impact on various aspects of well-being, focusing on SEWB and LS. This chapter will also discuss how demographic factors and hearing-related variables, influence outcomes of untreated HL. The discussions will draw on existing literature, aligning with the research aims and objectives outlined in the previous chapter.

The Auditory system

Hearing is essential but often taken for granted, with HL affecting people of all ages, though it becomes more common in older adults (Michels et al., 2019). The auditory system is a highly specialised network that detects, localises, and interprets sound. It comprises both peripheral and central parts. The peripheral auditory system includes the outer, middle, and inner ear, whereas the central auditory system includes structures such as the cochlear nuclei, superior olivary complex, inferior colliculus, medial geniculate body, lateral lemniscus, and auditory cortex (Peterson et al., 2023)

The outer ear collects sound, which is then amplified by the middle ear and converted into electrical signals by the cochlea in the inner ear. These signals are then transmitted via the auditory nerve to the brain (Sánchez López de Nava & Lasrado, 2023). The signals travel along the central auditory pathways, including areas like the superior olivary nucleus, inferior colliculus, and medial geniculate body, eventually reaching the auditory cortex where they are processed and recognised as sound (Davies & Sugano, 2020; Shahid, 2023). Additional details regarding the auditory system can be found in Appendix A.

Pathophysiology and causes of auditory system impairment

Normal hearing is defined by a threshold of 20 decibels [dB] or lower in both ears (British Society of Audiology [BSA], 2018; WHO, 2020). HL refers to a condition where an individual's ability to hear and their auditory sensitivity is diminished when compared to someone with typical hearing and can vary in severity. HL can be either *monaural* or *binaural* (ASHA, 2024).

The auditory system undergoes significant changes with increasing age (Do Couto & Brites, 2017). HL can arise due to various factors, such as genetic mutations, and noise-induced HL[NIHL], ototoxic medications and presbycusis (Cunningham & Tucci, 2019; WHO, 2025).

Genetic mutations represent a potential underlying cause of HL. In fact, several genes have been associated with HL, most of which exhibit an autosomal dominant inheritance pattern. These mutations typically impair the function of the sensory hair cells within the cochlea, resulting in the gradual deterioration of hearing ability (Griffith et al., 2017). NIHL occurs due to exposure to harmful noise levels and often results in irreversible damage, primarily attributed to the loss of sensory hair cells in the cochlea (Kujawa & Liberman, 2006). Emerging research has demonstrated that, beyond direct hair cell loss, noise exposure can also disrupt the connections between hair cells and auditory nerve fibres, with lasting hearing impairment even in the absence of significant hair cell degeneration (Liberman & Kujawa, 2017). Additionally, intense noise exposure induces vasoconstriction in the cochlear vasculature, and subsequent reperfusion leads to the generation of reactive oxygen species, contributing to further cochlear injury (Schaette & McAlpine, 2011; Basner et al., 2014). Ototoxicity from medications such as aminoglycosides or chemotherapeutic agents can also

be toxic to sensory hair cells, potentially leading to sensori-neural hearing loss [SNHL] (Wang et al., 2023). Additional detail can be found in Appendix B.

Age-related HL

Presbycusis or ARHL is a common condition in older adults that primarily affects high frequencies and worsens over time. It is most often associated with both ageing and cumulative noise exposure (Deveci, Yilmaz, Domuta, & Hizalan, 2024; Pacala et al., 2012). ARHL typically presents as a gradual, progressive, and bilateral SNHL (Bowl & Dawson, 2019). It may be sensory, involving the loss of cochlear hair cells, or metabolic, linked to the degeneration of the stria vascularis. This high-frequency loss makes speech comprehension, especially in noisy environments, particularly challenging. The prevalence of ARHL increases with age: 10.9–17.6% in individuals aged 60–69, 23.4–64.9% in those 70–79, 41.9–51.2% in the 80–89 age group, and 52.9–64.9% in those aged 90 and older (WHO, 2021).

Despite that the precise age-related mechanisms responsible for this decline remain unclear (Ropper et al., 2017), research by Peelle and Wingfield (2016) found that peripheral HL can lead to changes in both subcortical and cortical auditory processing. These alterations include modifications to cortical neurons and myelin within the auditory cortex. A critical issue is whether this sensory decline induces structural changes in cortical areas. To investigate this, Peelle et al. (2011) examined the relationship between auditory sensitivity, measured by PTA and grey matter volume in the auditory cortex of older adults. Despite participants reporting good hearing, their better-ear PTA threshold ranged from 10 to 33 dB HL, with no significant ear differences or correlation with age. MRI scans revealed that decreased hearing was linked to lower grey matter density in the right auditory cortex, even at mild levels of HL. This finding, which was corroborated in a later study (Lin et al., 2013) suggests that mild hearing impairment may cause cortical structural changes. Two

explanations were proposed: (1) a general age-related decline affecting both peripheral and cortical regions, or (2) a causal relationship where reduced sensory input leads to neural structural changes (Humes et al., 2013).

Types of HL

HL occurs when auditory signals from the ear to the brain are affected, which can be caused by factors affecting the outer, middle, or inner ear resulting in HL to be categorised as conductive, sensorineural, and mixed HL. Conductive HL [CHL] occurs when there are difficulties with sound transmission from the outer to the inner ear, often caused by conditions such as cerumen buildup, otosclerosis, or otitis media. In contrast, sensorineural HL [SNHL] is due to damage to the cochlea or auditory nerve. This type of HL may develop gradually (e.g., due to noise exposure), over weeks to months (e.g., from drug-induced causes), or suddenly (e.g., in Meniere's disease) (ASHA, 2024). Mixed HL occurs when there is impairment in both the outer or middle ear as well as the inner ear (ASHA, 2024). Bansal et al. (2022) reported that SNHL is the most common form of HL (44.55%) in older adults, while CHL and mixed HL are less prevalent.

Severities of Hearing impairment

The classification of HL is instrumental for audiological evaluation. Identifying the type, degree, and configuration of HL provides essential information that guides the selection of additional diagnostic tests and appropriate audiological. Moreover, these classifications help provide individuals with a clearer understanding of HL by offering detailed information about their HL interventions (Swanepoel & Laurent, 2019).

Various classification systems are commonly used among audiologists, including the HL classification proposed by Clark (1981), which is also referenced by ASHA (2015) and Swanepoel & Laurent (2019), both of whom highlight that it is the mostly used classification.

Other HL classifications include the BSA (2018) classification system and the newly revised system introduced by the WHO in 2021. The details of these classifications are described below.

Table 1

HL Classification: Clark (1981)

Degree of HL	HL range dB HL
Normal	-10 – 15
Slight	16 – 25
Mild	26 – 40
Moderate	41 – 55
Moderately severe	56 – 70
Severe	71 - 90
Profound	91 +

Note: Reprinted from *Uses and Abuses of Hearing Loss Classification*, by J. G. Clark, 1981, *ASHA*, 23(7), 493–500. Copyright 1981 by ASHA.

Clark's (1981) classification system categorises HL into seven categories based on pure-tone thresholds, from normal to profound. However, its strict definition of normal hearing excludes some individuals with thresholds up to 25 dB HL. The system assumes ideal testing conditions and does not account for the functional impact of HL on speech understanding (see Table 1).

In contrast, BSA (2018) classification system defines HL in five categories based on average thresholds at 250Hz, 500Hz, 1000Hz, 2000Hz, and 4000Hz. The BSA includes the 250Hz frequency in its average pure-tone threshold calculation and provides a standardised way for audiologists to assess and describe hearing loss severity (see Table 2).

Table 2

HL classification

Description	Average hearing threshold levels (dB HL)
Mild HL	21- 40
Moderate HL	41-70
Severe HL	71-95
Profound HL	>95

Note. Reprinted from *BSA recommended procedure: Pure-tone audiometry* (p. [27], British Society of Audiology, 2018). Retrieved from https://www.thebsa.org.uk/wp-content/uploads/2023/10/OD104-32-Recommended-Procedure-Pure-Tone-Audiometry-August-2018-FINAL-1.pdf

Conversely, a newly revised grading of severity HL was developed by WHO (2021). WHO (2021) classifies hearing impairment into categories from normal hearing to complete HL, using the pure-tone average thresholds of 500Hz, 1KHz, 2KHz, and 4KHz in the better ear. This system is an updated version of a previous classification system used by WHO (2001). The key differences include, lowering the threshold for mild HL from 26 dB to 20 dB, classifying HL into six categories, and adding unilateral HL into the classification (see Table 3).

Table 3

Grades of HL and related hearing experiences

Grade of HL	Hearing Threshold in Better Ear (dB)	Hearing difficulties for adults
Normal Hearing	Less than 20 dB	No difficulties experienced
Mild HL	20 to < 35 dB	May have difficulties in conversations
Moderate HL	35 to < 50 dB	Difficulty hearing conversations in both quiet and noisy environments

Moderately Severe HL	50 to < 65 dB	Difficulties hearing and engaging in conversations
Severe HL	65 to < 80 dB	Greater difficulty with conversational speech and raised voices irrespective of the environment
Profound HL	80 to < 95 dB	Severe difficulty hearing raised voices in quiet environments and inability to hear conversational speech in loud environments
Complete/Total HL	95 dB or greater	Unable to hear speech or most environmental sounds
Unilateral HL	< 20 dB in better ear, 35 dB or greater in worse ear	Hearing may not be affected unless the sound is near the ear with reduced hearing in a quiet environment, though localisation difficulties may occur. In a loud environment, hearing speech, locating sounds and taking part in conversation may be difficult.

Note. Reprinted and adapted from *World report on hearing* (p. [38]), World Health Organization (2021). Available from https://www.who.int/publications/i/item/world-report-on-hearing

The classification system used in WHO (2021) is based on the guidelines of the ICF framework introduced by WHO (2001). According to the ICF (WHO, 2001) even a slight reduction in hearing sensitivity can be considered a potential disability. It illustrated that HL as a disability, influences an individual's physical, social, and environment, as well as, their access to quality hearing care. The ICF also describes an individual's health status in terms of three dimensions: body functions and structure: the impairment (the HL), *activity limitation (*disability), and participation (restriction). Without proper hearing support, individuals with HL may face greater functional limitations and a higher degree of disability (WHO, 2021).

The WHO grading system has proven to be a reliable classification system for assessing communication difficulties in older adults, including those with ARHL, with

several studies supporting the use of this classification system (Humes et al., 2018; Stevens et al., 2013; Olusanya et al., 2021).

Consequences of hearing impairment

Hearing impairment, particularly ARHL, is a prevalent condition that not only affects the individual's ability to hear but also their overall well-being and interpersonal relationships. In fact, due to its subtle and gradual progressive nature, adults with presbycusis often dismiss their hearing impairment as a normal part of aging for years. Audiologists frequently encounter cases where a spouse or significant other expresses frustration with the HL long before the individual with the HL acknowledges the problem (Oyler, 2012). This shows how hearing impairment affects not only the individual but also their close social connections (Kamil & Lin, 2015).

Despite its high prevalence and apparent signs, such as difficulty understanding speech in noise, social withdrawal, or frequently increasing the volume on electronic devices, ARHL often goes unnoticed, underestimated, and untreated in older adults. This is due to its gradual onset, denial, stigma, and lack of awareness (Clergy, 2024; Diener & Pavot, 2008; Ftouh et al., 2018; Hawkley et al., 2009; Timmer et al., 2024; Wallhagen & Pettengill, 2008; WHO, 2025), with only 20% of individuals with ARHL seeking professional intervention (Donahue et al., 2010). Of those, only 11% consistently use hearing aids, while 24% never use their devices at all (Hartley et al., 2010). Moreover, research by Powers and Carr (2022), found that the average age at which individuals begin using hearing aids is 60 years. These delays in recognition and treatment can negatively affect both LS and SEWB for individuals as well as their loved ones (Timmer et al., 2024).

Multiple international research has found that ARHL is associated with increased psychological distress, including depression, anxiety, and loneliness (Nachtegaal et al., 2009; Jayakody et al., 2018). It significantly impairs communication, especially in noisy environments, often leading to social withdrawal and frustration. ARHL also contributes to heightened listening effort and cognitive load, increasing the risk of cognitive decline and dementia (Nachtegaal et al., 2009; Lin et al., 2013). Additionally, Schneider et al. (2010) highlight that HL reduces older adults' independence, leading to increased dependency on their family members and close social connections. These combined effects diminish QOL, even for those with mild to moderate HL (Chia et al., 2007; Dalton et al., 2003). International studies further support these findings, linking ARHL to increased social isolation, stress, and a higher incidence of mental health conditions (Dalton et al., 2003; Strawbridge et al., 2000). Consequences of HL on psychological well-being and communication are summarised below, while further details on cognitive and economic impacts can be found in Appendix C.

HL and psychological challenges

HL extends beyond the impairment itself, as it can also affect one's psychological well-being. HL leads to social isolation and emotional frustration both of which contribute to feelings of anxiety and depression.

Tambs (2004) explores the relationship between HL and mental health, specifically examining symptoms such as anxiety, self-esteem, depression and subjective well-being. A total of 50,398 participants aged 20 to 101 years were recruited for this study. Linear regression analyses showed that while HL significantly affects mental health, the relationship is moderate in strength. Research also indicated that HL had a greater influence on younger and middle-aged groups. Interestingly, the type of HL also played a role, whereby individuals with both low-frequency and high-frequency HL experienced adverse mental health effects,

while high-frequency or middle-frequency HL alone did not. Additionally, for each 10 dB increase in HL, there was a 0.1 standard deviation decrease in mental health ratings. These findings suggest that both the presence and the type of HL influence mental health, with stronger impact amongst younger populations. This may be because younger people are more affected by disruptions in social, professional, and family interactions, which can lead to greater emotional distress. Conversely, older adults may have adapted to HL over time, developed coping strategies, and became more resilient due to a lowered awareness of sensory decline. Additionally, they may have had other health concerns that overshadow the effects of HL on their mental well-being (Tambs, 2004). Lastly, combined frequency loss affected a broader range of speech and environmental sounds, leading to greater communication difficulties and social withdrawal, which are known risk factors for mental health issues.

In line with these findings, Lawrence et al. (2020) examined the association between HL and depression in older adults using cross-sectional and cohort studies with 147,148 participants aged over 60. HL was significantly associated with increased risk of depression. These outcomes are supported by, Jayakody et al. (2018), who studied 151 older adults (73 males and 78 females), grouping them by hearing ability to assess the impact of ARHL on depression, anxiety, and stress using the Depression, Anxiety, and Stress Scale (DASS-21). Individuals with moderately severe to profound HL were significantly more likely to experience depression, anxiety, and stress.

Similarly, Dillard et al. (2022) investigated how HL affects health-related quality of life [HRQoL], cognitive function, and depression, using data from both the Epidemiology of Hearing Loss Study and the Beaver Dam Offspring Study. Among 3,574 participants (mean age 66.2), HL was linked to poorer mental and physical HRQoL, as well as higher odds of

depression. The effects were strongest in those with moderate or worse HL. This is further supported by Mick et al. (2014) who explored HL and social isolation in adults aged 60–84. Greater HL correlated with increased isolation, particularly among women aged 60–69. Gender differences in communication style such as women's preference for emotional support and expressive communication may explain this finding. While HL was linked to social isolation overall, age-group differences were not statistically significant, granting further research.

HL and communication

Effective communication is crucial in preventing social isolation, particularly among older adults. Maintaining social connections through interaction is essential for emotional well-being and QOL (Cattan et al., 2005; Hawkley & Cacioppo, 2010). However, HL can significantly hinder this ability, often leading to increased social withdrawal (Lin et al., 2013; Mick et al., 2014). Individuals with HL often struggle to engage in conversations, leading to social isolation and feelings of loneliness, frustration, anxiety, and self-consciousness (Chia et al., 2007; Cormier et al., 2024; Frymark, 2023; Neal et al., 2022; Shukla et al., 2020). These emotional responses are often driven by the breakdown in relationships and a sense of disconnection from loved ones or peers. In turn, when communication skills are affected, the SEWB of the person is also impacted (Bennett et al., 2022; Heffernan et al., 2016; Timmer et al., 2024; Vas et al., 2017). Palmer et al. (2019) demonstrate that effective communication is essential for social engagement and participation, and that impaired communication can increase loneliness and depressive symptoms. Moreover, in older adults with ARHL, reduced auditory sensitivity and difficulty comprehending speech in noisy environments significantly

impede communication (Davis et al., 2016). Agrawal et al. (2008) also claims that about half of the adults in their seventies experience HL that is enough to impair communication.

The consequences outlined above may have a profound impact on SEWB and overall LS. These effects may include result in impaired communication, social interaction and emotional challenges such as stress or frustration, all contributing to a diminished sense of personal fulfillment and happiness (Jayakody et al., 2018, 2022; Lawrence et al., 2020).

Although multiple international studies have explored the effects of HL on depression, anxiety, and QOL, there is still limited research specifically addressing its impact on the two distinct variables of LS and SEWB. It is worth noting, however, that depression and anxiety are integral components of SEWB, and LS is closely related to QOL (Jayakody et al., 2018). Despite their correlation, LS and QOL are not interchangeable concepts. This difference is described hereunder.

The impact of untreated HL on SEWB and LS

Definition of well-being and QOL

Well-being is a broad concept that includes physical, emotional, social, and psychological health. It goes beyond just the absence of illness to include positive experiences (WHO, 2021). Often seen as a measure of QOL and LS, the WHO (2022) defines health as a state of ‘‘physical, mental, and social well-being’’. Emotional well-being, for instance, involves being able to express emotions, manage stress, and feel positive emotions like happiness, contentment, engagement, and affection (Huppert, 2019). On the other hand, social well-being is about forming meaningful relationships and being able to communicate effectively with others (WHO, 2022).

The WHO (2012) defines QOL as an individual's perception of their life, considering their personal and cultural context shaped by factors like health, independence, social connections, and the environment, all of which influence LS. Teoli and Bhardwaj (2023) also describe QOL as the overall state of well-being, which is influenced by both life's positive and negative dimensions.

It is worth noting that subjective well-being is a related yet more focused concept, consisting of three key elements: positive and negative affect, and LS (Arthaud-Day et al., 2005; Diener, 1984). LS is a cognitive judgment that individuals make about their life, summarising their evaluation of their circumstances (Diener, 1984). Although closely connected, it is distinct from the affective aspects of subjective well-being. According to Shin and Johnson (1978), LS involves individuals evaluating their overall QOL based on personal benchmarks. Each person measures their satisfaction by comparing their current life situation with their own standards of what constitutes a fulfilling or acceptable life.

Therefore, while QOL provides a broad view of an individual's overall well-being in relation to various life aspects, subjective well-being focuses specifically on the affective and evaluative dimensions of this perception, with LS serving as a key measure of how well individuals feel their lives meet their personal standards and expectations.

Definition of LS

Although terms like well-being, happiness, QoL, and LS are often used interchangeably, their meanings vary depending on life stage and context (Bień et al., 2017). When compared to emotions, such as happiness, which can be more fleeting and influenced by external factors, LS tends to be more stable and long-term (Bautista et al., 2023). Hansen (2012) explains it as a cognitive judgment of well-being, formed by comparing one's current

accomplishments with their desired goals or ideal life circumstances. Throughout life, people experience both happiness and stress, along with varying levels of overall well-being. Thus, LS may be defined as an enduring sense of fulfillment, reflecting how one evaluates the way their life has unfolded or the integrity of the choices they have made (Stahnke, 2022).

Changes in QoL directly impact LS because variations in health, social support, and environmental conditions affect how individuals perceive their overall life. For instance, improvements in QoL, such as enhanced social interactions or better health, typically lead to higher LS, as people feel their lives meet personal standards. Conversely, declines in QoL, like reduced social connections or poor health, can lower LS (Diener, 1984; Shin & Johnson, 1978; WHO, 1995). Thus, examining QoL offers important insights into factors influencing LS, making it relevant for understanding how untreated HL affects overall LS.

Research suggests that factors influencing LS in individuals with hearing disabilities are linked to the severity of their hearing impairment, the daily impact of HL, reduced social interactions, education attainment and mental well-being (Solheim et al., 2011; Tsimpida et al., 2018). Untreated HL can significantly influence social relationships, which in turn may affect overall LS. Strong, supportive relationships are a key factor in maintaining high LS, with individuals with close family and friends often reporting greater happiness. In contrast, those who experience a decline in social connections may feel more dissatisfied with life. Communication may also can also be affected, which can lead to social isolation, reducing the quality and frequency of interactions. As a result, this isolation can contribute to lower LS, creating a cycle where untreated HL negatively impacts both social well-being and overall happiness (Diener & Pavot, 2008; Hawkley et al., 2009).

Untreated HL is also widely recognised as a substantial obstacle to an individual's SEWB and LS (Jayakody et al., 2022; Monzani et al., 2007; Wallhagen, 2010). Despite the

significant health, societal, and economic impacts of ARHL, our knowledge of its biochemical and molecular basis is still limited in comparison to that of congenital and early-onset HL. This gap may be, partly attributed to the outdated belief that ARHL is an unavoidable consequence of aging, as well as the practical challenges involved in researching this chronic condition in older populations (Bowl & Dawson, 2019). Moreover, while there is research examining the effects of untreated HL on psychosocial outcomes such as depression and anxiety, studies focusing on SEWB and LS remain limited. This is further supported by Nordvik et al. (2018)'s systematic literature review, which emphasised the need for future research in these areas, as well as the influencing factors. Similarly, other international studies also call for future research in these areas (Brodie et al., 2018; Contrera et al., 2016). Given this gap, there is an even greater need to focus on its broader impacts on individuals, namely SEWB and LS.

The impact of untreated HL on SEWB

In a qualitative study exploring the social and emotional impacts of mild to moderate HL in adults aged between 20 and 91 years, Heffernan et al. (2016) found that HL negatively affects activity participation, particularly in social, leisure, and community settings. It is also associated with social restrictions, strained relationships, and communication challenges. In addition, it leads to emotional difficulties such as frustration, embarrassment, and loneliness, which are often the primary emotional responses to the condition. Similarly, a study by Yorgason et al. (2007), found several negative repercussions of HL such as, difficulties communicating in group settings, inability to watch television, feelings of embarrassment and frustration in social situations, and social restrictions in older adults aged over 60 years.

Both studies acknowledged several positive outcomes of HL however, Heffernan et al. (2006), found that the positive effects of HL, such as enhanced creativity, self-reliance,

reduced disruption from unwanted sounds, connections with others with HL, improvements in concentration, and strengthened relationships, were outweighed by the negative consequences of HL mentioned above. In contrast, Yorgason et al. (2007), presented a more resilience-oriented perspective, highlighting how couples dealing with HL develop optimism, gratitude, coping strategies and improved communication skills over time despite initial struggles with HL.

The disparity in the latter findings may be attributed to differences in the age groups studied and the focus of the research. Heffernan et al. (2016) explored individual experiences, highlighting personal challenges and growth, while Yorgason et al. (2007) explored the socio-emotional difficulties faced by couples with HL, emphasising relational resilience and shared coping mechanisms. Furthermore, while Heffernan et al. (2016) found that HL often strains relationships, Yorgason et al. (2007), suggested that couples may adapt together, strengthening communication and emotional connections. This underlines the potential for relational dynamics to mitigate the negative effects of HL, which Heffernan et al. (2016), only partially addressed. Despite these differences, both studies underscore the significant social and emotional toll of HL, particularly in group settings and social situations.

Further supporting these findings, Jayakody et al. (2022) explored the interaction between untreated HL and socioemotional outcomes in a cross-sectional study of 202 middle-aged and older adults. Social interaction was evaluated using the Social Interaction and Support Questionnaire, whereas socioemotional loneliness was measured with the Social and Emotional Loneliness Questionnaire. Research findings showed that untreated HL significantly increased the likelihood of experiencing social loneliness, and highlighted the importance of depression in exacerbating social and emotional loneliness. Despite the paucity of literature specifically examining the impact of untreated HL on SEWB, the results of these

studies collectively indicate that older adults, regardless of whether their HL is treated or untreated, are susceptible to adverse socioemotional difficulties, including loneliness and depression.

Further international studies have explored the socio-emotional impact of HL (Bennett et al., 2022; Kiely et al., 2013). Bennett et al. (2022), conducted a qualitative study with 21 adults aged 60 to 88 years, including 13 females and 8 males, out of which 19 had hearing amplification devices and 2 were non-users, while Kiely et al. (2013) carried out a 16 year longitudinal study with participants aged 65 to 103 years. Bennet et al. (2022), identified several social and emotional difficulties faced by individuals with HL and found that emotional responses to HL such as feelings of embarrassment, fatigue, anxiety and frustration, may contribute to withdrawal from social situations namely social overwhelm, exclusion, loneliness and the use or lack of coping strategies. Effective coping mechanisms mentioned included humour, communication repair, and support from others. In line with these findings, Kiely et al. (2013), also identified socio-emotional challenges faced by individuals with HL. Their research revealed that more severe HL was linked to higher levels of depression, with reduced activity engagement mediating this relationship. They highlighted that decreased participation in activities due to HL contributed to worsening depressive symptoms over time. Since both loneliness and depression are well-documented consequences of HL, research in this area is highly relevant, as these factors play a significant role in an individual's SEWB (Lieberz et al., 2021).

While both studies explore the socioemotional difficulties of HL, Bennett et al. (2022), found that coping strategies, such as humour and social support networks, are effective ways to manage these challenges. On the other hand, Kiely et al. (2013) found that activity engagement is instrumental in managing the challenges of HL. The disparity in

findings may be attributed to the research design and focus of their studies. Bennet et al. (2021) employed a qualitative design to gain deeper insight into personal experiences and coping mechanisms, while Kiely et al. (2013), employed a longitudinal study to explore the long-term effects and the mediating role of activity levels, particularly focusing on how HL affects depression. Despite their differences, both studies highlight the significant emotional and social consequences of HL, while outlining different ways individuals with HL can mitigate its impact.

In line with aforementioned research (Bennett et al., 2022; Heffernan et al., 2016; Jayakody et al., 2022; Kiely et al., 2013; Yorgason et al., 2007), a recent cross-sectional study by Tavanai et al. (2023) , also explored the socio-emotional impact of HL, particularly hearing handicap using the Hearing Handicap Inventory for the Elderly – Screening Version [HHIE-S]. This study is distinct as it explored a new area by including two groups: hearing aid users and non-users. A total of 114 participants, aged between 55 and 85 years, were recruited, with 57 hearing aid users and 57 non-users. These participants were referred to an audiology clinic and were required to have symmetrical SNHL with no other otological conditions. Hearing aid users were included if they had been using either unilateral or bilateral hearing aids for at least six months. The degree of HL was calculated using the average of four main frequencies based on Clark's (1981) classification.

Findings show that both groups had low scores for severe hearing handicap on the HHIE-S. Among hearing aid users, 61.4% reported a mild to moderate handicap, while 45.62% of non-users did. There was a statistically significant difference between the two groups, with hearing aid users having worse scores ($p = .01$). This could be because hearing aid users may be more aware of the socioemotional impact of HL, while non-users may have developed coping strategies or were less aware of their difficulties. Non-users may also have

lower expectations about their hearing, leading them to perceive less handicap despite similar HL. To the researchers' knowledge, no local study has directly compared individuals with untreated HL to those with typical hearing.

The impact of untreated HL on LS

Multiple international studies have explored the relationship between HL and LS in older adults (Bourque et al., 2008; Chen et al., 2024; Niazi et al., 2020).

Chen et al. (2024), carried out a retrospective study of 5,658 adults aged between 50 and 108 years. The findings revealed that HL did not directly affect LS; however, it was indirectly associated with cognitive deterioration and depressive symptoms. They also found that interventions targeting cognitive decline and depressive symptoms, could enhance LS. Similarly, Niazi et al. (2020), conducted a cross-sectional study of 200 participants aged between 53 and 89 years. The tool used to assess LS was the Satisfaction with Life Scale [SWLS] (Diener et al., 1985). Their findings revealed no significant differences in LS across levels of hearing impairment, indicating minimal direct effects. The similarities in findings could be attributed to the fact that both used quantitative research approach. Conversely, Bourque et al. (2008) who recruited 826 French-speaking participants aged 65 years and older, found a significant reduction in LS among individuals with HL. Whilst the disparity in findings warrants further investigation, it is probable that methodological differences, as well as, cultural differences account for these discrepancies, as Bourque et al. (2008), adopted a qualitative approach, other studies used a quantitative approach. The use of a qualitative approach might have provided deeper insights into the experiences analysed.

The influence of demographic variables on SEWB and LS in older adults with untreated HL

Influence of age on SEWB in older adults with untreated HL

Although multiple international have explored the influence of HL on psychosocial outcomes and SEWB, none of them has specifically examined how age might influence SEWB in the context of HL studies (Bennett et al., 2022; Heffernan et al., 2016; Yorgason et al., 2007). This gap in the literature may be attributed to the fact that these studies used qualitative methods, which, while offering rich insights into personal experiences, may not fully capture the broader, quantifiable relationship between age and SEWB. Consequently, there is a research gap in this area, which this study aims to address.

The study by Jayakody et al. (2022), as discussed earlier, has explored the relationship between age and psychosocial outcomes, namely social interaction and revealed that age had a significant effect on psychosocial outcomes ($p = .01$). Furthermore, even after adjusting for confounders in a multivariate analysis, age remained statistically significant ($p = 0.01$), indicating that age contributes to increased social isolation in individuals with HL.

In contrast, Tavanai et al. (2023), found no statistically significant correlation between age and HHIE scores, indicating no correlation between age and socio-emotional factors in individuals with HL. The difference in findings could be attributed to differences in sample sizes ($N = 202$ vs. $N = 114$), but other factors, such as the severity of HL, comorbid health conditions, or cultural and environmental differences, may also contribute to the differing results.

Influence of age on LS in older adults with untreated HL

Various studies have looked into the relationship between HL and LS in older adults (Bourque et al., 2008; Chen et al., 2024; Niazi et al., 2020), however, none have specifically explored the independent influence of age on LS in individuals with HL. This further

underscore the importance of exploring this aspect, which is currently limited in existing research. Notably, Chen et al. (2024) also called for further research in this area. In response to this, the current study aims to address both gaps by examining the influence of age on LS and SEWB in local older adults with untreated HL. Understanding how age interacts with LS and SEWB in this context can help identify age-specific challenges and inform targeted interventions to improve SEWB and LS within this population.

Influence of gender on SEWB in older adults with untreated HL

Globally, moderate or higher levels of HL are slightly more common in males than females, affecting approximately 217 million men compared to 211 million women (WHO, 2021). Interestingly, men aged 20- 69 are twice as likely to develop HL compared to women. This can be attributed to various factors, namely genetics and lifestyle. Moreover, men have a greater tendency to engage in jobs that place them near loud equipment for extended periods, such as construction and manufacturing, thus resulting in NIHL (Hoffman et al., 2017; Nolan, 2020).

Several studies namely those by Garstecki (1999), Harada et al. (2008), Lowery (2020), Mick et al. (2014), Niazi (2020), Tavanai et al. (2023) all examine the influence of gender on the socio-emotional impacts of HL, yet their findings diverge in several ways. Both Garstecki (1999), and Lowery (2020), found that although men are typically less inclined to seek treatment when they notice a hearing problem, women who suffer from HL are less concerned about the stigma associated with HL.

While different studies offer varied findings about the influence of gender on socio-emotional impacts of HL, cultural and methodological factors play key roles in explaining the discrepancies. For instance, Harada et al. (2008), carried out a study on 843 Japanese

participants aged 65 and older (including 351 males and 492 females) and found that men were more socio-emotionally affected by HL than women. This may be due to cultural expectations in Japanese societies, where retired men, having limited social roles, experienced greater social withdrawal and isolation when confronted with communication difficulties resulting from HL. Similarly, Niazi (2020), who studied the impact of HL on SEWB using the Kessler Psychological Distress Scale, found that, in a sample of 200 participants aged 53 to 89 years, there were notable gender differences in psychological distress. In fact, men reported higher levels of distress compared to women ($p < .05$). This suggests that men in the sample were more likely to experience socio-emotional strain related to their hearing impairment namely social isolation, communication difficulties and frustration. This could be because men often face additional psychological distress stemming from societal expectations to be the primary breadwinners, and the disability significantly disrupts their ability to perform daily responsibilities (Shamim & Muazzam, 2018).

In contrast to these findings, Mick et al. (2014), who carried out a cross-sectional study on 3,103 adults aged 60 to 84 years (derived from the 1999 to 2006 cycles of the National Health and Nutrition Examination Survey [NHNES), found that women aged 60- 69 were significantly more likely to experience social isolation due to HL, suggesting that the emotional and social consequences of HL might affect women more strongly. Specifically, for every 25-decibel reduction in hearing ability, these women were about 3.5 times more likely to experience social isolation. Similarly, Tavanai et al. (2023), examined the hearing handicap (social and emotional impact of HL) by comparing hearing aid users and non-users using the HHIE-S tool. The study revealed that females experienced a greater hearing handicap, as reflected in their HHIE scores; however, this finding was only observed among non-users and not in hearing aids users.

These findings are further supported by Gopinath et al. (2009) and Hallberg et al. (2008). Gopinath et al. (2009) studied 1,328 older adults and reported that women experienced greater socioemotional consequences of HL than men. Similarly, Hallberg et al. (2008), found that, despite men having worse hearing in higher frequencies and using fewer communication strategies, they reported better psychological well-being than women in a study of 79 participants.

The disparity in findings regarding gender and the socio-emotional impacts of HL may also be attributed to cultural norms. For instance, Harada et al. (2008) highlighted that cultural expectations in Japanese society exacerbates social withdrawal among men with HL, whereas Mick et al. (2014), suggested that women's reliance on verbal communication and openness about social isolation make them more vulnerable to the social consequences of HL. Moreover, while men were less likely to use communication strategies namely lip-reading or sitting closer to the speaker, the socio-emotional effects were still significantly higher amongst women. One possible reason is that women tend to be more open about feelings of social isolation and loneliness (Shukla et al., 2020), making them more aware of these challenges. Maltz and Borker (1982) also highlight that women rely more on verbal communication to maintain social connections, making them more vulnerable to the emotional and social challenges that come with HL, which impacts their ability to engage with their social networks (Shukla et al., 2020). Contrastingly, Hallberg et al. (2008) found that men experience fewer difficulties in sound localisation, which explain their lower levels of reported social and emotional distress. Most studies have focused on LS in individuals with treated HL, however, untreated HL has received significantly less attention. This gap in research is notable, as untreated HL may have a different impact on SEWB, which this study aims to address.

Influence of gender on LS in older adults with untreated HL

The study by Bourque et al. (2008), which examined the influence of HL to LS in older adults also, considered demographic factors like gender. The analysis of 826 older French-speaking participants (64% women, 36% men) revealed that women reported lower LS than men, with gender being a significant predictor ($p < .01$). One possible explanation for this finding is that older women may have experienced greater socioeconomic disadvantages, such as lower income and education. In contrast, Niazi's (2020), study found no statistically significant gender differences in LS related to HL ($p > 0.05$). This may be because, in old age, many individuals view age-related hearing impairment as a natural part of the aging process, possibly explaining why it tends to have a minimal impact on LS (Niazi, 2020). On the other hand, the difference in findings between these two studies could be the sample composition. Bourque et al.'s study included significantly more women (64%) than men (36%), potentially influencing the outcomes, whereas Niazi's study included 200 participants, evenly divided between men and women. Furthermore, women in older generations may have also experienced greater socioeconomic disadvantages, such as lower income and education levels, which have been found to be significant predictors of LS.

The pool of research on how gender and age influence SEWB and LS in individuals with HL is still relatively limited, further emphasising the importance of this study in addressing the research gap regarding the influence of these variables on LS.

Influence of education on SEWB and LS

Education is widely recognised as a key factor influencing SEWB an LS. The 1946 Compulsory Education Ordinance made schooling compulsory in Malta, initially requiring education until the age of 14. In 1974, the law was updated to enforce compulsory education up to the age of 16 (Eurydice, 2021).

Higher levels of education often enhance cognitive resilience, social connections, and emotional regulation, contributing to improved overall well-being. Conversely, limited education may hinder an individual's ability to cope with social and emotional challenges (Hoffman et al., 2017). Research consistently highlights the link between educational attainment and HL, suggesting that individuals with lower education levels face a higher likelihood of experiencing HL. Hoffman et al. (2017) employed data from the NHANES and found that individuals without a high school diploma had a significantly increased risk of bilateral speech-frequency HL, even after adjusting for factors like age and noise exposure. Similarly, Zhan et al. (2011), demonstrated that higher education was associated with lower odds of HL in both men and women, likely due to healthier lifestyle choices, better healthcare access, and greater awareness of hearing-related health risks. Helvik et al. (2009) further supported these findings, showing that individuals with more years of formal education had a lower prevalence of HL, reinforcing the protective role of education. This may be attributed to improved health literacy, proactive healthcare management, and reduced exposure to environmental risks.

Influence of education on SEWB

Jayakody et al. (2022), explored the relationship between years of formal education and socio-emotional factors namely, social isolation. They found that there was no significant relationship between the two variables, suggesting that the level of education does not directly influence socio-emotional factors such as, social isolation, in individuals with untreated HL. Nevertheless, research in this field is limited and thus, this study, aims to address this research gap.

Influence of education on LS

Bourque et al. (2008) explored the impact of education on LS in individuals with HL by recruiting a sample of 826 older adults (64% women, 36% men), aged 65 to 94, with varying educational backgrounds (56% with primary or less, 24% with secondary, and 17% with postsecondary education). Findings revealed that older women with, lower education and income levels reported lower LS. Women with higher levels of education were more proactive in preventive healthcare, which may help reduce the risk of HL and other health-related issues. They are better equipped to manage HL by accessing healthcare, seeking early interventions, and maintaining social connections, which support emotional resilience (Cruickshanks et al., 2010). Additionally, education is linked to greater economic and social resources, contributing to higher LS and improved well-being (Zhan et al., 2011). Higher education also fosters healthier lifestyles, including reduced smoking and lower noise exposure, both of which lower the risk of HL (Hill & Needham, 2006). Moreover, those with more formal education tend to have better nutrition, enhanced healthcare access, and increased awareness of hearing-related health risks (Albert et al., 2006; Cruickshanks et al., 2010). In contrast, individuals with lower education levels often face greater occupational hazards and health risks, potentially leading to lower LS.

While existing research has examined the impact of education levels on HL (Helvik et al., 2009; Hoffman et al., 2017; Zhan et al., 2011), few studies have specifically investigated the direct influence of years of formal education on SEWB and LS. This gap in the literature underscores the need for further research in this field.

The influence of hearing-related variables on SEWB and LS in older adults with HL

Type of HL

Influence of type of HL on SEWB and LS

The studies by Chia et al. (2007) and Stewart et al. (2000), offer contrasting insights on how different types of HL impact QOL and functional status. Chia et al. (2007) carried out a cross-sectional study with 2,431 participants (mean age 67 years) to assess HRQoL using the SF-36 health survey. They found that bilateral HL especially severe and or profound HL correlated with lower scores in both physical and mental health domains, with affected individuals exhibiting declines in both component scores. Those who used hearing aids habitually reported slightly better physical health scores than those who did not or used them less frequently, though this difference was not statistically significant. Individuals with self-reported HL had significantly lower HRQoL scores compared to those without HL. However, there was no significant difference in HRQoL between those with unilateral HL or high-frequency HL and those with normal hearing. These findings suggests that bilateral HL has a greater impact on communication, social interactions, and overall health compared to unilateral or high-frequency HL (Chia et al., 2007). On the other hand, Iwasaki et al. (2013), found that hearing handicap affects individuals with bilateral SNHL as well as those with unilateral SNHL.

Tavanai et al. (2023) studied the impact of hearing aid use vs non-users on hearing handicap in older adults. This study also did not find significant differences in HHIE-S scores between individuals with unilateral (16.64) and bilateral hearing aid fittings (16.45). In line with these findings, Stewart et al. (2000)’s longitudinal study assessed changes in QOL and hearing-specific functional status following treatment for CHL. Their results showed that

although CHL can be effectively treated with surgery or hearing aids, the impact on overall QOL remained largely unchanged. Significant improvements were noted primarily in hearing-specific dimensions, particularly emotional and social aspects. However, patients with CHL, especially those with poor baseline QOL, did not report significant improvements, and in some cases, their QOL even declined. This may be due to CHL patients generally having better cochlear function than those with sensorineural HL, limiting the effectiveness of hearing aids. Furthermore, the lack of improvement in QOL could be due to stigma surrounding hearing aid use or a general decline in QOL over time, rather than the treatment itself.

These studies highlight the varying effects of HL types on QOL, with bilateral sensorineural HL having a more pronounced impact on SEWB than conductive HL. While research has examined the impact of the type of HL on QOL, the specific relationship between the type of HL and SEWB and LS remains limited. The type and severity of HL, specifically untreated, might significantly affect an individual's SEWB and LS. This is because, research has shown that individuals with more severe forms of HL, particularly bilateral HL, often experience greater difficulties in social interactions, leading to feelings of isolation, frustration, and lower LS (Chia et al., 2007). This suggests that the type and severity of HL, could have profound implications for emotional and social well-being, warranting further investigation in the context of this study.

Degree of HL

Erdman & Demorest (1998), report that the connection between the extent of HL and individuals' psychosocial adjustment to it, is relatively weak. Even those with similar audiograms and clinical assessments may experience vastly different levels of difficulty in adapting to their condition. This suggests that factors beyond the physical severity of HL,

such as personal coping mechanisms, social support, and psychological resilience, play a significant role in how individuals manage and adjust to the impact of HL. In contrast, Brink and Stones (2007), Campbell (1999), and Yueh et al. (2003), found that as HL severity increases, there is a corresponding decline in their QOL. Similarly, Carlsson et al. (2015) found individuals with severe or profound HL experienced elevated levels of both depression and anxiety, and that these symptoms intensified with the duration of HL (Cetin et al., 2010), both of which influence the SEWB (Cacioppo et al., 2010).

The influence of degree of HL on SEWB

Both Chew and Yeak (2010), and Jayakody et al. (2022) investigate the impact of the degree of HL on SEWB, each highlighting different aspects of how the severity of HL affects emotional and social outcomes. Chew and Yeak (2010), focused on the relationship between the severity of HL and the reported degree of hearing handicap, using HHIE-S. The study found a strong correlation between the severity of HL and the degree of hearing handicap (Chew & Yeak, 2010), aligning with the results of other studies (Dalton et al., 2003; Yueh et al., 2003). In cases of ARHL, the loss of high-frequency hearing leads to poor speech perception, particularly affecting consonants, which are crucial for speech clarity. Chew and Yeak (2010) found that poor speech perception contributed to communication difficulties, negatively impacting SEWB. Participants reported issues, such as difficulty listening to TV and radio (61.2%), understanding whispered speech (75%), and frustration when talking to family members (60 %). In comparison, Weinstein et al. (1983) reported that approximately 50% of individuals exhibited impairments in these domains.

In contrast, Jayakody et al. (2022) delved deeper into the emotional aspects of HL specifically focusing on emotional loneliness rather than social loneliness. Their findings revealed that untreated HL was associated with emotional loneliness. In fact, the severity of

HL was linked to emotional loneliness, such that as HL severity increases, emotional loneliness also rises (Jayakody et al., 2022). This is further supported by Contrera et al. (2016)' s cross-sectional study investigating 1,903 participants, who found that individuals with more severe degree of hearing impairment are more likely to experience socio-emotional difficulties namely depressive symptoms when compared to those with mild or no HL.

In contrast to these findings, Niazi et al. (2020)'s study examining the relationship between HL and psychological distress in a sample of 200 participants aged 53 to 89 years, found no significant differences between varying levels of hearing impairment and psychological distress, namely emotional isolation ($p > 0.05$). Research suggests that issues with high or medium-frequency hearing, typically have minimal impact on psychological distress, provided that low-frequency hearing thresholds are still unaffected (Most & Aviner, 2009).

The disparity in findings may be associated with cultural influences which may influence the relationship between HL and socio-emotional factors in older adults, difference in sample sizes, and the scope of their study. While, Chew and Yeak (2010), focus on how HL impacts communication, particularly speech perception, and its consequences on social interactions, directly affecting SEWB. Jayakody et al. (2022), and Niazi et al. (2020), only explore the emotional isolation aspect, emphasising the contribution of severity of HL to emotional loneliness, which may not always be immediately evident in social interactions.

Nevertheless, all studies highlights that while the degree of HL contributes to SEWB, the mechanisms through which HL affects emotional outcomes vary. Chew and Yeak (2010), highlight the practical, communication-related consequences of HL, while Jayakody et al. (2022), and Niazi et al. (2020) bring attention to the emotional challenges and psychological distress that may be more pronounced in some individuals. Furthermore, they all emphasise

the importance of addressing the emotional aspects of HL and suggest that interventions may need to account for both communication barriers and emotional isolation.

The influence of degree of HL on LS

Niazi et al. (2020), explored the impact of the degree of HL on subjective well-being, including LS. The SWLS was used, with no statistically significant differences in subjective well-being across varying levels of hearing impairment found ($p > .05$). Conversely, Caballero et al. (2010), and Dalton et al. (2003), both of whom used the same tool to assess QOL (Short Form 36 [SF36]), found that the severity of HL influences QOL, which, is associated with reduced LS. Caballero et al. (2010), conducted a cross-sectional study on older adults aged 65 years and over and found an association between the severity of HL and QOL. Similarly, findings were reported by, Dalton et al. (2003), who recruited 2,800 participants aged 53 to 97 years. The disparity in findings may be attributed to differences in study design, sample characteristics, or measurement tools used.

Despite these findings, there is a notable lack of research specifically focusing on the degree of HL, particularly in relation to LS. Since as discussed, QOL and LS are related but not identical concepts, research that focuses on LS is necessary. This study aims to address this gap by investigating how different degrees of HL affect LS in older adults.

The association between SEWB and LS

The association between LS and SEWB is heavily influenced by the degree to which a person's emotional experiences correspond with societal expectations. Studies have shown that people who frequently experience positive emotions tend to report greater LS (Fredrickson, 2001), whereas those who acknowledge and accept their negative emotions often demonstrate improved psychological health (Rutherford et al., 2018). Contrastingly,

some individuals report lower well-being due to unrealistic expectations placed on emotional expression (DeJonckheere et al., 2022). Conversely, when society acknowledges and accepts a wider range of emotions, including negative ones, individuals tend to experience moderate to high levels of LS. This suggests that certain norms, play a crucial role in promoting both SEWB and overall LS (Bastian et al., 2012; Humphrey et al., 2022; Yeung & Lun, 2021).

Lombardo et al. (2018), found that LS is significantly linked to self-reported mental health, even when accounting for variables like general health, and gender. In this case, mental health was defined as a multifaceted concept that extends beyond the mere absence of mental illness. WHO (2022) defines mental health as "a state of well-being in which an individual realises their own abilities, can cope with the normal stresses of life, works productively, and can contribute to their community''. Moreover, mental health also corresponds to the SEWB of individuals (WHO, 2022). Lombardo et al. (2018)'s findings show that individuals reporting poor mental health demonstrated particularly low LS, whereas those with fair mental health had odds of achieving a higher LS, 2.35 times greater than those in the poor mental health category. Similarly, Niazi et al. (2020), explored the relationship between psychological distress, including socio-emotional factors, and subjective well-being, namely LS, in older adults, using linear regression. The results indicated that psychological distress was a significant predictor of subjective well-being namely LS.

In conclusion, subjective mental health plays a crucial role in LS, proving to be a stronger predictor than other commonly recognised factors. Future research is warranted to explore the relationships between SEWB and LS in individuals with HL, specifically untreated HL (Lombardo et al., 2018).

Hearing screening

International hearing screening guidelines and practices

Given the numerous negative consequences associated with hearing impairment including its association with cognitive decline, increased dementia risk, socio-emotional and communication difficulties, early identification of HL through hearing screening in adults is instrumental to detect those at risk of an undiagnosed hearing impairment. Although screenings do not provide a diagnosis, they serve as a preventative measure (WHO, 2021b). According to ASHA (n.d), audiologists are encouraged to conduct hearing screenings for timely interventions to reduce the adverse impacts of untreated HL. Further detail regarding hearing screening can be found in Appendix D.

Both internationally and locally, there is an absence of standardised guidelines for hearing screenings in older adults. While some guidelines exist, recommendations vary across countries exposing a research gap in the hearing care pathway (ASHA, 2006; WHO, 2021). For instance, in the United States, hearing screening is recommended only for individuals with specific clinical issues (US Preventive Services Task Force, 2021), while other European countries recommend screening every year or every three years (WHO, 2021). Individuals who are at a higher risk (e.g. individuals exposed to loud noise or taking *ototoxic medications),* should have screenings annually. Thus, it is ideal that, these recommendations are adjusted to fit each person's unique personal and life circumstances (ASHA, n.d; Gopinath et al., 2010; McMahon et al., 2008). Further information regarding different international hearing screening guidelines and recommendations can be found in Appendix E.

The local context

Locally, hearing screenings for adults are not readily available. Until recently, adults experiencing hearing difficulties were typically referred to the state general hospital, where an

audiologist conducted hearing assessments, followed by an evaluation from an ENT specialist (Active Ageing and Community Care [AACC], 2021; Allied Health Services, 2023). However, in the past few months, referrals for individuals aged 60 and over have shifted to a long-term care facility - day hospital. The typical care pathway begins with a general practitioner [GP], who assesses the patient and refers them accordingly. Both hospitals are equipped to conduct diagnostic tests and recommend appropriate treatment based on the assessment outcomes.

Comprehensive hearing assessment

Participants who do not pass the hearing screening assessment should be referred to an audiologist for a comprehensive audiologic evaluation. This includes a range of assessments to accurately diagnose hearing loss and guide intervention as follows(ASHA, 2024):

1. Case History: Provides insight into the individual's hearing concerns, medical background, and lifestyle factors.
2. Otoscopy: To examine the ear canal and tympanic membrane for abnormalities
3. Acoustic immittance testing, including tympanometry and acoustic reflex measures, evaluates middle ear function.
4. Otoacoustic emissions [OAEs] assess cochlear function, which is crucial for early detection of SNHL.
5. PTA: Both air and bone conduction, determines hearing thresholds across frequencies
6. Speech audiometry: in both quiet and noisy environments to evaluate the ability to understand spoken language

Based on the findings, a medical referral to an ENT may be recommended. This holistic approach ensures a thorough understanding of both the physiological and functional aspects of hearing (ASHA, 2024)

Hearing intervention

Hearing intervention plays a crucial role in reducing the impact of HL on QOL and overall well-being. Depending on the type and severity of HL, different intervention approaches are available. For mild to moderate HL, hearing aids are often the first line of treatment. Research shows that hearing aids can significantly improve QOL by enhancing communication, social interactions, and psychological well-being. They have been shown to reduce the risk of depression, isolation, and cognitive decline, particularly in adults with mild to moderate HL (Borre et al., 2023). Studies by Kochkin and Rogin (2000) and Mulrow et al. (1990) also demonstrate that hearing aid use improves psychosocial outcomes. However, despite these benefits, hearing aid uptake remains low due to factors such as cost, stigma, and appearance concerns (Chien et al., 2012). Further research has indicated that addressing HL positively impacts SEWB, with studies revealing that hearing aids can enhance social support, reduce psychological distress, and decrease mental health difficulties, especially when compared to individuals with untreated HL (Bigelow et al., 2020; Choi et al., 2016; Wells et al., 2020). Additional details on these studies can be found in Appendix F.

For individuals with severe to profound sensorineural HL, cochlear implants may be a more suitable solution when hearing aids provide limited benefit. For those with conductive or mixed hearing loss, or single-sided deafness, bone-anchored hearing aids [BAHA] offer an effective alternative by transmitting sound through bone conduction directly to the inner ear. Beyond amplification devices, aural rehabilitation plays a key role in supporting individuals with auditory training, communication strategies, speech reading, and counselling (ASHA, 2024; Ftouh et al., 2018; NHS Commissioning Board, 2013).

Conclusion

In conclusion, a narrative review of existing literature highlights the profound and often overlooked impact of hearing impairment, particularly untreated ARHL on the SEWB and LS of older adults. HL is the most common sensory disability in this population, yet it remains largely unrecognised and untreated.

Despite its significant effect on daily activities and social engagement, many societies still disregard ARHL, often resulting in delayed treatment. This lack of awareness leads individuals to miss the opportunity to address the condition early, which could slow its progression and help alleviate its detrimental effects on mental and emotional well-being (Niazi et al., 2020).

While numerous studies have examined the relationship between HL and various aspects of mental health there is still a research gap in understanding how untreated HL specifically affects SEWB and LS in older adults. Additionally, there is limited exploration into how demographic and hearing-related factors influence these outcomes. To the researcher's knowledge, no such studies have been conducted on the Maltese population despite the significant consequences of HL. Therefore, this study aims to address this gap by examining the aforementioned associations.

This research aims to evaluate the impact of untreated HL on SEWB and LS among older Maltese adults and to address the following research questions:

Research questions

1. How do older Maltese adults with untreated HL perceive their socio-emotional well-being?
2. How do older Maltese adults with untreated HL perceive their LS?
3. How does untreated hearing loss affect the socio-emotional well-being and life satisfaction of older Maltese adults compared to those without hearing loss?
4. How do demographic variables, such as age, years of education, and gender, influence scores related to socio-emotional factors and LS in older adults with untreated HL?
5. How do hearing-related variables, including the type, unilateral/bilateral nature, and degree of untreated HL, impact scores on socio-emotional factors and LS in older adults?
6. What is the relationship between socio-emotional factors and LS specifically among older Maltese adults with untreated HL?

Following a comprehensive literature review, the research design and methodology shall be described comprehensively in the next chapter.

Chapter 3: Methodology

This chapter will outline the research design, data collection methods, and analysis techniques used in the study. It also discusses participant identification and recruitment, as well as, ethical considerations.

Research Methodology

Research approach

The research study employed a quantitative research approach since the aim and objectives of this study were to explore relationships among variables. Indeed, the research aimed to investigate how older Maltese adults with untreated HL perceive their SEWB and LS while considering the influence of demographic and hearing-related variables outlined in the objectives. In this study, variables such as socio-emotional factors and LS were quantified using likert scales (Creswell & Creswell, 2022).

A qualitative approach was deemed less suitable for this study, as it explores subjective experiences through open-ended questions rather than measurable variables, which did not align closely with the research objectives.

Grover (2015) highlights that quantitative research is grounded in both positivist and post-positivist paradigms. Post-positivism, which evolved from positivism, challenges the notion of absolute truth in knowledge, offering a more realistic view, particularly in behavioural research, where certainty is difficult to achieve (Creswell & Creswell, 2022; Phillips & Burbules, 2000). Unlike qualitative approaches that explore the "how" and "why" through subjective understanding, quantitative research within a post-positivist framework focuses on testing hypotheses and identifying causal relationships (Bumbuc, 2016; Habib,

2021). In fact, the aim and objectives of this study are to explore the relationship between untreated HL and SEWB, as well as LS, across various variables.

Quantitative research aligns more closely with the assumptions of the post-positivist approach, where independent and dependent variables are investigated for possible associations (Creswell & Creswell, 2022; Grover, 2015). In this study, independent variable, untreated HL, and the dependent variables, SEWB, and LS were studied. Moreover, the post-positivist paradigm highlights the importance of numerical measurement in data collection, with a focus on validity and reliability of research instruments. Consequently, statistical analysis was employed for data analysis in this study.

Research design

There are two primary types of quantitative studies: observational and interventional. Observational research includes three main study designs namely, cross-sectional, cohort, and case-control studies (Mann, 2003). These studies are inherently observational, as researchers do not intervene but rather observe. This methodological approach is used to describe specific characteristics of a situation or to assess the impact of a particular outcome. It is especially advantageous in contexts where ethical considerations limit the possibility of experimental manipulation. Furthermore, such research does not manipulate independent variables, rather, it focuses on measuring variables (Mann, 2003).

Therefore, an observational study design specifically, a cross-sectional design with a control group was employed, as the researcher cannot manipulate the variables and instead aimed to measure the associations between them (see Table 4). This design was appropriate because data were collected at a single point in time and allowed for the identification of relationships among variables and the examination of interactions between various independent and dependent factors, such as demographic and hearing-related variables (Mann, 2003; Mbuva, 2023; Price et al., 2017).

Participants

Kochkin (2011) noted that one in three people over 65 experience some degree of HL globally. The WHO (2015; 2021) also reports that one-third of individuals aged 65 and older suffer from disabling HL. Based on these findings, this study recruited Maltese adults aged 65 years and older.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria are important for reliability and objectivity in participant selection to enhance the study's validity and applicability (Nikolopoulou, 2023).

Inclusion criteria. for this study included i) Maltese older adults aged 65 years or older. ii) older adults with untreated HL iii) permanent Maltese residents. Since this study focused on the local context, participants were required to be Maltese to eliminate any potential cultural barriers that could influence the results and iv) Cognitively intact as indicated by a score of 5 or 4 on the clock drawing test [CDT] (Shulman, 2000). It was crucial to exclude individuals with indications of cognitive impairment from this study, as participants need to fully understand the study, its risks and benefits, and be able to reliably answer the questions posed (Nokes et al., 2007).

Exclusion criteria. were established to reduce the impact of *confounding variables*. For this study, participants were excluded if they had: i) progressive neurological conditions, ii) a history of psychiatric disorders, iii) a history of substance abuse, iv) significant communication difficulties that could hinder their ability to understand or complete the assessment, or v) treated HL, such as the regular use of hearing aids vi) cognitively impaired older adults. These exclusions are supported by research showing that individuals with a history of substance abuse tend to have lower LS (Kang, 2023), neurological disorders are

linked to reduced LS (Gandy et al., 2021), and those with psychiatric conditions experience lower LS compared to those without (Muele et al., 2020).

Setting and Duration

In this study, recruitment took place at an outpatient day-hospital within a long-term care facility. This site of recruitment was chosen because it provides access to a large pool of older adults, facilitating data collection within an environment familiar with the needs of this population.

The researcher assessed participants over a 30–45-minute period at the Audiology Clinic, under the supervision of a registered audiologist. Participants were recruited from the outpatient day- hospital of the long-term care facility and from new clients referred to the audiology clinic at the day hospital. These individuals were visiting the audiology clinic or the facility for health screening and specialist services offered at the outpatient clinic. Participants were not residents of the long-term care facility. Recruitment took place between August 2024 and January 2025.

The audiological assessments were conducted in a quiet-untreated room which is currently being used to test older adults. Despite the clinic's routine use for audiological evaluations, the researcher took care to ensure the testing environment was free from background noise that could interfere with results. To objectively verify this, a validated application, the National Institute for Occupational Safety and Health (NIOSH) Sound Level Meter, was employed to measure ambient noise levels in accordance with WHO (2021) guidelines. Background noise was confirmed to be consistently below 40 dBA, adhering to the noise level recommendations outlined by WHO (2020). Additional measures were implemented to maintain a quiet environment, including closing all doors and windows,

turning off the air conditioning system, and ensuring that no one spoke or generated noise nearby during testing.

Participants Identification and Recruitment

Maltese adults aged 65 or older were invited by a registered audiologist to participate in a hearing screening. An information letter (see Appendix G) was distributed by the intermediary to participants who were interested in taking part in this study. Participants who agreed to participate voluntarily, filled out and signed a consent form (see Appendix H).

Sampling

In quantitative research, sampling is the process of selecting a smaller group from a larger population to serve as a representative sample (McCombes, 2019).

Non-probability sampling, specifically convenience sampling, was employed in this study. The participants were selected to include both individuals with untreated HL and those with typical hearing, who served as the control group. This approach was suitable because the study aimed to look at the impact of untreated HL on SEWB and LS, necessitating the inclusion of both groups for statistical analysis.

Convenience sampling was used as it facilitates the recruitment of participants who meet the specific criteria, ensuring the sample aligns with the study's objectives. Moreover, non-probability sampling is advantageous due to its simplicity, lower cost, and reduced time requirements compared to probability sampling (Berndt, 2020). This approach enabled the research to target a specific population which is easily accessible and likely to visit the audiology clinic for related services, making convenience sampling a practical and feasible approach for participant recruitment. The recruitment site was a facility catered for older adults, offering screening, assessment, and intervention services. This increases participant accessibility and improves the potential for recruitment.

Given that non-probability and convenience sampling methods do not ensure a representative sample of the broader population, this limitation will be taken into account when discussing the conclusions and implications of the study.

Sample size

According to the WHO (2021), over 1.5 billion people worldwide, or 20% of the global population, are affected by HL, with 1.16 billion experiencing mild loss. However, 430 million people, or 5.5%, suffer from moderate or severe HL, which can greatly impact daily life. The prevalence of moderate to severe HL increases with age, rising from 12.7% at 65 to over 58% at 90, with older adults making up most cases.

Locally, according to NSO (2023), there are currently approximately 103,406 Maltese older adults aged 65 years and above. Within this demographic, a portion of the population is believed to be living with untreated HL; however, no local register for these patients is currently available. Given, the lack of local data, a population proportion of 50% was used. This percentage is used when the population proportion is unknown and represents the maximum variability expected in a population. Therefore, it is considered the most conservative estimate (Siegle, 2021).

A margin of error of 10% with a confidence level of 95% was used in this study. A 95% confidence level indicates a high degree of certainty, where one can be confident 95% of the time in the accuracy of the findings. The margin of error represents the range within which the true population parameter is expected to fall, accounting for sampling variability. In this study, a margin of error of 10% indicates that the actual population value is likely within ±10 percentage points of the sample estimate (Coursera, 2024). This percentage is typically used in research (Siegle, 2021). This research aimed to recruit a sample of 100 participants from a larger pool of Maltese older adults aged 65 years and above who are experiencing untreated HL. Of these, 10 participants were intended to serve as the control group, consisting

of individuals with normal hearing. Another 10 participants were aimed to be selected as part of the pilot study.

Method

Research Instruments

The *research instruments* used in this study were:

1. CDT (Appendix I)
2. Case history (Appendix J)
3. Otoscopy
4. PTA to assess hearing
5. HHIE-S – Maltese version (Appendix K)
6. SWLS – adapted to Maltese (Appendix L)

Prior to data collection using the above research tools, the following ethical considerations were adhered to.

Ethical considerations

In this research study, ethical considerations were carefully followed to ensure the protection, privacy, and respect of all participants. Prior data collection, permissions were granted as follows.

Permission to use research tools

Permission to use the HHIE-S

Permission to use the HHIE-S was obtained from Professor Barbara Weinstein. The Maltese version, translated by a former MSc Audiology student (Galdes, 2017) was used.

Permission and adaptation of the SWLS

The SWLS did not require permission, as the tool can be used and adapted freely (Diener et al., 1985). The adaptation of the questionnaire was conducted through a forward-

and-backward process (WHO, 2016). This ensures conceptual equivalence of test items (Ozolins et al., 2020). A professional Maltese translator, adapted the questions, ensuring the use of common language and conceptual equivalence of test items. An independent person then re-translated the questions into English to verify consistency. The face and content validity of the tool were established through a pilot study, with content validity further confirmed by liaison with an audiologist. The final adaptation of the tool was deemed acceptable, except for one statement, which was revised to ensure greater clarity for older adults. This revision was made based on feedback from the pilot study and improved the tool's comprehensibility for this specific age group.

Permission to use CDT

Permission to use The Maltese version of the CDT was obtained from Dr. Ritienne Grima (Shulman 2000; Grima, 2011).

Additional ethical approvals

Additionally, formal approval was secured from the Chief Executive Officer [CEO], Medical Director, Data Protection Officer, and Ethics Committee of the long-term care facility where participant identification and recruitment took place (Appendix M)

Before participants were recruited, the intermediary audiologist distributed a detailed information letter. This document provided a thorough explanation of the study's procedures, allowing potential participants to make an informed and voluntary decision about their involvement. Those who chose to participate signed a consent form, which was then collected by the audiologist and handed over to the researcher, with all forms kept confidential and stored securely. To further protect participants' identities, a unique code replaced their names throughout the study, and all consent forms are stored separately from the coded data.

Confidentiality was maintained at all stages. Identifiable data were encrypted and stored offline on an external drive rather than on cloud-based services. All physical records,

including hearing assessment results and survey responses, were securely stored in a locked cabinet. If a participant chose to withdraw from the study, their data would be destroyed immediately; any remaining anonymous data would also be stripped of personal identifiers. However, no participant opted to withdraw from the study.

Moreover, the study proposal was reviewed and approved by the Faculty of Health Sciences Research Ethics Committee [FREC] with reference number FHS-2024-00203 to ensure ethical compliance and the protection of participants' rights and welfare (Appendix N).

Procedure

Prior starting the main data collection, a pilot study was carried out. The pilot study was undertaken to assess the effectiveness of the data collection instruments, ensure the clarity of instructions provided to participants, and identify any procedural challenges that could affect the main study (Hassan, 2006). For the pilot study, ten older Maltese adults were recruited through convenience sampling. Data collection procedures and assessments were trialled to confirm their suitability and practicality. Based on feedback, several changes were completed:

Case History: A question was added to the case history to assess participants' awareness of their hearing condition: "Do you think you have a HL?" This aimed to determine whether participants were aware of any hearing impairment they may have.

***Tympanometry*:** Prior to data collection, tympanometry was planned for use; however, it was unavailable at the recruitment site. Since bone-conduction testing and masking were sufficient to differentiate between SNHL and CHL, tympanometry was not deemed essential for the study. ASHA (2006; 2018) guidelines suggest that immittance measures like tympanometry are unnecessary for adults due to the low prevalence of middle ear disease and their limited diagnostic value. Additionally, WHO (2021) guidelines categorise tympanometry

as a diagnostic rather than a screening tool. One objective of this study was to explore how hearing-related variables, including the type of HL, affect SEWB and LS in older adults with untreated HL. In this context, bone conduction testing and masking were sufficient to differentiate HL types. Since this study does not examine the effects of different CHL types on SEWB or LS, tympanometry was not required. However, future research could investigate this in greater detail.

***SWLS*:** One statement was revised to enhance clarity and comprehension for older adults: Instead of ‘‘F' ħafna mill-affarijiet, ħajti tqarreb lejn dak li hu ideali għalija,’’ it was changed to ‘‘F' ħafna mill-affarijiet, ħajti hija qrib l-ideali għalija.’’ English version: In most ways, my life is close to my ideal."

***Time*:** Although the study was initially estimated to take one hour to complete, it was found to take approximately 30-45 minutes.

Order effect: During the pilot study, participants were randomly assigned to complete the HHIE-S and SWLS either before or after the hearing test. This randomisation was achieved by drawing lots, ensuring an unbiased distribution of the task order. Some participants filled out the Likert scales first, followed by the hearing test, while others completed the hearing test first, followed by the Likert scales. Participants reported no signs of fatigue, likely due to the test’s relatively short duration. However, it was noted that when the hearing results were discussed with the participants alongside the audiologist, prior to the completion of the two patient-reported tools, their awareness of their HL appeared to influence their answers on these two measures. To mitigate this risk of response bias, it was decided that the results of the hearing assessment would only be discussed with the participant at the end of the study. This ensured that, participants’ responses were not influenced by prior knowledge of their HL.

Although only minimal changes were made following the pilot study to maintain the validity of the results and ensure the integrity of the methodology, these participants were excluded from the main study participants and final analysis. The updated materials were then resubmitted to FREC for approval and approval was granted.

Research Procedure

After the pilot study was completed, the main data collection was collected. Research instruments and tools were administered with every participant on the same day at the Audiology clinic. Five participants from the sample returned on a different day for the test-retest procedure. The sequence of tasks in this research study were as follows.

1. Cognitive screening
2. Case history
3. Otoscopy
4. Hearing Screening/ Comprehensive hearing assessment
    - PTA
    - Hearing screening
    - Hearing assessment
5. Participant- reported outcomes
    - HHIE-S Scale
    - SWLS
6. Discussion of Results and referrals
7. Data Entry: Responses were inputted into Statistical Package for the Social Sciences [SPSS] version 29 (IBM, 2019)

A discussion of each research instrument is provided below.

Cognitive Screening

Cognitive screening was conducted using the Maltese version of the CDT (Shulman (2000; Grima, 2011). Screening for cognitive ability was necessary due to the likelihood of cognitive decline with age (Moraes-Crispim et al., 2013). A quick and easy cognitive screening was essential to confirm that participants had adequate cognitive functioning. The CDT was chosen because it is easier to administer and less time consuming. In fact, Pinto and Peters (2009) highlight several benefits of the CDT, including its simplicity, quick administration, and potential to be less intrusive for patients. In addition, Shulman (2000) found that the CDT although being a screening tool and not a diagnostic tool, has high sensitivity (85%) and specificity (85%) across published studies. It also shows strong correlations with the Mini-Mental State Examination [MMSE] (Folstein et al., 1975) and other cognitive tests. The test has high inter-rater and test-retest reliability, along with positive predictive value. Despite variations in scoring systems, the test consistently demonstrates good psychometric properties and sensitivity to cognitive change (Pinto & Peters, 2009; Shulman, 2000)

Case History

Demographic and health-related information were gathered through a case history form, available in both Maltese and English, consisting of close-ended questions. This was done to ensure participants met the study's inclusion and exclusion criteria.

Otoscopy

Otoscopy was performed by the researcher under the supervision of the intermediary. An otoscope (HEINE mini 3000 LED), a hand-held device equipped with a light source used

to examine the ear canal and eardrum (Falkson & Tadi, 2022) was used to examine the ear and rule out any pathologies that could interfere data collection and compromise findings**.**

Hearing screening/ Comprehensive hearing assessment

Pure-tone audiometry. To quantify the degree and severity of HL, hearing screening and comprehensive hearing assessment were conducted using PTA: Inventis - Harp Plus Diagnostic Audiometer, DD45 headphones and B-71 bone vibrator. These were carried out by the researcher under the supervision of the registered audiologist. PTA is considered the gold standard for identifying HL (Carl, Hohman, & Cornejo, 2023; Ramdoo et al., 2014) and to determine an individual's hearing threshold across frequencies ranging from 250 Hz to 8000 Hz, which are essential for speech comprehension (Salmon et al., 2023). According to the BSA (2018), a hearing assessment begins using with an otoscopic examination using an otoscope.

Hearing screening. First, a hearing screening was conducted in accordance with the WHO (2021) international guidelines for hearing screening. While there is currently a lack of standardisation in hearing screening protocols, WHO (2021) introduced hearing screening guidelines for older adults, which were followed in this study. In accordance with these guidelines, the 500Hz, 1000Hz, 2000Hz and 4000Hz were tested in each ear. Those individuals who were identified with a HL of more than 35dB, a comprehensive hearing assessment was carried out.

In this research study, the 35 dB HL threshold was adopted based on WHO (2021) guidelines. WHO (2021) hearing screening guidelines recommend this threshold as it enhances the reliability and consistency of screening results across different studies and

populations. This cut off criteria is also supported by several studies (ASHA, n.d.; Davis & Smith, 2013; Davis et al., 2007; Thodi et al., 2013).

WHO (2021) argues that using a lower threshold, such as 20 dB HL, could result in a higher number of referrals for diagnostic evaluation, potentially overburdening healthcare systems with an increased proportion of false-positive cases. Additionally, lower thresholds, such as 20–25 dB HL, are more challenging to assess in environments with background noise. As a result, the 35 dB HL is a more practical choice for hearing screening. For older adults with an average hearing threshold below 35 dB HL, a hearing assessment was carried out as follows.

Hearing assessment. Testing began with the ear that the participant perceived as their better hearing ear, following BSA guidelines (2018). The frequencies were assessed in the following order: 1000 Hz, 2000 Hz, 3000 Hz, 4000 Hz, 6000 Hz, 8000 Hz, 500 Hz, and 250 Hz. The 1000 Hz frequency was retested, as recommended by the BSA (2018) PTA guidelines, to ensure accuracy and reliability. Since the frequency range of 250 Hz to 8000 Hz is necessary to understand speech (Kung & Willcox, 2017) and older adults are more prone to high-frequency loss, testing at 8000 Hz is particularly important.

This method is also supported by ASHA (2005) hearing assessment guidelines, which states that for screening purposes, four thresholds should be tested, while a comprehensive hearing assessment requires testing all thresholds. This method provides a clearer picture of the participant’s HL.

Since, PTA provides quantitative measurements of AC and BC pure-tone thresholds, which are useful in differentiating the type and severity of HL (Carl, Hohman, & Cornejo, 2023; Schlauch & Nelson, 2015), both AC and BC thresholds were assessed in this research. Results were plotted on an audiogram. Thresholds at four frequencies, the 500, 1000, 2000, and 4000 Hz in the better-hearing ear were used to determine each participant's pure tone

average (WHO, 2021). Furthermore, the severity of HL was graded based on the revised WHO grading system (2001, 2021), a system that is supported by several studies, including those by Stevens et al. (2013) and Olusanya et al. (2019). The updated audiometric descriptors range from normal hearing to unilateral HL.

Additionally, the average hearing threshold was further categorised into a binaural low-frequency average (500, 1000, and 2000 Hz in both ears) and a high-frequency threshold (3000, 4000, 6000, and 8000 Hz in both ears), following the method outlined by Gomez et al. (2001). This approach was previously used in Gomez et al. (2001) and a local study conducted by Galdes (2017).

Participant-reported outcomes.

The HHIE-S (Ventry & Weinstein, 1983). The Maltese version of HHIE-S (Galdes, 2017; Weinstein & Ventry, 1983) was used to evaluate socio-emotional factors. The internal consistency was previously established using Cronbach's Alpha, yielding a score of 0.809.

This scale was used to explore how older Maltese adults with untreated HL perceive their SEWB. It is widely recognised as one of the most effective tools for assessing the social and emotional effects of HL (Demers, 2013) and has been used globally across various settings with community-dwelling older adults (Bagai et al., 2006; Chang et al., 2009; Tomioka et al., 2013).

This is a self-assessment tool designed to identify hearing-related challenges among older adults by evaluating the social and emotional effects of hearing impairment. This user-friendly tool includes 10 questions with response options of 'yes,' 'no,' or 'sometimes,' making it quick and easy to administer. The HHIE-S has two subscales: one assessing the social impact and the other evaluating the emotional impact of HL. In addition, this tool is frequently used to screen for hearing difficulties in elderly populations (Weinstein et al., 1986).

In fact, various studies have consistently reported high internal consistency for the HHIE-S and used this tool in various cultures (Deepthi et al., 2012; Diao et al., 2014; Tomioka et al., 2013). Moreover, in a study by Oberg (2016), the HHIE-S showed robust internal reliability, with a Cronbach's alpha of 0.87, and test-retest reliability of 0.84. When compared with audiogram-defined HL, the HHIE-S demonstrated sensitivity levels between 63-80% and specificity between 67-77% with a cutoff score of over 10. A higher cutoff score above 24 increased specificities to 88-98% (Weinstein and Ventry, 1983). A review of other related tools was conducted before selecting the most appropriate tool (see Appendix O).

SWLS (Diener et al., 1985). The adapted Maltese version of this self-reported tool, was used to assess LS in older Maltese adults. The SWLS (Diener et al., 1985) is a widely used self-report tool for assessing an individual's overall LS, a core element of subjective well-being. This scale comprises five statements related to LS, with responses captured on a seven- point Likert scale, where 1 signifies "Strongly Disagree" and 7 signifies "Strongly Agree.". This scoring method yields a total score between 5 and 35, with higher scores indicating greater LS (Dienet et al., 1985). Diener et al. (1985) developed the SWLS to address the limitations of previous instruments, which typically employed single-item measures and failed to distinguish between the cognitive and affective dimensions of subjective well-being (Galanakis et al., 2017). The SWLS has become one of the most widely used tools in LS research globally (Vásquez, Duque, & Hervás, 2013). It has been adapted and implemented in multiple countries including Spain, Brazil, Malaysia, and Sweden demonstrating its broad applicability and cross-cultural relevance (Gouveia et al., 2009; Hultell & Gustavsson, 2008; Swami & Chamorro-Premuzic, 2009; Vásquez et al., 2013)

The SWLS was purposefully developed to measure overall LS independently from broader constructs of subjective well-being, such as emotional states or social connectedness

(Diener et al., 1985). Unlike other tools that combine cognitive and affective dimensions, the SWLS focuses solely on individuals' evaluative judgments about their lives. Research report strong internal reliability, with Cronbach's alpha values around 0.87, and robust test–retest stability over time (Diener et al., 1985). Moreover, scores on the SWLS show moderate to high correlations with established indicators of psychological well-being, including the Rosenberg Self-Esteem Scale and the Marlowe-Crowne Social Desirability Scale, confirming its validity (Diener & Pavot, 2008). The psychometric characteristics of the SWLS, particularly its reliability coefficients ranging from 0.79 to 0.91, has been reaffirmed through subsequent studies involving diverse demographic groups (Clench-Aas et al., 2011; Hultell & Gustavsson, 2008; Diener & Pavot, 2008).

Several studies have also examined the scale's factor structure. In their original analysis, Diener et al. (1985) conducted principal axis factor analysis, which revealed a single factor accounting for 66% of the scale's variance. This unidimensional structure has been consistently replicated in subsequent research (Clench-Aas et al., 2011; Pavot et al., 1991; Vázquez et al., 2013). A review of other related tools was carried out and can be found in Appendix P.

Recording of responses

Data was collected on paper forms (audiogram - hearing assessment results, responses of questions asked in the case history form, consent forms, responses to the scales used). No photos and/or audio/video recordings were taken. Other data was recorded as follows:

- Case history form: Participants were asked questions related to their age, gender, educational status, number of years in each level of education, history of progressive neurological conditions/psychiatric disorders (answered with "yes" or "no" along with

the name of the condition), history of substance abuse (answered with "yes" or "no"), and questions related to their hearing (answered with "yes" or "no").

- Otoscopy: The ear was examined and any observations was noted down such as impacted cerumen.
- CDT: Participants were asked to draw a clock and draw the time to 10 mins past 11. Score was given accordingly. 5 points were given if participants drew a perfect clock, 4 points if there were minor visuo-spatial errors etc.
- PTA: This was used to assess hearing, depending on the type of loss, the degree of HL was illustrated in the audiogram (hearing test result).
- Participants expressed their level of agreement or disagreement with the statements in the SWLS by choosing from the statements such as "strongly agree," "agree," "slightly agree," "neither agree nor disagree," "slightly disagree," "disagree," and "strongly disagree." A numerical score was allotted for each statement as follows: 7 for "strongly agree," 6 for "agree," 5 for "slightly agree," 4 for "neither agree nor disagree," 3 for "slightly disagree," 2 for "disagree," and 1 for "strongly disagree."
- In the HHIE-S tool, each participant answered either "no," "sometimes," or "yes" for each statement. A numerical score was assigned to each response: 0 for "no," 2 for "sometimes," and 4 for "yes."
- In both scales mentioned above, data was ordinal categorical data using close-ended questions/statements. Ordinal categorical data consists of categories with a meaningful order or ranking (Dillman et al., 2014; Simplilearn, 2024).

Finally, discussion of the results was conducted, during which hearing test findings were also reviewed by the audiologist. Participants who were found to have HL and would benefit from further intervention were advised to be referred to the Audiology clinic for additional evaluation.

Reliability and Validity

Validity pertains to how effectively a study evaluates what researchers intended to measure, while reliability concerns the accuracy of the tool's functioning (Middleton, 2019).

Reliability

Through the research study, some reliability measures were considered to achieve consistency as follows:

- Internal consistency of the Maltese adapted tool (SWLS) was conducted. Statistical results can be found in Chapter 4.
- Test-retest and inter-rater reliability procedures for the HHIE-S and SWLS were carried out on five participants. This assesses the consistency and stability of the measurement tools. On one hand, test-retest reliability evaluates the stability of results over time by administering the same tool to the same participants on two separate occasions, ensuring that the tool produces consistent results when the measured construct remains unchanged. On the other hand, inter-rater reliability assesses the degree to which different raters provide consistent evaluations of the same phenomenon, confirming that any variations reflect actual differences in the construct rather than inconsistencies in rater judgment (Bobbitt, 2020). These procedures were implemented to establish the reliability of the tools, and the results are found in Chapter 4.

Validity

- Content validity was carried out on both SWLS and HHIE-S tools. This ensure that the assessment tools are relevant, and representative of the concept being measured. Content validity confirms that experts agree the tool effectively covers all necessary aspects of the concept (Bhandari, 2023). The content validity was determined with the

assistance of a registered audiologist, who suggested minor revisions, mainly focusing on simplifying the language for better clarity and comprehension for older adults.

- Face validity was also assessed on both SWLS and HHIE-S tools. This refers to how much a test seems to measure what it is designed to measure, based on feedback from non-experts (Bhandari, 2023). It also involves evaluating whether the tool is suitable for the participants. To ensure feasibility and assess face validity, a pilot study was conducted to test the procedure and questions with potential participants.
- Face and content validity of the Maltese version of the HHIE-S were previously established by a former audiologist.

Data Analysis

Data entry responses of the dependent and independent variables (see Table 4) were gathered and analysed using quantitative methods. SPSS version 29 (IBM, 2019) was used to conduct the analysis, applying appropriate statistical tests.

Table 4

Independent and dependent variables used in this study

Variable	Level
Independent variables	
Gender	Male, Female
Age groups	65-69 70-74 75-79 80 +
Level of Education	Primary Secondary Post-Secondary Tertiary No years of formal education
Type of HL	SNHL

	CHL
	Mixed HL
	Unilateral
	Bilateral
Degree of HL	Normal hearing
	Mild HL
	Moderate HL
	Moderately-severe HL
	Severe HL
	Profound HL
	Unilateral HL
	Bilateral HL
	Complete HL
Dependent variables	
The HHIE-S scores	Score of 0, 2 or 4
The SWLS scores	Score of 1-7

Descriptives, such as, median and percentages, and inferential statistics were used to summarise the data. Since most data collection tools employed in this study consisted of an ordinal type of data (Sullivan & Artino, 2013), non-parametric statistical tests were used.

The inferential statistical tests that were employed for data analysis, along with their descriptions and hypothesis, are summarised in Table 5 (Bevans, 2023)

Table 5

Non-parametric tests descriptions

Test	Purpose	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)
Shapiro-Wilk Test	Assess whether the distribution of data is either normal or deviates normality (skewed).	The distribution is normal (accepted if **p >.05**).	The distribution is skewed (accepted if **p < .05**).
Friedman Test	Compares median rating scores across multiple	The mean scores differ across the questions	The mean rating scores differ significantly across

	related statements (Likert scale).	(accepted if **p < .05).**	statements (accepted if **p <.05**).
Mann-Whitney U Test	Compares mean rating scores primarily between two independent groups.	If **p > .05,** the mean rating scores between the two groups are considered statistically similar	If **p <.05,** there is a statistically significant difference in the mean rating scores between two groups
Kruskal-Wallis Test	Compares mean rating scores across more than two groups.	The mean rating scores across groups are similar (accepted if **p > 0.05**).	The mean rating scores differ significantly across groups (accepted if **p < 0.05**).
Spearman Correlation Coefficient	Assesses both the degree and direction of the relationship between two continuous variables.	No significant association exists between the two variables when the p-value exceeds 0.05 (p > 0.05).	A significant relationship is observed between the two variables when p <.05).

Conclusion

This chapter has detailed the methodology used to explore the impact of untreated HL on SEWB and LS among older adults in Malta. The research design was carefully chosen to ensure a reliable approach, including clear inclusion and exclusion criteria, data collection methods, and ethical considerations. The results obtained from the data collection shall be presented in the following chapter.

Chapter 4: Results and Analysis

This chapter presents the findings derived from the data collected from participants. The data were analysed using various statistical tests, namely non-parametric tests, to interpret the results and draw meaningful conclusions that align with the research aim and objectives.

Reliability results of the SWLS and LS tools

The internal consistency of the ML adapted tool was conducted using Cronbach's alpha and yielded a score of 0.707 indicating acceptable internal consistency (Bobbitt, 2020). Intraclass correlation coefficients were carried out for test retest of the HHIE-s tool and the SWLS tools yielding a score of 0.997 and 0.876 respectively. The inter-rater test of the HHIE-S tool yielded a score of 1, while for the SWLS a score of 0.993 was obtained.

Test of normality

Prior to conducting data analysis, a test of normality was performed to determine whether the data followed a normal or non-normal distribution. Parametric tests are used when the data exhibits a normal distribution, whereas non-parametric tests are employed if the data deviates from normality. A significance threshold of 0.05 is established. When the p-value exceeds 0.05, the null hypothesis is retained; conversely, if the p-value is below 0.05, the alternative hypothesis is supported.

Null hypothesis

H_0: The score distribution follows a normal distribution

Alternative hypothesis

H_1: The score distribution is not normal and hence, does not follow a normal distribution.

The distribution of the sample data was assessed using the Shapiro-Wilk test and the results are shown below:

Table 6

Test of normality

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	p
SWLS raw score	0.919	92	<.001
HHIE-S raw score	0.916	92	<.001
HHIE-S emotional questions score	0.830	92	<.001
HHIE-S social questions score	0.931	92	<.001

Table 7

Test of Normality

	Average hearing threshold level dB HL of better ear	**Shapiro-Wilk**		
		Statistic	**df**	**p**
HHIE-S total score	Mild	0.918	9	.373
	Moderate	**0.898**	**36**	**.003**
	Moderately-severe	0.914	17	.118
	Severe	0.925	8	.473
	Profound			

Table 6 and 7 show that both scales used in this study, the HHIE-S and the SWLS have a non-normal distribution, since all Shapiro-Wilk p-values are smaller than the 0.05 level of significance. Given the normality findings and the nature of the data collection tools employed in this research, comprising Likert scale questions that yield ordinal rather than continuous data (HHIE-S and SWLS), non-parametric tests were used for inferential analysis.

Study Sample

A total of 102 participants consented to take part in this study. Of these, 10 were involved in a pilot study, and 19 were identified as having no HL and assigned to the control group, based on the WHO (2021) hearing screening guidelines, as discussed in Chapter 3. The remaining 73 participants, all older adults with untreated HL, comprised the target group. Although the primary focus of the analysis is on the target group, a control group was included to explore the validity of the findings and to explore any potential differences that may provide insightful information. However, the number of participants in each group (target and control group) are significantly different, hence, results should be interpreted with caution.

Demographic characteristics of participants

Table 8

*Table Detailing Sample Demographic Characteristics – **Target Group***

Age	**Gender**		**Educational Status**			
	Males	**Females**	**Primary**	**Secondary**	**Post-Secondary**	**Tertiary**
65-69	3	5	3	4	0	1
	8.3%	13.5%	6.7%	18.2%		16.7%
70-74	6	5	6	3	0	2
	16.7%	13.5%	13.3%	13.6%		33.3%
75-79	13	14	16	9	0	2
	36.1%	37.8%	35.6%	40.9%		33.3%
80-84	10	6	12	3	0	1
	27.8%	16.2%	26.7%	13.6%		16.7%
85+	4	7	8	3	0	0
	11.1%	18.9%	17.8%	13.6%		0%
Total within age	49.3%	50.7%	61.6%	30.10%	0%	8.2%

The target group in this study consisted of older adults who met the World Health Organization (WHO, 2021) criteria for hearing screening, as outlined in Chapter 3. A total of 73 participants participated in this study, with 36 males (49.3%) and 37 females (50.7%) (Table

8). Table 8 shows that most participants (n = 45, 61.6%) in the target group reported primary education as their highest level of educational attainment.

Table 9

*Table Detailing Sample Demographic Characteristics – **Control Group***

Age	Gender		Educational Status			
	Males	**Females**	**Primary**	**Secondary**	**Post-Secondary**	**Tertiary**
65-69	5	6	1	6	1	3
	55.6%	60%	25%	85.7%	100%	42.9%
70-74	3	2	2	1	0	2
	33.3%	20 %	50%	14.3%		28.6%
80-84	1	2	1	0	0	2
	11.1 %	20 %	25%	0%		28.6%
Total within age	47.4%	52.6%	21.1%	36.8%	5.3%	36.8%

Within the control group, 10 participants (52.6%) were female, and 9 participants (47.4%) were male. Most participants n =7 (36.8%) attained secondary education as their highest level of education in the control group as illustrated in Table 9.

Table 10

*Hearing-Related Variables – **Target Group***

Age	Average H. threshold of better ear						Type of HL	
	Normal	**Mild**	**Moderate**	**Moderately-severe**	**Severe**	**Profound**	**SNHL**	**Mixed HL**
65-69	1	4	1	2	0	0	6	2
	100%	44.4%	2.8%	11.8%	0%	0%	10.9%	11.1%
70-74	0	1	6	3	1	0	6	5
	0%	11.1%	16.7%	17.6%	12.5%	0%	10.9%	27.8%
75-79	0	2	17	5	1	2	22	5
	0%	22.2%	47.2%	29.4%	12.5%	100%	40%	27.8%
80-84	0	2	7	4	3	0	10	6
	0%	22.2%	19.4%	23.5%	37.5%	0%	18.2%	33.3%
85+	0	0	5	3	3	0	11	0
	0%	0%	13.9%	17.6%	37.5%	0%	20%	0%
Total	1	9	36	17	8	2	55	18

Table 11

Hearing Related Variables cont. – ***Target group***

Age Groups	Type of HL			
	Unilateral	**Bilateral**	**SNHL**	**Mixed**
65-69	1	7	6	2
	100%	9.7%	10.9%	11.1%
70-74	0 %	11	6	5
		15.3%	10.9%	27.8%
75-79	0 %	27	22	5
		37.5%	40%	27.8%
80-84	0 %	16	10	6
		22.2%	18.2%	33.3%
85+	0 %	11	11	0
		15.3%	20%	0%
Total % within target group	1	72	55	18
	100%	98.6%	75.3%	24.7%

Table 10 shows that most participants in the target group were found to have moderate HL, particularly within the 75–79 age range (n = 17, 47.2%).

Table 11 shows that in terms of the type of HL, only one participant presented with unilateral HL, while the remaining participants (n = 72, 98.6%) had bilateral HL (Table 11). SNHL was the most common type of HL identified, especially among participants aged 75–79 (n = 22), while the remaining 18 participants (24.7%) had mixed HL. None of the participants were found to have CHL.

Table 12

Hearing Test History Among the ***Target and Control groups***

		Group	
Have you ever done a hearing test?		**Target**	**Control**
No	Count	52	13
	% within group	71.2%	68.4%
Yes	Count	21	6
	% within group	28.8%	31.6%

Participants were asked whether they had ever undergone a hearing test. Most participants in both the target group (n = 52, 71.2%) and the control group (n = 13, 68.4%) reported never having had a hearing test as illustrated in Table 12. Furthermore, participants had neither used nor were currently using a hearing aid. Participants were asked about any history of substance abuse, psychiatric conditions, or progressive neurological disorders. However, none of the participants reported having a history of these conditions.

Before the hearing assessment, participants were asked whether they believed they had HL. In the target group, 32 participants (43.8%) believed they had HL while 41 participants were unaware of their HL (n= 41; 56.2% - target group).

Table 13

Descriptive Statistics for Age, Education, and Onset of HL by Group

Descriptives

		M	**SD**	**95% Confidence Interval for Mean**	
				Lower Bound	**Upper Bound**
Age	Target	78.04	6.11	76.62	79.47
	Control	69.80	5.55	67.11	72.47
Total number of years of education	Target	15.23	4.23	14.23	16.23
	Control	19.89	6.94	16.55	23.24
When did you notice the HL? (in years)	Target	3.93	8.370	1.98	5.89

Table 13 shows that the target group has an average age of 78.04 years, while the control group has a slightly younger average age of 69.79 years . In terms of education, the target group has an average of 15.23 years while the control group has a slightly higher average of 19.89 years. When it comes to the onset of HL, the target group noticed their HL an average of 3.93 years ago.

PTA

HL was classified based on the PTA of the better ear's hearing threshold at these frequencies. The categories for HL were classified as normal, mild, moderate, moderately severe, severe, and profound (WHO, 2021). Since most participants exhibited high-frequency loss, primarily due to presbycusis, the average hearing threshold level was further classified as binaural high-frequency average hearing threshold [BHF] and binaural low-frequency average hearing threshold [BLF]. The results for this sample population are provided in Table 14 below.

Table 14

*Degree of HL Based on Different Frequencies – **Target Group***

Degree of HL	Total no. of participants Target group		
	Average hearing threshold level dB HL of better ear	**BHF average hearing threshold level dB HL**	**BLF average hearing threshold level dB HL**
Normal (0-19dB)	1 (1.4%)	0	1 (1.4%)
Mild (20-34dB)	9 (12.3%)	5 (6.8%)	21 (28.8%)
Moderate (35-49dB)	36 (49.3%)	7 (9.6%)	31 (42.5%)
Moderately-severe (50-64dB)	17 (23.3%)	18 (24.7%)	10 (13.7%)
Severe (65-79dB)	8 (11.0%)	27 (37%)	7 (9.6%)
Profound (80-94dB)	2 (2.7%)	16 (21.9%)	3 (4.1%)

Table 14 shows that when examining the average hearing threshold of the better ear (WHO, 2021), most participants in the target group had moderate HL (n=36; 49.3%). However, when classification was based on the binaural high-frequency average hearing threshold, most participants had severe HL (n=27; 37%). It was also noted that the number of participants with severe and profound HL increased, indicating that the most affected frequencies were the high-

frequency thresholds, primarily due to presbycusis. The binaural low-frequency average hearing threshold was similar to the average hearing thresholds.

Additional analyses of binaural high and low frequency average hearing thresholds with respect to gender can be found in Appendix Q.

RQ 1: How do older Maltese adults with untreated HL perceive their socio-emotional well-being?

All 93 older Maltese adults responded to the 10-ordinal categorical HHIE-S questions, with each question categorised as either emotional (E) or social (S) in impact. Older Maltese adults were asked 10 questions related to social and emotional difficulties experienced by hearing impairment individuals. The initial analysis will focus on the target group, followed by a section highlighting any differences between the target and control group.

The HHIE-S Results Among Older Maltese Adults: Target Group

Table 15 shows the mean and median scores for ten social and emotional questions, compared using the Friedman test. Questions labelled with 'S' refer to social factors, while those marked with 'E' pertain to emotional factors.

Table 15

Friedman Test: HHIE-S Questions Scored by the ***Target Group***

HHIE-S Questions **E:Emotional questions** **S:Social questions**	**Mdn**	**M**	**SD**	**95.0% Lower CL for Mean**	**95.0% Upper CL for Mean**
E1: Does a hearing problem cause you to feel embarrassed when you meet new people?	2.00	1.86	1.74	1.46	2.27
E2: Does a hearing problem cause you to feel frustrated when talking to members of your family?	2.00	1.64	1.77	1.23	2.06

S1: Do you have difficulty hearing when someone speaks in a whisper?	4.00	3.12	1.56	2.76	3.49
E3: Do you feel handicapped by a hearing problem?	0.00	1.26	1.75	.85	1.67
S2: Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbours?	0.00	1.45	1.80	1.03	1.87
S3: Does a hearing problem cause you to attend religious services less often than you would like?	0.00	.96	1.60	.59	1.33
E4: Does a hearing problem cause you to have arguments with family members?	2.00	1.53	1.68	1.14	1.93
S4:Does a hearing problem cause you difficulty when listening to TV or radio?	4.00	2.55	1.80	2.13	2.97
E5:Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	.00	1.18	1.73	.78	1.58
S5:Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	.00	1.07	1.67	.68	1.46

χ^2 (9) = 138.916, **p < .001**

As shown in Table 15 above, the mean rating score ranged from 0 to 4, with the following scale: 0 = no, 2 = moderate, and 4 = yes. A higher HHIE mean rating score indicated a greater perceived hearing difficulty and severity.

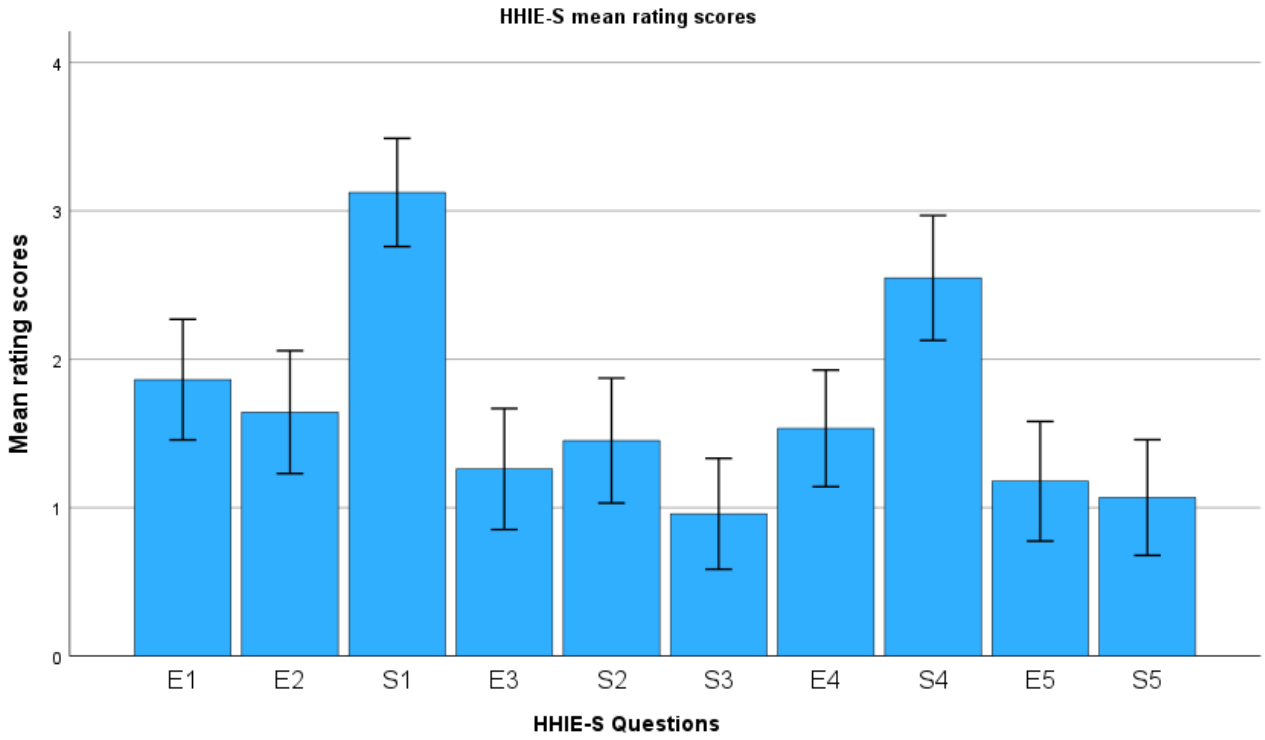
The Friedman test showed that the distribution of scores across the HHIE-S questions was statistically significant (p<.001), indicating variations in the difficulties participants experienced as illustrated in Table 15. On average, participants reported the most difficulty when someone spoke in a whisper (mean=3.12) and when listening to TV or radio (mean=2.55) In contrast, the least difficulty was reported for attending religious services (mean=0.96), suggesting that untreated HL had a relatively smaller impact on this activity compared to others.

Pairwise comparisons revealed significant differences between “S3: Attend religious services less often” and “S4: Difficulty listening to TV or radio” (p < .001), as well as between

"S3" and "S1 ($p < .001$). Significant differences were also found between "S5: Difficulty in restaurants" and both "S4" and "S1". Additional significant contrasts included questions E5, E3, S2, and E4 compared with S1 and/or S4 as well as E2 and E1 with S1. Other pairwise comparisons were not statistically significant.

Figure 2

Mean Rating Score for each Question by older Maltese Adults



The error bar graph illustrated in Figure 2 shows the 95% confidence intervals for the average HHIE scores reported by older Maltese adults. If the entire population of older Maltese adults in Malta with untreated HL were included, the variation in mean rating scores across different questions would still be statistically significant ($p < .001$).

Ventry and Weinstein (1983) also classified the total raw HHIE scores into three categories as follows:

- No hearing handicap: HHIE raw score 0-8
- Mild-to-moderate hearing handicap: HHIE raw score 10-24
- Severe hearing handicap: HHIE raw score 26-40

Hearing handicap categories based on participants' responses are presented in Table 16

Table 16

HHIE Handicap Score of the Target Group

HHIE Handicap Score			
		Frequency	**Percent**
HHIE-S: Handicap category	no hearing handicap	23	31.5%
	mild to moderate hearing handicap	32	43.8%
	severe hearing handicap	18	24.7%

Out of the 73 participants, most participants (n=32; 43.8%) experienced a mild to moderate hearing handicap, with scores ranging from 10 to 24.

RQ 3: How does untreated hearing loss affect the socio-emotional well-being and life satisfaction of older Maltese adults compared to those without hearing loss?

Untreated HL vs no HL (target vs control) group analysis for SEWB

The Mann-Whitney U test was used to compare HHIE scores of the target group with the control group.

Table 17

HHIE scores across different groups

Untreated HL vs No HL					
	Group	**N**	**M**	**SD.**	**p**
HHIE-S raw Score	Target	73	**16.52**	11.11	<.001
	Control	19	**3.89**	4.64	
HHIE-S Total emotional score	Target	73	**5.95**	5.50	<.001
	Control	19	**0.95**	1.92	
HHIE-S Total social score	Target	73	**9.15**	5.56	<.001
	Control	19	**2.53**	3.04	

The Mann Whitney U-test showed statistically significant differences between the two groups for the total HHIE-S raw score, emotional score, and social score (<.001) with the untreated HL group (target group) exhibiting higher scores compared to the no HL group (control group) as illustrated in Table 17. This suggests that individuals in the untreated HL group experience greater socio-emotional impact. The Null and Alternative hypothesis as well as hypothesis test summary can be found in Appendix R.

Table 18

Comparisons of HHIE-S Questions Between the Target and Control Group

HHIE-S Questions					
	Group	**N**	**M**	**SD**	**p**
E1: Does a hearing problem cause you to feel embarrassed when you meet new people?	Target	73	**1.86**	1.74	<.001
	Control	19	**0.32**	0.75	
E2: Does a hearing problem cause you to feel frustrated when talking to members of your family?	Target	73	**1.64**	1.78	.005
	Control	19	**0.42**	1.07	
S1:Do you have difficulty hearing when someone speaks in a whisper?	Target	73	**3.12**	1.56	<.001
	Control	19	**1.16**	1.39	
E3:Do you feel handicapped by a hearing problem?	Target	73	**1.26**	1.75	.002
	Control	19	**0.00**	0.00	

S2:Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbours?	Target	73	**1.45**	1.80	.002
	Control	19	**0.11**	0.46	
S3:Does a hearing problem cause you to attend religious services less often than you would like?	Target	73	**0.96**	1.60	.028
	Control	19	**0.11**	0.46	
E4:Does a hearing problem cause you to have arguments with family members?	Target	73	**1.53**	1.68	.009
	Control	19	**0.42**	0.84	
S4:Does a hearing problem cause you difficulty when listening to TV or radio?	Target	73	**2.55**	1.80	.001
	Control	19	**1.05**	1.39	
E5:Do you feel that any difficulty with your hearing limits or hampers your personal or social life?	Target	73	**1.18**	1.73	.028
	Control	19	**0.21**	0.63	
S5:Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?	Target	73	**1.07**	1.67	.017
	Control	19	**0.11**	0.46	

Table 18 shows that individual HHIE-S questions were also compared between the target and control groups, and a statistically significant difference was found across all questions ($p < .05$), with higher mean scores in the untreated HL group, indicating greater perceived hearing-related difficulties, particularly in SEWB.

RQ 2: How do older Maltese adults with untreated hearing loss perceive their life satisfaction?

Participants were also asked to complete the SWLS (Diener et al., 1985).

The SWLS Results Among Older Maltese Adults: Target Group

The Friedman test was used to compare the median scores across the five statements of SWLS. Older Maltese adults were presented with five statements and required to rate each one on a scale from 1 to 7, where 1 represented "strongly disagree" and 7 represented "strongly agree. A higher score indicates that they are highly satisfied with life and, hence, greater LS.

Table 19

*Friedman test: SWLS Questions Scored by the **Target Group***

SWLS statements	Mdn	M	SD	95.0 % Lower CL for Mean	95.0 % Upper CL for Mean
In most ways my life is close to my ideal	6.00	5.45	1.54	5.09	5.81
The conditions of my life are excellent	6.00	5.05	1.81	4.63	5.48
I am satisfied with my life	6.00	5.85	1.42	5.52	6.18
So far I have gotten the important things in my life	6.00	5.96	1.21	5.68	6.24
If I could live my life over, I would change almost nothing	6.00	5.07	2.09	4.58	5.56

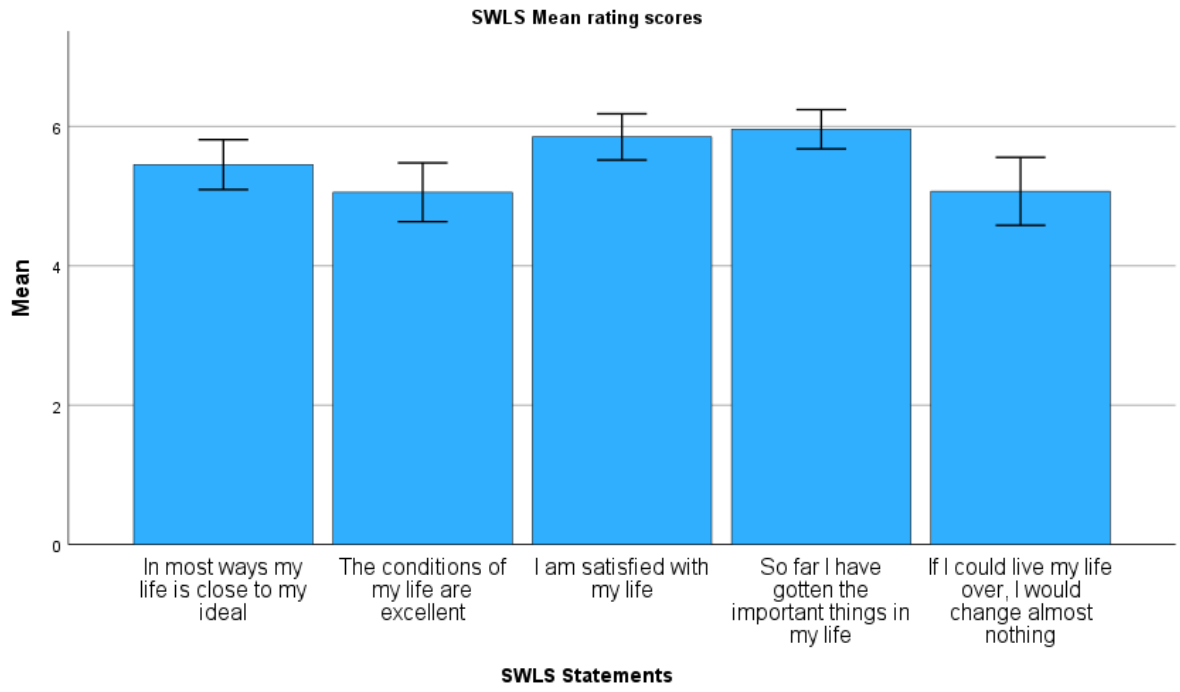
χ^2 (4) =29.776, p < .001

The Friedman test revealed statistically significant variations across the SWLS statements (p <.001) as illustrated in Table 19. On average, the statement "So far, I have gotten the important things in my life" had the highest mean score, indicating respondents feel satisfied with their life accomplishments. In contrast, the statement "The conditions of my life are excellent" had the lowest mean score, suggesting that respondents do not perceive their life conditions as excellent.

Pairwise comparisons revealed significant differences between "The conditions of my life are excellent" and "So far, I have gotten the important things in my life" (p = 0.010), as well as between "The conditions of my life are excellent" and "I am satisfied with my life" (p = .006). These differences contribute to the overall statistical significance. Other pairwise comparisons were not statistically significant.

Figure 3

Mean Rating score for each Statement by older Maltese Adults – Target Group



The error bar graph (Figure 3) illustrates the 95% confidence intervals for the average SWLS scores reported by older Maltese adults. If the entire population of older Maltese adults in Malta with untreated HL were included, the variation in mean rating scores across different statements would still be statistically significant ($p < .001$).

Moreover, SWLS were categorised based on Diener (2006) classification as follows:

- Score 5-9: Extremely dissatisfied
- Score 10-14: Dissatisfied
- Score 15-19: Slightly below average in life satisfaction
- Score 20-24: Average score
- Score 25-29: High score
- Score 30-35: Very high score; highly satisfied

SWLS scores, according to Diener's (2006) classification, are presented below (Table 20).

Table 20

SWLS Categories – Target Group

SWLS Categories	Frequency	Percent
Dissatisfied	3	4.1%
Slightly Below Average in Life Satisfaction	4	5.5%
Average Score	13	17.8%
High Score	20	27.4%
Very High Score; Highly Satisfied	33	45.2%

Table 20 show that more than two- thirds of participants were satisfied (n = 20, 27.4%) or highly satisfied (n = 33, 45.2%) with their life. In contrast, less than 10% of participants reported dissatisfaction with their life.

RQ 3: How does untreated hearing loss affect the socio-emotional well-being and life satisfaction of older Maltese adults compared to those without hearing loss?

Untreated HL vs no HL (target vs control) group analysis for LS

The Mann-Whitney U test was used to compare the SWLS scores of the target group with the control group.

Table 21

SWLS Scores Across Different Groups

Untreated HL vs No HL					
	Group	**N**	**M**	**SD**	**p**
SWLS score	Target	73	**27.48**	5.701	.492
	Control	19	**28.58**	4.776	

The Mann-Whitney U test showed no statistically significant difference between the two groups for the SWLS scores (p = .492), with both groups exhibiting similar mean scores as illustrated in Table 21. This suggests that both groups experience similar levels of life satisfaction. Null and Alternative hypothesis and a summary of the hypothesis test can be found in Appendix S.

Table 22

Comparisons of SWLS Statements Between the Target and Control Group

SWLS statements					
	Group	**N**	**M**	**SD**	**p**
In most ways my life is close to my ideal	Target	73	5.45	1.54	.870
	Control	19	5.58	1.12	
The conditions of my life are excellent	Target	73	5.05	1.81	.708
	Control	19	5.05	1.62	
I am satisfied with my life	Target	73	5.85	1.42	.322
	Control	19	**6.26**	0.93	
So far I have gotten the important things in my life	Target	73	**5.96**	1.21	.801

	Control	19	**6.11**	0.66	
If I could live my life over, I would change almost nothing	Target	73	**5.07**	2.09	.661
	Control	19	**5.53**	1.54	

Table 22 shows that no statistically significant differences were identified (p >.05), indicating similar scores across SWLS statements.

RQ 4: How do demographic variables, such as age, gender, years of education influence scores related to socio-emotional factors and LS in older adults with untreated HL?

The influence of age on scores related to SEWB – target group

The Kruskal-Wallis test was used to determine the distribution of HHIE scores across different age groups in the target group.

Table 23

Kruskal- Wallis Test: HHIE Scores Across Different Age Groups

HHIE	Age group	N	M	Mdn	SD	p
HHIE-S raw score	65-69	8	13.25	11.00	10.14	.335
	70-74	11	22.18	22.00	13.25	
	75-79	27	14.15	12.00	10.81	
	80-84	16	17.63	14.00	10.71	
	85+	11	17.45	18.00	10.16	
HHIE-S Emotional Questions Score	65-69	8	4.25	4.00	3.92	.643
	70-74	11	8.18	8.00	7.29	
	75-79	27	5.19	2.00	5.64	

	80-84	16	5.88	6.00	4.81	
	85+	11	6.91	8.00	5.08	
HHIE-S Social Questions Score	65-69	8	7.50	6.00	5.32	.296
	70-74	11	11.64	14.00	5.92	
	75-79	27	7.78	6.00	5.56	
	80-84	16	10.00	10.00	5.51	
	85+	11	10.00	10.00	5.06	

Table 23 shows that the 70-74 age group has the highest perceived hearing handicap (mean = 22.18), compared to 13.25 in the 65-69 group. A similar trend is seen in the emotional and social scores, with the 75-79 age group reporting the highest perceived handicap. However, Kruskal- Wallis test results revealed that these results are not statistically significant indicating that there is not difference in the HHIE total score (p =.335), HHIE emotional score (p =.643), and HHIE social score across different age groups (p =.296).

Analyses were also conducted using different age categories (65-74, 75-84, 85+), however, similar findings were found (Appendix T).

The influence of age on scores related to life satisfaction – target group

The Kruskal-Wallis test was also used to determine the distribution of SWLS scores across different age groups in the target group.

Table 24

Kruskal- Wallis Test: SWLS Statements Across Different Age Groups

Scale	Age group	M	Mdn	SD	p

SWLS	65-69	29.75	30.50	3.45	.163
	70-74	24.91	28.00	8.76	
	75-79	27.41	27.00	5.13	
	80-84	26.38	28.50	6.02	
	85+	30.64	31.00	3.44	

The results of the Kruskal-Wallis test revealed no statistically significant differences (p =.163) between age groups and SWLS scores, indicating that age does not affect LS (Table 24). A summary of the hypothesis test can be found in Appendix U.

The influence of gender on scores related to SEWB – target group

Table 25

Influence of Gender across HHIE scores – Target Group

Gender and HHIE scores	Gender	M	Mdn	SD	p
HHIE-S raw score	Female	14.97	12.00	10.73	.245
	Male	18.11	18.00	11.42	
HHIE-S Emotional Questions Score	Female	5.46	4.00	5.31	.081
	Male	6.44	6.00	5.72	
HHIE-S Social Questions Score	Female	8.05	8.00	5.32	.618
	Male	10.28	12.00	5.64	

Although males had a slightly higher mean HHIE-S raw score (18.11) than females, the Mann-Whitney U test showed no statistically significant differences in HHIE raw scores (p = .245), emotional scores (p =.081), or social scores (p =.618) between females and males in the target group. This suggests comparable HHIE scores for both genders with untreated HL in this study.

The influence of gender on scores related to life satisfaction

Table 26

Influence of Gender Across SWLS statements – Target Group

Gender and SWLS scores	Gender	M	Mdn	SD	p
SWLS Score	Female	26.68	29.00	5.96	.209
	Male	28.44	29.50	5.62	

Table 26 shows a slightly higher mean SWLS score in males (28.44 vs. 26.68), however, the Mann-Whitney U test revealed no statistically significant difference (p =.209) between genders. This suggests that there are no meaningful differences across groups. Hypothesis test summary can be found in Appendix V.

The influence of highest level of education on scores related to HHIE – target group

To determine whether the highest level of education obtained by older Maltese adults in the target group influences their HHIE scores, the Kruskal-Wallis test was used.

Table 27

Influence of HHIE scores with Education – Target Group

HHIE scores	Highest level of education	Mean	Mdn	SD	p

HHIE-S raw score	Primary	**16.84**	14.00	10.54	.871
	Secondary	**16.00**	14.00	12.78	
	Tertiary	**16.00**	16.00	10.58	
HHIE-S Emotional Questions Score	Primary	**5.82**	4.00	5.61	.954
	Secondary	**6.27**	6.00	5.59	
	Tertiary	**5.67**	6.00	5.13	
HHIE-S Social Questions Score	Primary	**9.69**	10.00	5.23	.444
	Secondary	**8.00**	6.00	6.26	
	Tertiary	**9.33**	10.00	5.32	

Table 27 shows a slight discrepancy between the mean and median for individuals with primary and secondary education in the HHIE emotional and social sub-scores. The mean is slightly higher for those with primary education, indicating a greater perceived hearing handicap. However, Kruskal-Wallis test results (HHIE raw scores: p =.871, emotional scores: p = .954, social scores: p =.444) revealed no statistically significant difference, suggesting that education level does not affect HHIE scores.

The influence of highest level of education on scores related to LS – target group

Table 28

Influence of SWLS Scores with Education – Target Group

SWLS	Highest level of education	M	Mdn	SD	p
Satisfaction with life score	Primary	**27.93**	29.00	6.14	.495
	Secondary	**27.50**	28.00	4.67	
	Tertiary	**24.83**	28.00	7.41	

Table 28 shows a slight discrepancy between individuals with primary and secondary education compared to those with tertiary education. Specifically, the mean (27.93) is slightly

higher for individuals with primary education, suggesting higher LS in this group. However, Kruskal-Wallis test results revealed no statistically significant difference (p = .495) between SWLS scores across different levels of education. Hypothesis test summary can be found in Appendix W.

A stepwise multiple linear regression analysis was carried out to identify a parsimonious model examining the impact of age, gender, and years of education on scores related to socio-emotional factors and LS. The results revealed no statistically significant differences (p > .05), consistent with the findings reported above. Detailed statistical results can be found in Appendix X.

RQ 5: How do hearing-related variables, including the type, unilateral/bilateral nature, and degree of untreated HL, impact scores on socio-emotional factors and LS in older adults?

The influence of the degree of untreated HL on SEWB – target group

Table 29

Degree of HL with HHIE scores – Target Group

		HHIE-S total score						
		N	**Mdn**	**M**	**SD**	**95.0% Lower CL for Mean**	**95.0% Upper CL for Mean**	**p**
Average hearing threshold level dB HL of better ear	Normal	1	26.00	**26.00**	.	.	.	.020
	Mild	9	14.00	**11.11**	9.01	4.19	18.03	
	Moderate	36	10.00	**13.50**	10.78	9.85	17.15	
	Moderately-severe	17	18.00	**20.59**	11.57	14.64	26.54	
	Severe	8	24.00	**24.25**	7.05	18.36	30.14	
	Profound	2	25.00	**25.00**	9.90	- 63.94	113.94	

Binaural high frequency average hearing threshold level dB HL	Mild	5	6.00	**11.20**	10.26	- 1.54	23.94	.00
	Moderate	7	8.00	**6.29**	5.22	1.46	11.11	
	Moderately-severe	18	14.00	**13.67**	9.73	8.83	18.51	
	Severe	27	12.00	**17.78**	11.49	13.23	22.32	
	Profound	16	24.00	**23.75**	9.52	18.68	28.82	
Binaural low frequency average hearing threshold level dB HL	Normal	1	28.00	**28.00**	.	.	.	.03
	Mild	21	8.00	**11.62**	9.58	7.26	15.98	
	Moderate	31	12.00	**15.23**	11.06	11.17	19.28	
	Moderately-severe	10	24.00	**23.40**	11.00	15.53	31.27	
	Severe	7	24.00	**22.29**	10.23	12.83	31.74	
	Profound	3	22.00	**24.00**	7.21	6.09	41.91	

When examining the impact of hearing-related variables, specifically the degree of HL determined by calculating the average hearing threshold level (dB) of the better ear on the HHIE-S raw score, as illustrated in Table 29 the highest mean score was observed in the profound HL group. Conversely, the lowest HHIE-S score, with the lowest mean distribution, was found in the mild HL group. This indicates that as HL worsens (i.e., in the profound HL group), the HHIE-S score increases, reflecting a greater hearing handicap. Similar patterns were observed when analysing both binaural high-frequency and low-frequency average hearing thresholds. However, this result could not be generalised due to the low sampling counts in the profound categories. The normal category result was not interpreted as there was only one participant in that group. Moreover, Kruskal- Wallis test revealed that results are statistically significant ($p < .05$) indicating that the degree of HL influence SEWB.

Additionally, the analysis of the type of HL, specifically whether it is SNHL, or mixed HL was conducted using Mann-Whitney U Test. Table 30 showed no statistically significant

differences in the mean distribution of the HHIE-S scores between the two types of HL (p = .705).

Table 30

Type of HL and HHIE scores – Target Group

		HHIE-S Raw Scores across type of HL				
		N	**Mdn**	**M**	**SD**	**p**
Type of HL	SNHL	55	14.00	16.80	11.21	.71
	Mixed HL	18	15.00	15.67	11.09	

The influence of the degree of untreated HL on life satisfaction – target group

Kruskal-Wallis test was used to compare mean rating scores between SWLS and HL across more than two groups(normal, mild, moderate, moderately-severe,severe and profound).

Table 31

Degree of HL and SWLS scores

		SWLS total score						
		N	**Mdn**	**M**	**SD**	**95.0% Lower CL for Mean**	**95.0% Upper CL for Mean**	**p**
Average hearing threshold level dB HL of better ear	Normal	1	31.00	31.00	.	.	.	.33
	Mild	9	30.00	30.56	3.75	27.68	33.43	
	Moderate	36	29.00	27.17	5.48	25.31	29.02	
	Moderately-severe	17	29.00	26.94	6.59	23.55	30.33	
	Severe	8	28.00	27.38	6.82	21.67	33.08	
	Profound	2	22.50	22.50	0.71	16.15	28.85	
Binaural high frequency average hearing	Mild	5	29.00	28.20	2.17	25.51	30.89	.71
	Moderate	7	30.00	27.14	6.54	21.09	33.19	

threshold level dB HL	Moderately-severe	18	28.50	28.39	5.12	25.84	30.94	
	Severe	27	30.00	27.93	5.70	25.67	30.18	
	Profound	16	26.50	25.62	6.81	22.00	29.25	
Binaural low frequency average hearing threshold level dB HL	Normal	1	24.00	24.00	.	.	.	.360
	Mild	21	30.00	28.38	6.73	25.32	31.45	
	Moderate	31	29.00	27.68	4.98	25.85	29.51	
	Moderately-severe	10	29.50	27.10	6.10	22.74	31.46	
	Severe	7	28.00	26.86	6.54	20.81	32.91	
	Profound	3	23.00	23.00	1.00	20.52	25.48	

Table 32

Type of HL and SWLS Scores

		SWLS across type of HL				
		N	**Mdn**	**M**	**SD**	**p**
Type of HL	SNHL	55	28.00	27.15	5.29	.128
	Mixed HL	18	30.50	28.50	6.89	

Table 31 shows that there is a very small difference in the mean scores between degree of HL and satisfaction with life. Kruskal-Wallis test revealed no statistically significant difference between all three average hearing threshold scores (average of the better ear, high and low frequencies) and SWLS indicating that degree of HL does not influence LS. Moreover, Mann Whitney U test revealed no statistically significant difference between the type of HL (SNHL/Mixed) and LS (p =.128) (Table 32).

A multiple linear regression analysis was carried out to identify a parsimonious model examining the impact of the type of HL and degree of HL on scores related to socio-emotional factors and LS. The results revealed no statistically significant differences ($p > .05$), consistent with the findings reported above. However, when the degree of HL was analysed alone with the HHIE scores using Kruskal-Wallis tests, the results were statistically significant. Other results remained consistent with the previous analyses. Detailed statistical results can be found in Appendix Y.

A comparison between the types of HL, specifically unilateral and bilateral HL, was also intended to be explored. However, since only one participant had unilateral Hl and the rest had bilateral HL, this comparison could not be carried out.

RQ 6: What is the relationship between socio-emotional factors and LS specifically among older Maltese adults with untreated HL?

Table 33

Relationship Between SWL and HHIE

Correlations				
			SWLS total score	**HHIE total score**
Spearman's rho	SWLS total score	Correlation Coefficient	1.000	-0.185
		Sig. (2-tailed)	.	0.118
		N	73	73
	HHIE total score	Correlation Coefficient	-0.19	1.000
		Sig. (2-tailed)	0.12	.
		N	73	73

Figure 4

Scatter plot: HHIE vs SWLS

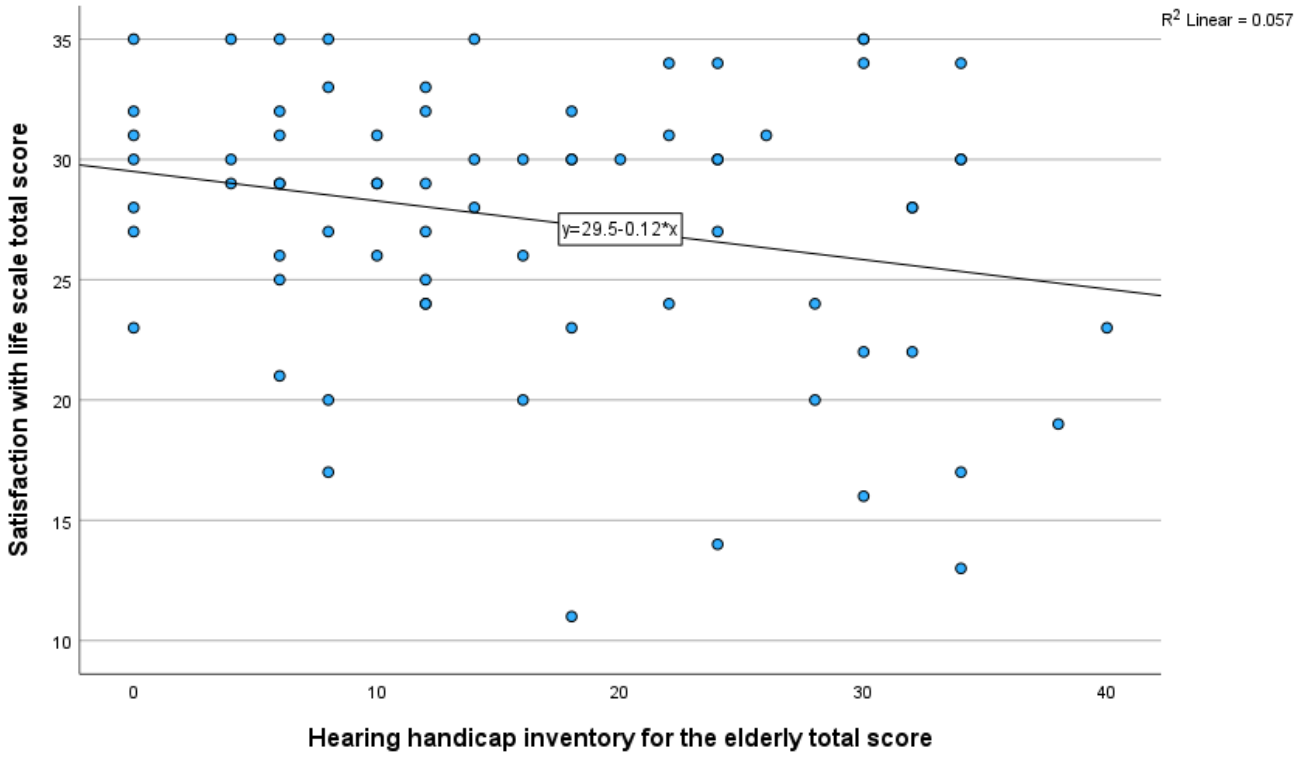


Table 33 and Figure 4 illustrates the relationship between the HHIE Total Score and the SWLS Total Score, with a fitted linear regression line having a negative slope of -0.12, represented by the equation $y = 29.5 - 0.12x$. This means that for each one-unit increase in the HHIE score (indicating a greater hearing handicap), the SWLS score (life satisfaction) decreases by 0.12 points, though the slope is shallow, indicating only a weak decline. The coefficient of determination (R^2) is 0.057, meaning only 5.7% of the variance in LS is explained by hearing handicap, with 94.3% of the variation unexplained, suggesting other factors may

affect LS. The data points are widely scattered, showing high variability in life satisfaction regardless of hearing handicap, with no clear trend or clustering.

The Spearman correlation analysis yielded a rho value of -0.19, indicating a weak negative non- statistically significant correlation between the two variables (p =.12). Therefore, there is no strong evidence to suggest a meaningful association between the HHIE scores and SWLS and no relationship between the two variables.

The next chapter will present the interpretation and discussion of the results in relation to the research questions.

Chapter 5: Discussion

Introduction

This study addresses an important research gap, as there is limited research both locally and internationally on the impact of HL, particularly untreated HL, on SEWB and LS among older adults. By focusing on the Maltese context, this study aims to provide valuable insight into this underexplored area.

Demographic characteristics of participants

Most participants were unaware of their HL, with 41 individuals (56.2%) reporting no prior recognition of their HL. This finding aligns with international research (Ftouh et al., 2018; Kockin, 2019; Wallhagen & Pettengill, 2008; WHO, 2025), which reports that older adults often delay seeking help despite clear signs of HL. One contributing factor is the widespread belief that HL is a natural part of aging, leading many to underestimate its impact and timely intervention (Barbee et al., 2018; Johnson, 2018). Additionally, societal stigma, limited public awareness, and restricted access to hearing healthcare services further discourage individuals from acknowledging or addressing their hearing difficulties (Clergy, 2024; Diener & Pavot, 2008; Timmer et al., 2024; WHO, 2025).

ARHL also tends to progress gradually, making it difficult for individuals to notice the subtle changes over time (Bowl & Dawson, 2019). This slow onset often contributes to under recognition and delayed diagnosis. In Malta, the absence of a standardised national hearing screening programme further exacerbates the issue, potentially leaving many cases undetected. Implementing regular hearing screenings for older adults could play a critical role in mitigating the negative consequences of untreated HL. Such screenings are effective in identifying

individuals at risk for undiagnosed hearing impairment, thereby enabling timely intervention (Barbee et al., 2018; Johnson, 2018).

Based on the average hearing threshold of the better ear, nearly half of the participants were found to have moderate HL (n = 36; 49.3%). However, when classified using the binaural high-frequency average hearing threshold, a greater proportion of participants were found to have severe HL (n = 27; 37%). This discrepancy reflects the fact that ARHL primarily affects the higher frequencies, a finding that is consistent with results from multiple international studies (Bowl & Dawson, 2019; Pacala et al., 2012; WHO, 2021b). This high-frequency hearing decline is largely attributed to presbycusis, a progressive, bilateral SNHL commonly associated with aging and whose prevalence increases with advancing age (WHO, 2021).

Furthermore, most participants in this study were found to have SNHL (n = 55; 75.3%). This aligns with previous research who found that SNHL is the most prevalent type of HL among older adults (Bansal et al. (2022). Bowl and Dawson (2019) also characterise ARHL as SNHL, describing it as a sensory deficit that predominantly affects the aging population.

RQ 1: How do older Maltese adults with untreated HL perceive their SEWB? AND RQ3: How does untreated HL affect the SEWB and LS of older Maltese adults compared to those without HL?

The first objective of this study was to explore how older Maltese adults with untreated HL perceive their SEWB. This focus is particularly important, as SEWB is regarded as a holistic indicator of one's overall LS (WHO, 2021). Despite its importance for healthy

aging, there is paucity of research exploring how older adults with untreated HL perceive it. This study addresses that gap through the findings discussed below.

The findings from this study indicate that older Maltese adults with untreated HL experience more socio-emotional difficulties compared to the group without HL. This was evident from the significantly higher mean score on the HHIE-S, where individuals with HL had an average score of 16.52, in contrast to a much lower mean score of 3.89 reported by those without HL. The difference between the two groups was statistically significant ($p < .001$), indicating that untreated HL in older adults is associated with a greater negative socio-emotional impact.

Despite variations in the tools and constructs used to evaluate SEWB, the findings of this study are consistent with several international studies that highlight the negative impact of HL on SEWB. For instance, Jayakody et al. (2022) used the *Social Interaction and Support Questionnaire* and the *Social and Emotional Loneliness Questionnaire* to show that untreated HL significantly increases the risk of social loneliness and depression. While the present study did not assess loneliness or depression directly, the use of the HHIE-S, which captures perceived social and emotional consequences of HL, offers indirect insight into these components, both of which are widely acknowledged as central to SEWB (Lieberz et al., 2021). The higher HHIE-S scores among participants with untreated HL in this study reflect a broader perception of hearing-related handicap, aligning with Jayakody et al.'s findings on social outcomes.

Similarly, Bennett et al. (2022) and Kiely et al. (2013) support the negative socio-emotional effects of HL. Bennett's qualitative design enabled a deeper exploration of participants' lived experiences, highlighting themes such as social overwhelm, exclusion, anxiety, fatigue, and inadequate coping strategies. In contrast, the present study, using a quantitative approach, identified a broader impact of HL as reflected by elevated HHIE-S

scores. This difference in detail likely stems from methodological variation whereby, qualitative tools offer richer, subjective accounts, while structured scales like the HHIE-S provide measurable comparisons but less depth.

Kiely et al. (2013), using a longitudinal approach, found that more severe HL correlated with increased depression, mediated by reduced activity engagement. This further supports the current study's findings, suggesting that participants with untreated HL may perceive greater handicap due to cumulative social withdrawal and reduced emotional engagement over time, factors implied through high HHIE-S scores, even if not explicitly captured. Moreover, this study has also found that individuals with profound HL exhibited the greatest socio-emotional impact, with a mean score of 23.75.

A particularly relevant comparison is Tavanai et al. (2023), who also used the HHIE-S to compare hearing aid users and non-users. Interestingly, they reported generally low scores for severe hearing handicap, with hearing aid users scoring higher than non-users. This contrasts with the present study, where participants with untreated HL reported a more significant hearing handicap. One possible explanation is that this study compared HHIE-S scores against those with typical hearing, whereas Tavanai et al. (2023) compared scores between hearing aid users and non-users. Moreover, differences in awareness and perception might explain this disparity. Individuals using hearing aids may be more aware of their limitations and dissatisfaction with hearing aid performance, leading to higher self-reported handicap. Conversely, non-users in Tavanai's study, and potentially in this study sample, participants may have developed coping strategies or underestimated their difficulties due to lack of insight or denial. Indeed, many participants in the present study were not fully aware of their HL, yet still reported high HHIE-S scores, suggesting that the negative impact is felt even if not fully recognised or acknowledged.

Overall, although different tools assess SEWB from varying perspectives, the consistency of findings across studies highlights the substantial and often underappreciated toll of HL on older adults. Regardless of the method used, untreated HL consistently emerges as a significant barrier to SEWB. Moreover, whether HL is treated or not, it continues to pose communication challenges that can lead to frustration, social withdrawal, and emotional loneliness, factors that negatively influence an individual's SEWB. These difficulties are further supported by findings from Cattan et al. (2005), Hawkley and Cacioppo (2010), Valenzuela et al. (2019), and Neal et al. (2022), who collectively highlights the link between HL with reduced social engagement, and emotional loneliness and overall SEWB.

In addition, the results of this study suggest that older Maltese adults with untreated HL are more socially affected than emotionally, as indicated by the higher HHIE-S social subscale score (mean = 9.15) compared to the emotional subscale score (mean= 5.95). This pattern aligns with findings from several international studies (Cormier et al., 2024; Davis et al., 2016; Frymark, 2023; Palmer et al., 2019; Shukla et al., 2020), which report that individuals with HL often begin by withdrawing from social situations, with emotional difficulties such as loneliness and frustration emerging later. This progression is likely due to the communicative challenges HL presents, particularly in social environments, which lead to reduced participation and, over time, emotional strain.

However, contrasting findings were found by Heffernan et al. (2016), who found that individuals with HL often experienced immediate emotional responses, such as frustration, embarrassment, and loneliness, suggesting a more direct psychological impact. Similarly, Bennett et al. (2022) noted that emotional reactions, particularly embarrassment, played a significant role in prompting social withdrawal and isolation.

The disparity in these findings may be explained by differences in hearing status. Participants in Heffernan's and Bennett's studies were primarily hearing aid users, while in the current study, participants had untreated HL. This may have led to reduced awareness of their condition, yet a greater perceived handicap potentially due to the absence of hearing support or intervention. In fact, multiple international studies highlight that hearing aids may enhance communication, social engagement, and overall SEWB, potentially moderating emotional distress that untreated individuals continue to experience (Bigelow et al., 2020; Borre et al., 2023; Choi et al., 2016; Wells et al., 2020).

For the HHIE, the most challenging situations perceived by participants in this study, were understanding someone speaking in a whisper (mean =3.12) and difficulty following the television or radio (mean =2.55). These questions are both social consequences of HL. These findings align closely with previous research by Chew and Yeak (2010), Yorgason et al. (2007), and Weinstein et al. (1983), all of which identified similar difficulties among individuals with HL. Specifically, these studies consistently reported that trouble hearing soft speech and following media content were common and disruptive aspects of daily communication for people with HL.

This similarity in findings across studies supports the reliability and relevance of the present findings in highlighting everyday social challenges experienced by individuals with untreated HL. Moreover, the comparable results may be attributed to the use of a similar self-reported assessment tool (HHIE), as well as to the fact that both this study and the others involved older adult populations who are more likely to experience ARHL and encounter similar listening challenges. These include understanding speech in both noisy and quiet environments, which require advanced auditory processing and speech discrimination, both of which are often compromised in individuals with ARHL. This is supported by Bowl and

Dawson (2019), David et al. (2016), and Stach (2010), who highlight that individuals with ARHL often experience a diminished ability to perceive and interpret speech in various auditory settings.

Chew and Yeak (2010), Yorgason et al. (2007), and Weinstein et al. (1983) reported additional socio-emotional difficulties such as frustration during family communication, social withdrawal, and challenges in group interactions. In contrast, the current study found these aspects to be less impacted, as reflected in lower mean scores (e.g., frustration with family communication mean =1.64; difficulty visiting friends or relatives mean =1.45; limitations in personal or social life mean =1.18). This difference may stem from that fact that participants in this study had untreated HL and may have developed long-term coping strategies or adapted expectations, leading to lower reported socio-emotional distress. Additionally, stigma around HL or socio-emotional expression may have led to underreporting of these challenges in the current sample.

On the other hand, the least reported difficulty was attending religious services (mean =0.96), suggesting that untreated HL had the least impact on this activity. This may be due to the strong religiosity among older Maltese adults, where religious services are an important cultural and social activity. The familiar and predictable nature of these services, along with personal motivation and usual church routine, may reduce the communicative strain for individuals with HL, making it easier for them to participate. Moreover, the routine use of microphones during church services may improve speech clarity and audibility for individuals with hearing impairment. Similarly, Huang et al. (2024) also found that hearing loss did not influence religious attendance. They highlighted that the availability of accommodations, such as amplification devices and transportation support, further facilitates participation.

The study's findings also show that most participants (n = 32; 43.8%) experienced a mild to moderate hearing handicap, as indicated by their total HHIE raw scores. This aligns

with WHO (2001), which reports that even a slight reduction in hearing can significantly impact an individual's daily life. Specifically, individuals with untreated HL may experience greater participation restrictions in social and communicative activities. This finding is consistent with those reported by Tavanai et al. (2023), who, using the same assessment instrument, the HHIE, also found that individuals with untreated HL reported a mild to moderate hearing handicap, particularly in relation to the social and emotional consequences of HL.

RQ 2: How do older Maltese adults with untreated HL perceive their satisfaction with life? AND R3: How does untreated HL affect the SEWB and LS of older Maltese adults compared to those without HL?

The present study aimed to explore LS among older Maltese adults with untreated HL, focusing on how participants rated various LS statements. In this study, findings showed that participants' ratings of LS differed significantly across the statements, indicating that perceptions vary depending on specific aspect of life. However, overall, the results suggest that LS in older Maltese adults are generally high, regardless of whether they have no hearing impairment or untreated HL.

The limited research on the perception of LS among older Maltese adults, along with the scarce international literature focusing on LS in both untreated and treated HL, makes interpretations of findings challenging. Nevertheless, plausible explanations and indications are proposed to support the interpretation of the results.

In this study, most participants (n = 33, 45.2%) were found to be highly satisfied with their life. This suggests that, despite living with untreated HL, many older adults maintain a positive overall evaluation of their life. Notably, the highest mean score (m =5.96) was for the

statement *"So far, I have gotten the important things I want in life,"* indicating that participants feel they have achieved significant personal goals and are satisfied with their life accomplishments. In contrast, the lowest mean score (mean= 5.05) was associated with the statement *"The conditions of my life are excellent,"* suggesting that, on average, participants do not perceive their overall life conditions as particularly favourable. These findings are coherent with the findings of Chen et al. (2024) and Niazi et al. (2020), who also found that many individuals with HL maintain relatively high levels of LS. However, Bourque et al. (2008) present a contrasting perspective, reporting that individuals with HL experience lower LS. One plausible explanation for this disparity in findings could be attributed to methodological differences. Bourque et al. (2008) conducted a qualitative study, capturing more in-depth negative experiences related to HL, whereas the present study employed a quantitative approach, focusing on broader perceptions.

Moreover, this study recruited individuals with untreated HL and hence, individuals with untreated HL might not be seeking hearing interventions due to their high reported LS. Nevertheless, the lower mean score related to life conditions suggests there may be underlying or unacknowledged difficulties that participants are either unaware of or have normalised as part of aging, such as challenges associated with untreated HL. This is further supported by Oyler (2012), who claims that older adults often normalise HL as part of aging.

Moreover, despite efforts to control for potential confounding variables, it remains a limitation of this study that some unmeasured factors may still be present and may have influenced participants' perceptions of the conditions of their life. For example, social support, cultural factors, and personality traits can all play a significant role in shaping an individual’s perception of their LS. Social support from family, friends, and community networks can help mitigate the emotional challenges associated with HL promoting greater social integration and emotional well-being (Heffernan et al., 2016; Yorgason et al., 2007).

Cultural factors influence how HL is viewed and managed, with different societies attributing varying levels of stigma or respect to impairments, which can affect overall LS. Additionally, personality traits, such as resilience and coping styles, can impact how individuals respond to challenges. Those with stronger adaptive coping mechanisms or a more optimistic outlook may be better equipped to maintain LS despite the difficulties posed by HL (Heffernan et al., 2016; Yorgason et al., 2007).

In addition, this study found no statistically significant difference in LS between individuals with HL and those without HL, suggesting that older adults with untreated HL perceive similar levels of LS as those without HL. One possible explanation is that a significant proportion of those with HL in this study were unaware of their condition. As a result, they may evaluate their LS without accounting for hearing-related challenges, perceiving ARHL as a natural aspect of aging. This perception could help explain why HL had minimal influence on their reported LS (Niazi, 2020). Additionally, the similarity in LS may reflect the inherently multidimensional nature of the construct. LS is shaped by a range of factors beyond hearing status, including physical health, psychological resilience, social support, and economic stability (Diener, 1984; Hansen, 2012; Shin & Johnson, 1978; Stahnke, 2022; WHO, 1995). It is therefore plausible that individuals with untreated HL draw upon these broader life domains to maintain a positive evaluation of their lives, even in the presence of hearing-related challenges.

RQ 4: How do demographic variables, such as age, years of education, and gender, influence scores related to socio-emotional factors and LS in older adults with untreated HL?

Influence of age on scores related to SEWB and LS

The research findings of this study found that although the age group 70–74 had a higher HHIE mean score (mean =22.18), particularly on the social questions, compared to the

slightly younger age group 65–69 (m =13.25), no statistically significant difference (p >.05) was found between socio-emotional difficulties in individuals with HL and the age of the participants. These findings are in line with the studies by Tavanai et al. (2023) and Mick et al. (2014). Similarities in findings between this study and these latter studies may be related to the inclusion of similar age groups (Tavanai et al. (2023) recruited participants aged 55 years and older while Mick et al. (2014) recruited older adults aged 60 years and older respectively), and used the HHIE-S as the assessment tool.

In contrast to the current study, Jayakody et al. (2022) found that advancing age among individuals with HL is associated with increased social isolation, which affects one's SEWB. The difference in findings may stem from the fact that Jayakody et al. (2022) included a broader age range, with more younger participants (40-89 years), which could have highlighted the greater influence of advancing age on SEWB.

In addition, the results of this study revealed no statistically significant difference between age and LS among older Maltese adults with untreated HL. This may be because older adults with untreated HL often develop coping mechanisms that help them maintain stable levels of LS, despite potential declines in their hearing. Moreover, Maltese older adults often live close to or with family members, receiving support that can enhance LS across different ages. Research on the impact of age on LS among individuals with HL remains limited, as further supported by Chen et al. (2024). Consequently, the findings of this study cannot be readily compared to existing literature, given the scarcity of studies that explore this specific relationship.

Influence of gender on scores related to SEWB and LS

This study found no statistically significant difference in SEWB between males and females with untreated HL, despite slightly higher HHIE scores among men (mean =18.11) compared to women (mean =14.97). These results suggest that gender did not significantly

influence the perceived socio-emotional impact of HL in this sample. International studies have reported mixed findings. For instance, Garstecki (1999), Harada et al. (2008), and Niazi (2020) found that men experienced greater socio-emotional effects, often attributed to cultural expectations that limit men's social roles post-retirement, making communication difficulties more isolating. In contrast, studies by Gopinath et al. (2009), Hallberg et al. (2008), Mick et al. (2014), and Tavanai et al. (2023) reported a stronger impact on women, often linking this to women's greater reliance on verbal communication and higher sensitivity to social disconnection. These gendered interpretations may reflect cultural, social, and psychological factors influencing how men and women perceive and respond to HL.

In the current study, the absence of significant gender differences may be due to the relatively small sample size, cultural norms within the Maltese context, or the shared experience of untreated HL across genders, which may overshadow gender-specific coping mechanisms. It is also possible that both men and women in this sample had limited awareness of their condition, thereby reducing reported differences in socio-emotional impact.

Moreover, this study found no statistically significant difference in LS between males and females with untreated HL. Both groups reported similar scores on the SWLS with men showing a slightly higher mean (mean= 28.44) compared to women (mean= 26.68), though this difference was not statistically significant. These findings align with those reported by Niazi (2020), who also found no gender-based differences in LS among individuals with HL. The consistency across studies may be explained by similarities in methodology, including the use of the same validated measure (SWLS) and balanced gender representation in the sample. It is also possible that both men and women in these studies had developed comparable coping mechanisms, allowing them to maintain similar levels of LS despite their hearing difficulties. In contrast, Bourque et al. (2008) reported that women had significantly lower LS than men.

One explanation for this difference may be the sample composition in Bourque's study which was predominated by female participants. Hence, the study was biased towards females (64% vs 36%). Additionally, socioeconomic factors such as lower income and education levels among older women may have contributed to reduced LS in that sample. These contrasting results highlight the multifaceted nature of LS and the importance of considering demographic, cultural, and contextual factors when interpreting gender differences.

Influence of highest level of education with SEWB and LS

The results of this study revealed that there was no statistically significant difference between level of education and scores related to SEWB (Primary: mean= 16.84; Secondary: mean= 16.00; Tertiary: mean= 16.00). This finding is in line with Jayakody et al. (2022) study who also found no significant association between education and SEWB. Moreover, this study also revealed no statistically significance difference between level of education and scores related to LS (Primary: m = 27.93; Secondary: m = 27.50; Tertiary: m = 24.83). However, Bourque et al. (2008) found different findings, indicating that older women with lower education reported lower LS in participants with HL.

Women are often more engaged in preventive healthcare practices, which may lower their risk of developing HL and related health issues. Education is also associated with improved access to healthcare services, earlier intervention, and stronger social support networks, all of which contribute to greater emotional resilience and LS (Cruickshanks et al., 2010). Furthermore, higher educational attainment tends to correlate with better economic resources, healthier lifestyles, and increased awareness of health risks, including those related to hearing (Hill & Needham, 2006; Albert et al., 2006). This disparity in the results may be due to the larger sample size used in Bourque et al. (2008) (n = 826) and may also be partly attributed to the cultural and historical context of the study sample, adults aged 65 and over who were born in or before 1960. In Malta, compulsory education was only introduced in

1946, and even then, many individuals, particularly women, had limited access to extended education due to socioeconomic and cultural factors (Eurydice, 2021). As a result, there is likely less variation in educational attainment among this age group. Furthermore, Malta's strong familial networks, religious values, and close communities may offer social and emotional support that compensates for lower education levels (Satariano & Curtis, 2018). These cultural conditions may help explain the contrast with findings from studies in Western contexts, such as Bourque et al. (2008) (French speaking participants), where broader educational and socioeconomic disparities are more pronounced and may exert a greater influence on LS.

RQ 5: How do hearing-related variables, including the type, unilateral/bilateral nature, and degree of untreated HL, impact scores on socio-emotional factors and LS in older adults?

The influence of hearing-related variables on SEWB and LS in older adults with HL

The influence of degree of HL on SEWB

This research study has found a statistically significant difference between the degree of HL and SEWB. The average hearing threshold of the better ear, the binaural high frequency average hearing threshold, and the binaural low frequency average hearing threshold all yielded statistically significant results (p=:.020, .004, and .029, respectively), with the profound HL group showing the highest socio-emotional impact (mean= 23.75). This finding is coherent with other international studies (Carlsson et al., 2015; Chew & Yeak, 2010; Contrera et al., 2016; Jayakody et al., 2022), which have reported that individuals with more severe degrees of HL, such as severe or profound HL, experience greater socio-

emotional difficulties. These results suggest that individuals with more severe HL may face more substantial communication barriers, leading to increased social isolation, frustration, and emotional strain.

Conversely, Niazi et al. (2020) and Most and Aviner (2009) reported different findings, with the former study finding no significant difference between the degree of HL and psychological distress namely, social isolation, and the latter study concluding that individuals with high-frequency HL do not experience significant psychological distress, respectively. This disparity in findings may stem from the smaller number of participants in the severe and profound HL groups in Niazi et al. (2020) study. However, these discrepancies in findings warrant further investigation.

The influence of degree of HL on LS

This study found no statistically significant relationship between the degree of HL and LS scores on the SWLS. This aligns with Niazi et al. (2020), who also reported no significant association between HL severity and LS. One possible explanation for this is that individuals with untreated HL in this study reported relatively high LS, suggesting they have adapted to their condition and are comfortable with their current situation. This could indicate that HL may not serve as a strong predictor of LS. Furthermore, individuals with more profound HL may have adjusted to their communication challenges over time, and support from family members who have adapted to their needs may help minimise any perceived negative impact on their overall satisfaction, as also suggested by Schneider et al. (2010).

In contrast to these findings, Caballero et al. (2010) and Dalton et al. (2003) found an association between the degree of HL and QOL. The contrasting findings between the current study and those of Caballero et al. (2010) and Dalton et al. (2003) may be explained by the different tools used to measure QOL and LS. While this study and Niazi et al. (2020) used the

SWLS, which specifically measures LS, Caballero et al. (2010) and Dalton et al. (2003) used the SF36, a tool that assesses broader aspects of QOL, including physical and mental health domains. Although LS and QOL are related, they are not identical concepts (Bien et al., 2017). LS refers to an individual's overall evaluation of their life (Hansen, 2012; Stahnke, 2022), while QOL encompasses a broader range of physical, mental, and social factors that contribute to a person's well-being (Teoli and Bhardwaj, 2023; WHO, 2012). As a result, the use of different tools may have influenced the outcomes, with the SF36 capturing more varied aspects of life that could be more sensitive to the effects of HL, while the SWLS focuses more on subjective LS which might not directly correlate with HL severity in the same way.

The influence of type of HL on SEWB and LS

This research study revealed that most participants had SNHL (75.3%), with the remaining having mixed HL (24.7%). This aligns with Bansal et al. (2022) study, who reported that SNHL is more common in older adults.

To the researcher's knowledge, there is limited research on the influence of the type of HL (CHL, SNHL, or mixed HL) on SEWB and LS, making meaningful comparisons challenging in this study. The findings indicated that the type of HL did not significantly influence scores related to SEWB or LS. Individuals with both SNHL and mixed HL may have developed coping mechanisms or adjustments that mitigate the impact of HL on their daily life and overall satisfaction, particularly in cases of untreated HL where participants may be unaware of their condition.

While the difference between unilateral and bilateral HL was initially intended to be explored, the limited number of participants with unilateral HL prevented any meaningful comparisons between these groups. However, examining the type of HL in relation to SEWB and LS remains relevant. Existing literature suggests that the impact of HL on QOL varies significantly based on its type and severity. Chia et al. (2007) found that bilateral HL,

especially severe forms, is associated with lower scores in both physical and mental health domains, due to greater communication barriers and social isolation. This aligns with Iwasaki et al. (2013), who noted that while bilateral SNHL presents significant challenges, unilateral SNHL also contributes to hearing handicap. In contrast, unilateral HL seems to have a less severe effect on social interactions and QOL. However, Tavanai et al. (2023) reported no significant difference in hearing handicap scores between unilateral and bilateral hearing aid users, suggesting that interventions, such as hearing aids, may help mitigate the impact of unilateral HL.

Additionally, Tambs (2004) found that the type and severity of HL can also have a significant impact on mental health, with individuals experiencing low-frequency or high-frequency HL showing worse mental health outcomes. For each 10 dB increase in HL, there was a corresponding decline in mental health ratings, with younger populations being more affected. This suggests that the type and severity of HL, particularly in younger individuals, can significantly disrupt social, professional, and familial interactions, contributing to emotional distress. However, older adults may have adapted to HL over time, developing coping strategies and resilience.

Overall, while interventions can improve hearing-specific domains, their effect on overall QOL may be limited, particularly for individuals with bilateral SNHL, which likely has a more profound and long-term impact on SEWB and LS compared to unilateral HL.

RQ 6: What is the relationship between socio-emotional factors and LS specifically among older Maltese adults with untreated HL?

Despite several international studies reporting an association between SEWB and LS, with positive SEWB being linked to higher LS (Dejonckheere et al., 2022; Ford et al., 2018; Fredrickson, 2001; Lombardo et al., 2018), this study revealed no statistically significant

relationship between SEWB and LS. Although this study identified a weak negative association between HHIE scores and SWLS, where each increase in the HHIE score was accompanied by a slight decrease in LS, this relationship was not statistically significant. In contrast to this research study findings, Niazi et al. (2020) found a significant relationship between the two, with psychological distress (SEWB) significantly predicting subjective well-being (LS).

The disparity in findings could be attributed to the fact that both LS and SEWB encompass multiple dimensions of QOL, which means the relationship between these components and the factors under study may not be linear. Factors such as social support, physical health, and emotional resilience can interact in complex ways, influencing individuals' life satisfaction and socio-emotional well-being (Lombardo et al., 2018; WHO, 2022). Additionally, both LS and SEWB are dynamic and prone to fluctuations over time. These fluctuations may be influenced by changing life circumstances, evolving coping strategies, or interventions such as hearing aids or social support networks. For instance, while HL may have an immediate negative impact on SEWB, over time, individuals may adjust or develop strategies that mitigate the effect. Similarly, external factors like changes in health status, family dynamics, or environmental factors can affect life satisfaction and emotional well-being. Hence, the findings of this study may vary across different time points, regardless of hearing status, as the interactions between the various dimensions of QOL are subject to ongoing change and adaptation (Lombardo et al., 2018).

Strengths and Limitations

A notable strength of this study is that, to the researcher’s knowledge, it is the first to explore, both locally and internationally, the impact of untreated HL on SEWB and LS, while also comparing it to a control group of individuals without HL. Research in this area is relatively sparse, which is also acknowledged by other international studies (Brodie et al.,

2018; Contrera et al., 2016; Nordvik et al., 2018). Additionally, the use of hearing screening helped to identify untreated HL which could potentially mitigate the negative effects discussed in this study. Furthermore, the study followed a rigorous methodology, incorporating test-retest reliability, inter-rater reliability, and a pilot study. These measures were crucial in ensuring the consistency and accuracy of the data, ultimately strengthening the robustness of the study's findings

However, while this quantitative study provided valuable insights on the topic, several limitations should be acknowledged. Due to the limited sample size, the results may not be representative of the entire local population. Furthermore, the convenience sampling method used, although simple and efficient, introduces potential bias and limits the generalisability of the results. As such, the findings cannot be applied broadly to other populations. Moreover, despite efforts to control for confounding variables, unmeasured factors may still have influenced participants' perceptions of their SEWB and LS. Moreover, given the time-frame for recruitment and analysis, a mixed method approach was not conduced however, this may have provided additional insight.

A larger number of participants with unilateral HL would have provided meaningful insights and allowed for comparisons with other international studies. However, this was beyond the researcher's control and, as research has shown, unilateral HL is less common in older adults compared to bilateral ARHL (Bowl & Dawson, 2019). While a control group was included, an additional control group consisting of hearing aid users would have allowed for further comparisons and enriched the study.

The control and target groups were included to explore potential similarities or differences between individuals with untreated HL and those without HL. However, due to the variations between the two groups, any observed associations should be interpreted with caution. While the primary emphasis of this study was on the target group, the control group

was included to explore the validity of the findings. These results are preliminary, and should be interpreted with caution. Future research could benefit from a larger control group to investigate this area more thoroughly.

Another limitation of the present study relates to the testing environment. Audiometric assessments were conducted in a quiet, untreated room rather than in a fully sound-treated booth. Although this room is currently used as an audiology clinic space for assessing hearing in older adults, it does not provide the same level of acoustic isolation as a standard sound-treated booth. To minimize the impact of environmental noise, the researcher ensured that testing was performed with the door closed, the air conditioning turned off, and ambient noise levels monitored using a NIOSH-validated sound level meter application. Importantly, all participants were tested in the same environment, ensuring consistency across the sample. While pure-tone thresholds obtained in this setting may be slightly elevated compared to those recorded in a fully sound-treated booth, relative comparisons between participants are unlikely to be significantly affected, since they were all tested in the same environment and any increase in thresholds would similarly impact everyone. Nonetheless, the use of a fully sound-treated environment is recommended for future research to eliminate any potential confounding effects of ambient noise and to ensure the highest accuracy in threshold measurements.

Finally, despite reviewing available literature from various databases, research specifically addressing the impact of untreated HL on SEWB and LS was limited (Brodie et al., 2018; Contrera et al., 2016; Nordvik et al., 2018).

Implications of the findings for:

Life Participation

The findings of this study underscore the importance of addressing untreated HL in older adults, as it can significantly affect their participation in daily activities and overall life engagement. A substantial proportion of participants (49.3%) were unaware of their HL which

may have contributed to their relatively high LS, as they might not have recognised the limitations associated with the condition. Nonetheless, HL may not necessarily be a strong predictor of LS among older Maltese adults. Despite this, untreated HL can still affect communication, social interactions, and involvement in various life activities, leading to potential isolation and reduced engagement. This shows the critical need for regular hearing screenings to identify those with undiagnosed HL and provide them with the necessary support to maintain active participation in social, professional, and recreational activities. Raising awareness about HL and its potential impact on life participation is crucial for encouraging individuals to seek appropriate interventions and maintain a fulfilling life.

Clinical Practice

Given that SEWB is often impacted by untreated HL, and that this, in turn, may affect the participation component of the ICF framework (WHO, 2001), it is important to assess SEWB more regularly in clinical practice, both before and after hearing intervention e.g. hearing aid fitting. Doing so may highlight the broader benefits of amplification, not only in reducing impairment and improving activity but also in enhancing overall participation.

Policy makers

Given that a significant number of participants were unaware of their HL, the findings highlight the need for routine hearing screenings in healthcare for older adults. Early identification is essential, as untreated HL was associated with decreased SEWB in this study. Although LS was not directly affected by HL in this sample, a decline in SEWB can influence broader aspects of well-being, potentially leading to long-term impacts on LS. This highlights the importance of addressing hearing health, as untreated HL may have wider implications for mental and emotional health as shown in the literature. Policymakers should consider these outcomes when developing strategies to promote healthy aging and integrate hearing health into public health initiatives.

Chapter 6: Conclusion

In summary, this study provides important insight into the SEWB and LS impact of untreated HL among older Maltese adults. The findings indicate that individuals with untreated HL perceive their SEWB as significantly poorer compared to those with typical hearing. Interestingly, however, no statistically significant difference was observed in life satisfaction between the two groups, with the target group reporting high levels of satisfaction. These findings suggest that individuals may experience emotional and social challenges without necessarily perceiving a decline in overall LS. This may be partially attributed to a lack of awareness regarding their HL, as most participants were not previously aware of their HL prior to hearing screening. Consequently, their perception of LS may remain unaffected until the condition progresses and its negative impact becomes more apparent, or it may be that HL is not a relevant factor or predictor of LS in older Maltese adults.

Given that most participants were unaware of their HL, routine hearing screenings for older adults are important, not only to detect HL early but also to mitigate its negative effects on SEWB, as extensively reported in the literature. Although participants reported relatively high LS, this should not diminish the importance of addressing the subtle yet meaningful socio-emotional challenges associated with undiagnosed and untreated HL. This research adds to the increasing evidence supporting the need for a more proactive public health strategy regarding hearing care in older populations.

Recommendations

Future research could benefit from adopting a mixed-methods research design, integrating both qualitative and quantitative methods to gain a more comprehensive understanding of the impact of HL. This would allow for a deeper exploration of how untreated HL affects SEWB and overall LS.

Moreover, there is a need for more studies that explore how different types of HL such as unilateral, bilateral, and varying severities affect LS and SEWB over time. Additionally, examining the effectiveness of early interventions, such as hearing aids and hearing rehabilitation programs, could provide valuable insights into improving outcomes for those with HL, not only at an impairment and activity levels but also in enhancing participation.

Additionally, exploring the long-term effects of untreated HL through longitudinal research could provide valuable insights into how HL gradually influences social and emotional well-being. Tracking these changes over time would help in employing more effective interventions tailored to individuals at different stages of HL.

Future studies could also investigate the role of socio-economic factors, such as income and access to healthcare, in both the onset of HL and its socio-emotional effects. Moreover, local research could further explore the impact of untreated HL on cognitive function, particularly its potential links to memory decline, attention deficits, and overall cognitive health.

Understanding why some individuals with HL do not seek help is another critical area to explore. Conducting interviews or using other qualitative methods could uncover barriers such as stigma, lack of awareness, or difficulties in accessing hearing care services. Identifying these challenges would be essential in developing targeted support systems and encouraging those in need to seek timely intervention.

Furthermore, future research should aim to include a larger and more diverse sample, incorporating individuals from different age groups, geographic regions across Malta and Gozo, and various cultural backgrounds. This would provide a more accurate representation of the local population and ensure that findings are applicable to a wider range of individuals affected by HL.

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Appendix A

The Peripheral and Central Auditory System

Peripheral Auditory system

The human ear is anatomically divided into three distinct regions as follows:

1. The outer ear comprises the auricle / pinna and external auditory canal – collects sound waves from the environment and directs them through the auditory canal and then towards the ear drum / tympanic membrane (Sánchez López de Nava & Lasrado, 2023).

2. The middle ear – begins at the tympanic membrane and vibrates when there are incoming sound waves. Vibrations travel through the three ossicles (malleus, incus and stapes: located in the air-filled tympanic cavity). Then, the stapes, delivers the vibrations to the oval window, which is an opening leading to the inner ear (Sánchez López de Nava & Lasrado, 2023).

3. The inner ear - contains the cochlea containing hair cells. As the stapes transfers mechanical vibrations into the cochlear fluids, these vibrations generate waves that displace the hair cells, which in turn convert the mechanical energy into electrical impulses. These impulses are transmitted via the auditory nerve to the auditory cortex of the brain, where they are interpreted as sound. In addition to auditory function, the inner ear also contributes to the maintenance of balance and spatial orientation through its vestibular components, highlighting its significance in both hearing and equilibrium (Sánchez López de Nava & Lasrado, 2023).

Central Auditory Structures

Sensory information from the receptors located in the organ of Corti within the inner ear is transmitted to the central nervous system through the vestibulocochlear nerve (Davies & Sugano, 2020). From there, signals are relayed to the superior olivary nucleus, where sound localisation occurs by comparing timing and intensity differences between ears. The signal then moves to the inferior colliculus, which integrates auditory input, followed by the medial geniculate nucleus, where further processing happens before the signal reaches the auditory cortex for sound recognition and comprehension (Shahid, 2023).

Appendix B

Other causes of HL

Genetic mutations

Genetic mutations represent a potential underlying cause of HL. Approximately thirty genes have been associated with HL. These mutations typically impair the function of the sensory hair cells within the cochlea, resulting in the gradual deterioration of hearing ability (Griffith et al., 2017).

Noise exposure

NIHL is another potential cause of hearing impairment. It occurs due to exposure to harmful noise levels, which is common in workplaces like factories or military settings. However, it can also affect individuals outside such environments through exposure to loud noises, such as at concerts, listening to music at high volumes, shooting, or other activities involving excessive sound levels (Cunningham and Tucci, 2019).

NIHL may present as either a temporary or permanent condition. However, consistent or prolonged exposure to high-intensity noise often results in irreversible damage, primarily due to the degeneration of sensory hair cells in the cochlea (Kujawa & Liberman, 2006).

Emerging research has demonstrated that, beyond direct hair cell loss, noise exposure can also disrupt the synaptic connections between hair cells and auditory nerve fibers. Notably, such synaptic damage can occur even in the absence of significant hair cell degeneration, indicating that lasting hearing impairment may arise solely from these neural disruptions (Liberman & Kujawa, 2017).

The development of NIHL involves a complex interaction of biological mechanisms. Among these, oxidative stress, inflammatory processes, and immune system activation play central roles. Intense noise exposure induces vasoconstriction in the cochlear vasculature, which limits blood flow to the inner ear. Upon cessation of the noise, reperfusion leads to the generation of reactive oxygen species (ROS), contributing to further cochlear injury (Schaette & McAlpine, 2011). These findings shows that NIHL is not solely the result of hair cell loss but rather a multifactorial condition shaped by a range of physiological responses to acoustic trauma (Basner et al., 2014).

Ototoxicity

Ototoxicity occurs when certain medications negatively impact the auditory system. Some known ototoxic medications include aminoglycoside antibiotics, chemotherapeutic agents like cisplatin, and certain blood pressure medications. These substances can be toxic to sensory hair cells, potentially leading to sensorineural HL (Wang et al., 2023).

Appendix C

Other consequences of HL

HL and cognitive decline

Livingston et al. (2017; 2020) found that untreated HL, is linked to cognitive decline, one that could potentially be addressed. Although the connection between HL and cognitive decline is well established, researchers still aren't sure exactly how or why the two are related. Various theories have been suggested, each pointing to different possible benefits of treating HL.

One theory, known as the cognitive load theory, posits that individuals with hearing impairment has to put additional effort to interpret speech, leading to chronic cognitive strain that affects attention and memory. According to this theory, such cognitive strain might be mitigated with appropriate hearing treatments (Pichora et al., 2016).

Another theory, the cascade hypothesis, suggests that auditory deprivation from HL, combined with social isolation, leads to changes in the structure of the brain. These changes may negatively impact cognitive function (Powell et al., 2021; Uchida et al., 2019).

Wei et al. (2017) conducted a meta-analysis of cohort studies to examine the relationship between HL and the risk of mild cognitive impairment [MCI] and dementia. Using random-effects models, they analysed data from 15,521 participants with follow-up periods ranging from 2 to 16.8 years. Their findings revealed a significant correlation between HL and elevated risks for MCI (RR = 1.30) and dementia (RR = 2.39).

Similarly, Yu et al. (2024) reviewed 50 cohort studies with over 1.5 million participants, analysing dose-response effects and dementia subtypes. They found HL to be associated with a significantly higher risk of dementia (HR = 1.35), MCI (HR = 1.29),

Alzheimer's disease (HR = 1.56), but not vascular dementia. They also determined that every 10-decibel reduction in hearing increased dementia risk by 16%.

Heywood et al. (2017) used a cross-sectional and longitudinal analysis with 2,599 participants aged 55+ to investigate the impact of HL on MCI and dementia. HL was identified via a whispered voice test, and cognitive decline was measured with various assessments. The study found HL linked to higher dementia prevalence but did not show a significant association with MCI alone. Additionally, cognitively normal individuals with HL at baseline were more likely to develop MCI or dementia over time.

Further supporting these findings, Loughrey et al. (2018) carried out a meta-analysis using PTA to measure HL. They found a weak but significant association between HL and cognitive impairment. Similarly, Lin et al. (2011) recruited 639 participants over 10 years, finding that initial HL levels were linked to an increased risk of developing Alzheimer's disease (63% of cases).

Gallacher et al. (2012) examined dementia subtypes and HL severity using PTA. Their study found that 51% of dementia cases were non-vascular, with Alzheimer's being the most common. Livingston et al. (2017) pooled data from multiple studies and found a relative risk of 1.94 for dementia linked to HL, even after adjusting for other factors.

The studies in question used different methodologies to assess the association between HL and cognitive decline. Wei et al. (2017), Yu et al. (2024), and Loughrey et al. (2018) used meta-analyses, synthesising data from multiple cohort studies to provide robust statistical estimates. Their strength lies in the use of large sample sizes and the ability to generalize findings across diverse populations. In contrast, Heywood et al. (2017) used both cross-sectional and longitudinal analyses, which allowed them to explore not only the association

between HL and dementia prevalence but also the potential for HL to predict the development of dementia over time.

Lin et al. (2011) and Gallacher et al. (2012) used longitudinal studies that followed participants over time, which helped shed light on the potential causal link between HL and dementia. Notably, Lin et al. (2011) accounted for several confounding factors such as age, gender, and existing health issues, which strengthened the reliability of their findings.

PTA was the preferred method for assessing HL in Loughrey et al. (2018), Lin et al. (2011), and Gallacher et al. (2012) studies. PTA is considered the gold standard for hearing assessments and provides more accurate, objective measurements of HL compared to other methods, such as the whispered voice test used by Heywood et al. (2017). The latter's use of a simpler hearing test might explain some of the discrepancies in the findings related to MCI and dementia. Furthermore, the cognitive assessments varied across studies, with some carrying out more detailed diagnostic tools like the Mini-Mental State Examination or the Alzheimer's Disease Assessment Scale, while others relied on broader categorisations of cognitive impairment.

HL and economic challenges

Comparing the economic impact of HL between the United States and Europe, including Malta, highlights the considerable financial strain it places on societies. In the U.S., HL in adults 65 and older was projected to cost around $9.5 billion in 2002, with the potential to rise to approximately $60 billion by 2030 due to an aging population (Stucky et al., 2010). In the EU, untreated HL costs about €185 billion annually, driven by reduced quality of life and productivity losses, particularly affecting employment for those with significant hearing impairments. This economic burden is projected to increase with the aging population and

prolonged life expectancy across Europe, including Malta (European Hearing Instrument Manufacturers Association [EHIMA], 2019). Additionally, the high cost of quality digital hearing aids places a financial strain on both individuals with ARHL and society (Donahue et al., 2010).

In Malta specifically, though there isn't an exact local economic estimate, the prevalence and effects of HL align with EU findings, suggesting substantial costs associated with healthcare needs, unemployment, and quality-of-life impacts on individuals with hearing impairments.

Appendix D

Hearing screening

Hearing screenings for older adults can be conducted in primary healthcare centres, clinics, or even at home, with a quiet, private environment ensuring accurate results and comfort (ASHA, n.d.; WHO, 2021). Several methods are available for screening: the Pure-Tone Detection test evaluates both ears separately at 1000 Hz, 2000 Hz, and 4000 Hz at 35 dB HL, with failure to respond indicating the need for further assessment (WHO, 2021). The Digit Triplet-in-Noise Test uses the hearWHO tool to assess both ears simultaneously, with a score below 50 suggesting hearing difficulty (WHO, 2021). Air Conduction Thresholds are typically conducted in an audiology clinic using pure-tone audiometry at 0.5 kHz, 1 kHz, 2 kHz, and 4 kHz to measure hearing sensitivity; results below 35 dB HL indicate the need for further evaluation (ASHA, n.d.; WHO, 2021). The Whispered Voice Test is used as a last resort when other methods are unavailable (WHO, 2021).

When conducting any of the tests mentioned above, it is instrumental that background noise levels is kept below 40 dBA. A sound level meter or a validated smartphone application can be used to confirm this. This is required for accurate testing results, as higher noise levels can interfere with the assessment of hearing ability (WHO, 2021).

After the hearing screening is carried out, individuals who receive a "refer" (thresholds below 35dB) may undergo specific follow-up actions as follows (WHO, 2021):

1. A red flag questionnaire can be carried out

2. Ear examination using an otoscope to check for wax impaction. If necessary, the wax should be removed by an ENT doctor.

3. After wax removal, a repeat hearing screening should be conducted.

If a subsequent "refer" result is still indicated, diagnostic testing should be carried out using PTA and tympanometry to assess middle ear function. Referral to an ENT for further evaluation may be required, regardless of their screening results (ASHA, n.d; WHO, 2021).

Appendix E

International hearing screening guidelines and recommendations

In 2021, the U.S. Preventive Services Task Force [USPSTF] conducted an updated assessment of the existing evidence regarding the benefits and potential harms of hearing screening in older adults, revisiting and expanding upon the findings of its 2012 review. The review determined that current evidence remains insufficient to recommend routine hearing screenings, as few studies clearly demonstrated the benefits of hearing interventions, and findings could not be reliably applied to the broader population. Additionally, limited research is available to support that screening enhances hearing function and quality of life in individuals who have not exhibited signs of HL. However, the review did indicate that several screening methods are effective in accurately identifying HL among older adults (US Preventive Services Task Force, 2021; Reed & Oh, 2021).

According to the UK National Screening Committee (2021), the evidence summary on HL screening for adults in the UK concludes that there is insufficient evidence to justify a nationwide screening program. The studies reviewed showed inconsistent results regarding the effectiveness of various screening methods, with significant methodological limitations such as biases in participant selection and issues in the comparability of measurement tools. Despite the existence of effective interventions, the review found no clear benefits to early screening compared to later treatment in improving health outcomes. Therefore, further robust, UK-specific research is needed before implementing any national screening program.

In contrast, the American Geriatrics Society (2018) recommends that all individuals aged 65 and older be screened for HL. This guideline is also being adhered to by the Centers for Medicare & Medicaid Services (2021), which now mandates healthcare providers to assess hearing difficulties annually. Screening can be as simple as asking patients about any

hearing difficulties. Furthermore, the ASHA (n.d) recommends that adults undergo hearing evaluations by an audiologist every ten years, with the frequency increasing to every three years starting at age 50, particularly for individuals with known risk factors or specific exposures. The American Geriatrics Society supports routine screening for older adults, citing the reliability and efficiency of self-reported assessments, which have proven effective in identifying hearing impairments (Dang & Hsu, 2023; American Geriatrics Society, 2018; Centers for Medicare & Medicaid Services, 2021).

One of the main challenges in expanding HL screening programs for older adults is the lack of strong evidence supporting systematic screening. Because of this, WHO (2021) has developed guidelines to help countries design, carry out, and assess their own hearing screening efforts using the best available evidence. Similar guidance is also provided by ASHA (2023) and the International Association of Communication Sciences and Disorders.

Appendix F

Treated vs untreated HL

Borre et al. (2023) found that addressing HL can lead to notable improvements in an individual's quality of life. Their research highlights that for adults experiencing mild to moderate HL, the use of hearing aids offers significant benefits, particularly in enhancing overall wellbeing and daily functioning. Hearing aids not only help with communication and social interactions but also contribute to mental health by mitigating the risk of social isolation, cognitive difficulties and depression.

Kochkin and Rogin (2000) conducted a survey of nearly 4,000 adults with HL and their significant others, revealing that those who did not use hearing aids experienced significantly higher levels of depression, anxiety, and other social and emotional difficulties. The study also found that the use of hearing aids led to substantial improvements in QOL, not only for individuals with hearing loss but also for their close companions. These findings align with a large randomised controlled trial by Mulrow et al. (1990), which demonstrated that untreated HL was associated with declines in social, emotional, communication, and cognitive functioning, as well as heightened depression. Importantly, these issues improved notably when participants were provided with hearing aids.

Despite the clear benefits of hearing aids such as improved communication, enhanced social interactions, and better overall QOL, the uptake rate among older adults remains low. Humes (2023) analysed data from the 2012 National Health and Nutrition Examination Survey and found that only 14.2% of adults with hearing impairment reported using hearing aids.

This low usage is attributed to several factors, including cost, stigma, doubts about their effectiveness, ongoing expenses for batteries and maintenance, and concerns about appearance. Even in countries with government subsidies, many individuals still do not use hearing aids. For example, in Finland, only 15% of eligible individuals use them, while the rate in Denmark is 50% (Chien et al., 2012). This may be attributed to cultural difference as well as the stigma association with wearing hearing aids. It was also found that fewer than 4% of older adults with mild HL use hearing aids. However, the prevalence of hearing aid use tends to increase with age in those experiencing moderate or more severe HL (Chien et al., 2012; Ropper, Cunningham, & Tucci, 2017).

Appendix G

Information Letter

L-Università ta' Malta

Participants` Information Sheet

Dear Participant,

My name is Raisa Borg and I am currently reading for a Master of Science in Audiology at the University of Malta. As part of my course requirements I am conducting a research study entitled, **"the impact of untreated hearing loss on socio-emotional wellbeing and life satisfaction in older Maltese adults"** under the supervision of Dr Ritienne Grima and co-supervisor Mr Pasquale Balzan. The aim of this study is to investigate how untreated hearing loss affects different facets of well-being in older Maltese adults. Your participation in this study would help us gain a better understanding of how untreated hearing loss may affect one's socio-emotional and life satisfaction in older Maltese adults. Furthermore, all data collected from this research shall be used solely for the purpose of this study.

During your visit t[redacted] related services, you are being invited to participate in a study which will investigate the impact of untreated hearing loss on socio-emotional factors and life satisfaction in older Maltese adults. If you agree to participate, you will meet the researcher once, at[redacted] a time most suitable for you as much as possible, for approximately 45 minutes. The subjects need to be permanent Maltese residents aged 65 years and older not institutionalized. The target group should include older adults with untreated hearing loss, while the control group should consist of typical older adults with no hearing loss. Participants should be able to communicate effectively and have no major difficulties in cognition.

During the visit I, as the researcher will:

1. **Ask some demographic and health-related questions**
2. **Conduct a quick test to screen cognition**
3. **Examine your outer and middle ear using otoscopy**
4. **Conduct a hearing screening assessment. Different tones of varying frequencies and intensities will be presented. Each ear assessed independently at four frequencies (500Hz, 1000Hz, 2000Hz and 4000Hz). You are required to press a button, when you hear the tone.**
5. **If a hearing loss is identified, a comprehensive hearing assessment will be carried out by measuring all frequencies. These tests will be administered under the supervision of** [redacted].

6. **Ask questions related to socio-emotional factors and life satisfaction. For the former, you be asked 10 questions for which, you will respond with either 'yes', 'no' or 'sometimes'. For the latter, you will be asked five statements, indicating your level of agreement on a 7-point scale ranging from strongly agree (7) to strongly disagree.**

You are not obliged to participate in this study or to answer all the questions and you may withdraw from the study at any time without giving a reason. Furthermore, withdrawal from the study will not have any negative repercussions on you. Should you choose to withdraw, any data collected will be erased as long as this is technically possible (for example, before it is anonymised or published), unless erasure of data would render impossible or seriously impair achievement of the research objectives, in which case it shall be retained in an anonymised form. I can assure you that confidentiality will be maintained throughout the study and that your identity and personal information will not be revealed in any publications, reports or presentations arising from this research. All data collected will be pseudonymised meaning that the data will be assigned codes and that this data will be stored securely and separately from any codes and personal data.

This data may only be accessed by the researcher. The academic supervisor/s and the examiners will typically have access to coded data only. There may be exceptional circumstances which allow the supervisor and examiners to have access to personal data too, for verification purposes. The consent forms and personal data will be stored on the researcher`s personal computer that is password protected and in an encrypted format. Identifiable data will be encrypted and stored offline on an external hard drive or flash drive, or a secure UM server (not the UM Google Drive). Any material in hard-copy form will be placed in a locked cupboard.

In the event that you feel distressed due to participation in this study the service of a healthcare professional, **Richmond Foundation can be contacted on their helpline 1**[redacted]y will be available at no financial cost on your part.

Participation in this study is completely voluntary and you are free to accept or refuse to take part without giving a reason. A copy of the information sheet and consent form will be provided for future reference. As a participant, you have the right, under the General Data Protection Regulation (GDPR) and national legislation that implements and further specifies the relevant provisions of said regulation, to access, rectify and where applicable ask for the data concerning you to be erased. Personally identifiable data will be deleted when it is no longer necessary, which should be July 2025. Any subsequent anonymised data may be kept indefinitely.

This study has been approved by the Research Ethics Committee of the Faculty of Health Sciences at the University of Malta.

Thank you for your time and consideration. Should you have any questions or concerns do not hesitate to contact me on **+356** [redacted] by e-mail [redacted] or my supervisor **Dr Ritienne Grima** on [redacted] and office contact number on **+356** [redacted]

Yours Sincerely,

[redacted]

[redacted]

Raisa Borg

[redacted]

Researcher

Dr Ritienne Grima

[redacted]

Main Research Supervisor

Appendix H

Consent Form

Participants` Consent Form

I, the undersigned, give my consent to take part in the study conducted by Raisa Borg. The purpose of this document is to specify the terms of my participation in this research study.

1. I have been given written and verbal information about the purpose of the study and all questions have been answered.
2. I understand that I have been invited to participate in the study by Raisa Borg.
3. I am aware that the meeting will take approximately 1 hour. I understand that the meeting is to be conducted at the place indicated in the information letter and at a time most suitable for me as much as possible.
4. I am aware that my responses and data will be written on the prepared forms.
5. I am aware that the data collected will be coded and that this data will be stored securely and separately from any codes and personal data.
6. I am aware that the researcher is the only person who has access to this data. The academic supervisor/s and examiners will typically have access to coded data only. There may be exceptional circumstances which allow the supervisor and examiners to have access to personal data too, for verification purposes.
7. I am also aware that any material in hard-copy form will be placed in a locked cupboard and kept until results are published.
8. I am aware that my identity and personal information will not be revealed in any publications, reports or presentations arising from this research.
9. I also understand that I am free to accept, refuse or stop participation at any time without giving any reason. This will have no negative repercussions on myself, and that any data collected form me will be erased. Data will be stored anonymously if it is impossible to delete (e.g., if it has already been anonymised).
10. Participation in this research study might evoke certain feelings. Hence, if I feel distressed as a result of participation in this study, **Richmond Foundation** will be available to provide a service at no financial costs on my part.
11. I understand that under the General Data Protection Regulation (GDPR) and national legislation that implements and further specifies the relevant provisions of said regulation,

I have the right to access, rectify, and where applicable ask for the data concerning me to be erased.

12. I also understand that personally identifiable data will be deleted when it is no longer necessary, which should be **around July 2025.** Any subsequent anonymised data may be kept indefinitely.
13. I will be provided with a copy of the information letter and consent form for future reference.
14. I have read and understood the points and statements of this form. I have had all the questions answered to my satisfaction, and I agree to participate in this study.

Participant: _____

Signature: _____

Date: _____

[redacted]
_____
Raisa Borg
[redacted]
Researcher

[redacted]
_____
Dr Ritienne Grima
+[redacted]
Main Research Supervisor

Appendix I

Clock drawing test (Shulman, 2000; Grima, 2011)

Method of instruction of the Shulman scale (Shulman 2000)

The individual is presented with a pre-drawn circle of 4 inches or 10cm in diameter and he or she is given the following instructions:

"This circle represents a clock face. Please put in the numbers so that it looks like a clock and then set the time to 10 minutes past 11."

(Shulman 2000, p. 550)[1]

Maltese instruction:

"Dan iċ-ċirku jirrapreżenta arloġġ. Jekk jogħġbok, niżżel in-numri biex b'hekk jidher bħala arloġġ u wara agħmlu juri l-ħdax u għaxra."

Scoring procedure of the Shulman scale (Shulman 2000)

The scoring procedure involves a simple 0 – 5 point system. Table 3.5 gives a brief description of each point. Shulman (1986: 136) provides a more detailed explanation of the above clock errors. However, the point-system is reversed, such that a score of V was given to an inability to make a reasonable attempt at a clock (0 points), while a score of I was given for minor visuo-spatial errors (4 points). For the purpose of this research a "cut-off" score of 3 was used. This "cut-off" was recommended by Shulman in emails to the researcher (Sept 2008), and it was agreed that any respondent who scored 3 points or less would be excluded from the study.

Scoring procedure for Clock Drawing Test

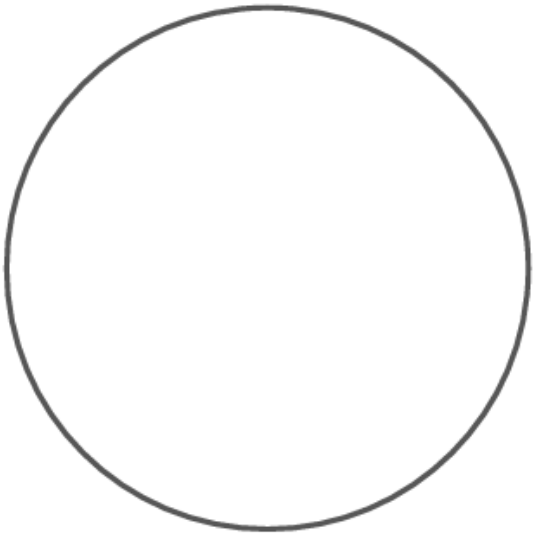
5 points	'Perfect' clock
4 points	Minor visuo-spatial errors
3 points	Inaccurate representation of 10 after 11 when the visuo-spatial organization is well done
2 points	Moderate visuo-spatial disorganization of numbers such that accurate denotation of '10 after 11' is impossible
1 point	Severe level of visuo-spatial disorganization
0 points	Inability to make any reasonable representation of a clock

Shulman (2000: 554)

Shulman, K. I. (2000) 'Clock-Drawing: Is it the Ideal Cognitive Screening Test?', *International Journal of Geriatric Psychiatry*, 15, 548-561.
Strauss, E., Spreen, O. and Sherman, E. M. (2006) *A Compendium of Neuropsychological Tests: Administration, Norms and Commentary*, New York: Oxford University Press.

[1] The use of setting the time to 11:10 is of importance as it involves both visual fields (Shulman, 2000; Strauss et al, 2006).

Ritienne Grima



Ritienne Grima

Appendix J

Case history form in English and Maltese

Case history form – English version

Date _____

Participant code number:	
Age	
Gender	
Educational Status Write the number of years in each level	Literate ____ Illiterate ____ Primary level Secondary level Post-secondary level Tertiary level
Do you have a history of? If yes, kindly indicate the name of the condition or disorder	Progressive neurological condition Yes No Name of condition: Psychiatric disorder Yes No Name of disorder: Substance abuse Yes No
Have you ever had a hearing test?	Yes No
Do you think you have a hearing loss? If yes, when did you first notice your hearing loss?	Yes No
Have you ever worn a hearing aid?	Yes No
Do you currently use a hearing aid?	Yes No

Il- formola tal-istorja tal-parteċipant - Maltese Version

Data _____

Numru tal-kodiċi tal-parteċipant:	
Eta’	
Sess	
Skola Ikteb in-numru ta’snin f’kull livell	Illiterat ____ Litterat ____ livell PRIMARJU ____ livell SEKONDARJU ____ livell POST-SEKONDARJU ____ Livell TERZJARJU ____
Għandek storja ta’ ? Jekk iva, indika l-isem tal-kundizzjoni jew id- disturb	Kundizzjoni newroloġika progressiva Iva Le Isem tal-kundizzjoni: Disturb psikjatriku Iva Le Isem tad-disturb: Abbuż ta’ sustanzi Iva Le
Qatt għamilt test tas-smiegħ?	Iva Le

Taħseb li għandek nuqqas ta' smigħ? Jekk iva, meta indunajt l-ewwel bin-nuqqas ta' smigħ?	Iva Le
Qatt użajt *hearing aid?*	Iva Le
Tuża *hearing aid* bħalissa?	Iva Le

Appendix K

Hearing Handicap Inventory for the Elderly – Screening Version in English and Maltese (Galdes, 2017; Weinstein, 1983).

Instructions: The purpose of this questionnaire is to identify difficulties you may be experiencing because of impaired hearing. Please check the clear box that best describes your experience.

Item	Hearing Handicap Inventory for the Elderly (HHIE-S)	YES 4 points	SOME TIME 2 points	NO 0 points
E1	Does a hearing problem cause you to feel embarrassed when you meet new people?			
E2	Does a hearing problem cause you to feel frustrated when talking to members of your family?			
S1	Do you have difficulty hearing when someone speaks in a whisper?			
E3	Do you feel handicapped by a hearing problem?			
S2	Does a hearing problem cause you difficulty when visiting friends, relatives, or neighbors?			
S3	Does a hearing problem cause you to attend religious services less often than you would like?			
E4	Does a hearing problem cause you to have arguments with family members?			
S4	Does a hearing problem cause you difficulty when listening to TV or radio?			
E5	Do you feel that any difficulty with your hearing limits or hampers your personal or social life?			
S5	Does a hearing problem cause you difficulty when in a restaurant with relatives or friends?			
	Total Points of Items with Letter Indications E1 through E5:			
	Total Points of Items with Letter Indications S1 through S5:			
	TOTAL RAW SCORE : _____ ***(Sum of all points E+S)***			

INTERPRETING THE RAW SCORE:

0 to 8 = 13% probability of hearing impairment (no handicap/no referral)

10 to 24 = 50% probability of hearing impairment (mild-moderate handicap/refer)

26 to 40 = 84% probability of hearing impairment (severe handicap/refer)

Source: Ventry, I, Weinstein B. (1983). "Identification of elderly people with hearing problems." ©*American Speech-Language-Hearing Association*, July, 37-42.

Inventarju tad-Diżabbilità tas-Smigħ fl-Anzjani – Verżjoni qasira

Introduzzjoni: Għandi xi mistoqsijiet dwar kif tħossok dwar is-smigħ tiegħek. Għal kull mistoqsija, jekk jogħġbok għidli jekk il-mistoqsija tiddeskrivikx, ma tiddeskrivikx, jew tiddeskrivik xi kultant.

Agħżel ir-risposta addatata għal kull mistoqsija:

		Il-mistoqsija tiddeskrivik...?		
	Mistoqsija	**LE**	**XI KULTANT**	**IVA**
1	Għandek problema tas-smigħ li timbarazzak meta tiltaqa' ma' nies ġodda?	0	2	4
2	Għandek problema tas-smigħ li tiffrustrak meta titkellem ma' membri tal-familja tiegħek?	0	2	4
3	Issib diffikultà meta xi ħadd jitkellem minn taħt l-ilsien?	0	2	4
4	Tħoss li għandek diżabiltà minħabba diffikultà tas-smigħ?	0	2	4
5	Għandek problema tas-smigħ li toħloqlok diffikultajiet meta tmur għand il-ħbieb, il-qraba jew il-ġirien?	0	2	4
6	Għandek problema tas-smigħ li iżżommok lura milli tattendi servizzi reliġjużi iktar ta' spiss minn dak li tkun tixtieq?	0	2	4
7	Għandek problema tas-smigħ li toħloqlok argumenti mal-membri tal-familja?	0	2	4
8	Għandek problema tas-smigħ li toħloqlok diffikultà meta tisma' t-televiżjoni jew ir-radju?	0	2	4
9	Tħoss li għandek diffikultà tas-smigħ li qed tillimitalek il-ħajja tiegħek b'mod personali jew soċjali?	0	2	4
10	Għandek problema tas-smigħ li toħloqlok diffikultà f'ristorant mal-qraba jew il-ħbieb?	0	2	4
	Total			
	Total Globali			

Martina Galdes

Ventry, I, Weinstein B. (1983). "Identification of elderly people with hearing problems." ©American Speech-Language-Hearing Association, July, 37-42.
Translated to Maltese by Ms. Martina Galdes : Galdes, M. (2017). Perceptions of Maltese senior citizens on hearing acuity.

Appendix L

Satisfaction with Life Scale in English and Maltese (Diener et al., 1985)

Scale:

Skala:

Instructions: Below are five statements that you may agree or disagree with. Using the 1 - 7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

Istruzzjonijiet: Hawn taħt għandek ħames stqarrijiet li tista' taqbel magħhom jew ma taqbilx. Uża l-iskala minn 1 sa 7 li qed tidher hawn taħt biex turi kemm qed taqbel ma' kull stqarrija billi tniżżel in-numru x-xieraq fil-linja misjuba qabel l-istqarrija nnifisha. Jekk jogħġbok wieġeb b'mod sinċier.

• 7 - Strongly agree	Naqbel ħafna
• 6 – Agree	Naqbel
• 5 - Slightly agree	Naqbel ftit
• 4 - Neither agree nor disagree	La naqbel u lanqas ma naqbilx
• 3 - Slightly disagree	Ma tantx naqbel
• 2 – Disagree	Ma naqbilx
• 1 - Strongly disagree	Ma naqbel xejn

____ In most ways my life is close to my ideal.
____ The conditions of my life are excellent.
____ I am satisfied with my life.
____ So far I have gotten the important things I want in life.
____ If I could live my life over, I would change almost nothing.

____ F'ħafna mill-affarijiet ħajti tqarreb lejn dak li hu ideali għalija.
____ Il-kundizzjonijiet ta' ħajti huma eċċellenti.
____ Sodisfatt/a b'ħajti.
____ S'issa ksibt l-affarijiet importanti li rrid f'ħajti.
____ Kieku kelli nerġa' ngħix ħajti mill-ġdid, ma nbiddel kważi xejn.

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. Journal of Personality Assessment, 49(1), 71-75.

Translated to Maltese by a professional translator: Mr Kenneth Grima

Appendix M

Approval from CEO

[redacted]

Tue, 12 Mar 2024, 18:15

to [redacted]

Dear Ms.Borg,

Approved from my end.

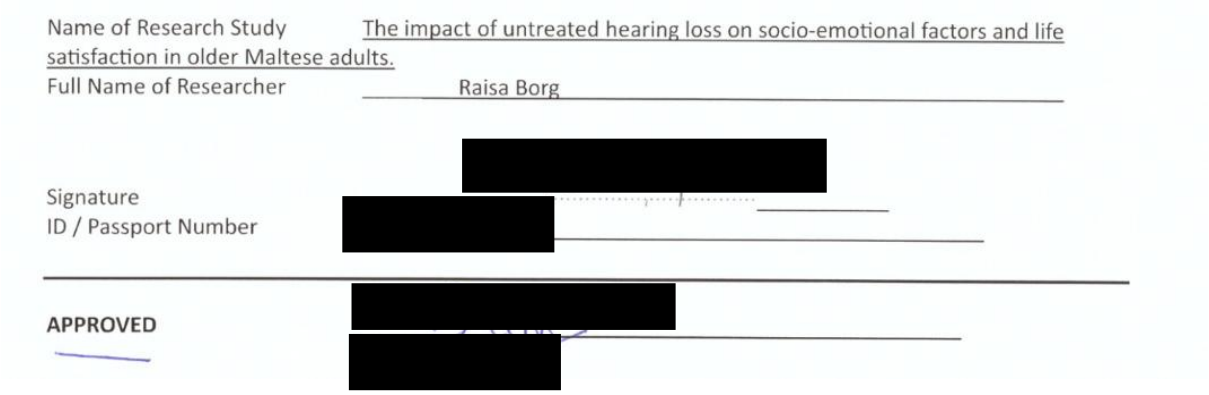
Regards

[redacted]

Chief Executive Officer

[redacted]

Approval from DPO



Name of Research Study The impact of untreated hearing loss on socio-emotional factors and life satisfaction in older Maltese adults.

Full Name of Researcher Raisa Borg

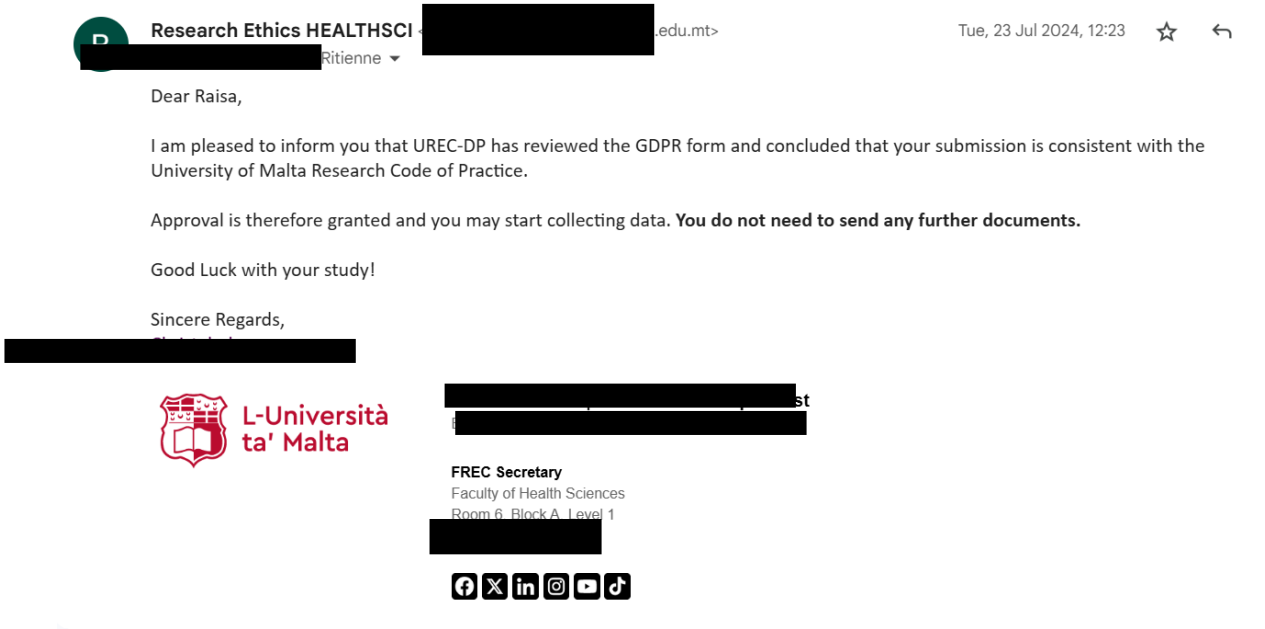
Signature [redacted]

ID / Passport Number [redacted]

APPROVED [redacted]

Appendix N

Approval from Faculty of Health Sciences Research Ethics Committee: reference number FHS-2024-00203



Research Ethics HEALTHSCI <[redacted].edu.mt> Tue, 23 Jul 2024, 12:23

[redacted] Ritienne

Dear Raisa,

I am pleased to inform you that UREC-DP has reviewed the GDPR form and concluded that your submission is consistent with the University of Malta Research Code of Practice.

Approval is therefore granted and you may start collecting data. **You do not need to send any further documents.**

Good Luck with your study!

Sincere Regards,

[redacted]

L-Università ta' Malta

[redacted]

FREC Secretary
Faculty of Health Sciences
Room 6, Block A, Level 1
[redacted]

Appendix O

Table O34

Review of other related tools - HHIE

Tool	Author	Description	Key Features	Limitations
Hearing Handicap Scale	High, Fairbanks, & Glorig (1964)	Measures difficulties that individuals experience while listening.	40 items, 5-point scale.	Lengthy (40 items)
Hearing Disabilities and Handicap Scale (HDHS)	Hétu et al., (1994)	Shortened version of the Hearing Measurement Scale. Measures handicap experienced by individuals	20 items, 4-point Likert scale.	Lacks validity.
Hearing Handicap Inventory for the Elderly (HHIE)	Ventry & Weinstein (1983)	Measures socioemotional impacts of HL.	25 items; valid and reliable	lenghty
Korean Evaluation Scale for Hearing Handicap (KESHH)	Ku & Kim (2010)	Assesses physical, personal, psyhological and emotional impact of HL	24 items; developed for Korean populations.	No English version available.
Hearing Handicap Questionnaire (HHQ)	Gatehouse & Noble (2004)	Measures social, emotional, and participation limitations.	12 items, 5-point scale.	Weaker correlation with PTA compared to HHIE.
Self-Assessment of Communication (SAC)	Schow & Nerbonne (1982)	Measures effect of HL	10 items, 5-point Likert scale.	Focuses more on communication

				rather than hearing difficulties.
Significant other scale for hearing disability [SOS-HEAR]	Scarinci et al ., 2009	Screening tool for older adults for the assessment of socioemotional impact of HL	5 – 10 items	Still emerging and less known and not widely implemented
Patient Health Questionnaire – PHQ – 4	Kroenke et al., 2009	Screens anxiety and depression symptoms	4 item general emotional distress screening – useful in audiology	Not hearing specific; although used
Acceptance and Action Questionnaire – Adult HL – AAQ-AHL	Ong et al., 2019	Assess psychological flexibility specific to HL	Measures emotional adjustment and coping with HL	Still emerging
Social Isolation Measure - SIM	Heffernan et al., 2019	Screens for social isolation in adults with HL	5 item	Oversimplify complex social issues

Compared to the HHIE- S (Ventry & Weinstein, 1983), which is a concise and validated 10-item questionnaire widely used in clinical settings to assess the social and emotional impact of HL in older adults, several other tools vary significantly in scope, length, and applicability. The Hearing Handicap Scale (High, Fairbanks, & Glorig, 1964) is one of the earliest tools, offering a broad view of listening difficulties but is impractical for quick screening due to its 40 items. The HDS (Hétu et al., 1994), a 20-item shortened version of a previous tool, addresses perceived handicap but is weakened by limited validity. The KESHH (Ku & Kim, 2010) offers a culturally specific approach with 24 items assessing emotional and psychological aspects but lacks accessibility due to the absence of an English version. The HHQ (Gatehouse & Noble, 2004), with 12 items, shares a similar focus with HHIE-S but shows weaker correlation with pure-tone average (PTA) thresholds. The SAC (Schow & Nerbonne, 1982), though also brief, emphasises communication skills rather than socioemotional impacts. Meanwhile, newer tools such as the Significant Other Scale for

Hearing Disability (SOS-HEAR) (Scarinci et al., 2009), the Acceptance and Action Questionnaire – Adult Hearing Loss (AAQ-AHL) (Ong et al., 2019), the Patient Health Questionnaire-4 (PHQ-4) (Kroenke et al., 2009), and the Social Isolation Measure (SIM) (Heffernan et al., 2019) offer targeted insights into psychological flexibility, emotional distress, and looks at the impact of HL on significant others. However, these are still emerging in clinical practice and may not yet match the HHIE-S in terms of familiarity, validation, and ease of use. Overall, the HHIE-S remains one of the most used, practical, and validated tools for assessing the socioemotional impact of HL in older adults.

Appendix P

Table P35

Review of other related tools - SWLS

Tool	Author	Key Features	Limitations
Quality of Life Scale	Flanagan, 1982	- Assesses general well-being across personal, social, and environmental domains. - Includes multiple items across different domains.	- Lengthy - Focuses on overall quality of life rather than life satisfaction specifically. - To be used mostly with chronic illness groups
WHOQOL-BREF	WHO, 1996	- Measures physical and psychological health as well as social dynamics and the environment using domain – specific questions.	Low internal consistency mostly the social domain (Naumann, 2012; Viana et al., 2007; Taylor, 2004).
Life Satisfaction Index-A (LSI-A)	Neugarten, Havighurst, & Tobin, 1961	- To be used for older adults, measuring life satisfaction, happiness, and social engagement. - Focuses on psychological well-being and subjective satisfaction with life.	20 items – lengthy and assess mostly zest vs apathy, resolution, fortitude etc.
General well-being schedule	Dupuy (1978)	Assess various aspects of well-being namely LS, health related issues and mental health conditions such as depression etc.	Lengthy scale consisting of 18 items that may affect fatigue or incomplete responses

The SWLS (Diener et al., 1985) is a brief and focused tool, consisting of just 5 items, designed specifically to measure global life satisfaction. In contrast, the QOL Scale (Flanagan, 1982) assesses general well-being across personal, social, and environmental

domains, but it is much longer and broader, making it less specific to life satisfaction alone. It also targets chronic illness groups, which may limit its applicability to general populations.

The WHOQOL-BREF (World Health Organization, 1996) is a more comprehensive tool that covers four domains namely physical psychological health as well as the social and environment aspect. While this tool is widely used, its low internal consistency, particularly in the social domain, can limit its reliability compared to the SWLS, which is consistently validated for measuring LS directly.

The Life Satisfaction Index-A (LSI-A) (Neugarten et al., 1961), may be used for older adults, and this tool shares some overlap with the SWLS in assessing LS, but it is more focused on psychological well-being, including aspects like zest vs. apathy and fortitude. It is also much lengthier, with 20 items, which may make it less convenient for quick assessments compared to the SWLS.

The General Well-Being Schedule (Dupuy, 1978) assesses seven different aspects of well-being namely, LS, health- related issues and mental health conditions including depression. It is more comprehensive and lengthier (18 items), which may lead to respondent fatigue or incomplete answers.

The SWLS is highly effective tool for providing a quick and reliable measure of LS. Unlike more comprehensive well-being assessments, it offers a concise approach that is particularly useful for studies or evaluations of LS.

Appendix Q

Analysis of average, high and low hearing threshold of better ear with gender

Figure Q5

Participants' average hearing threshold (dB HL) of the better ear

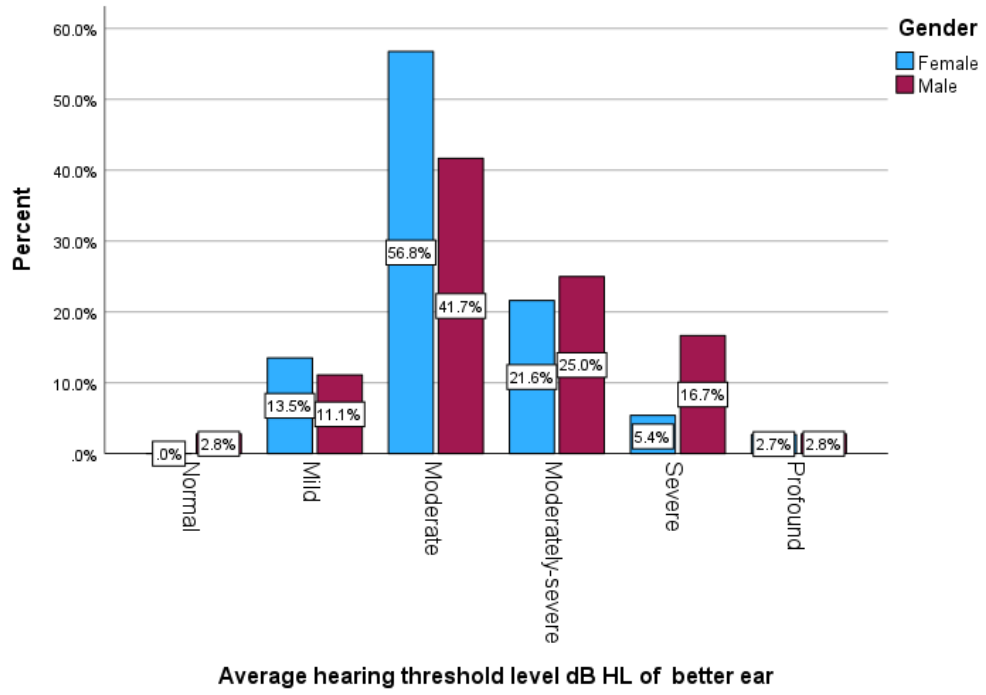


Figure Q6

Participants' high average hearing threshold (dB HL) of the better ear

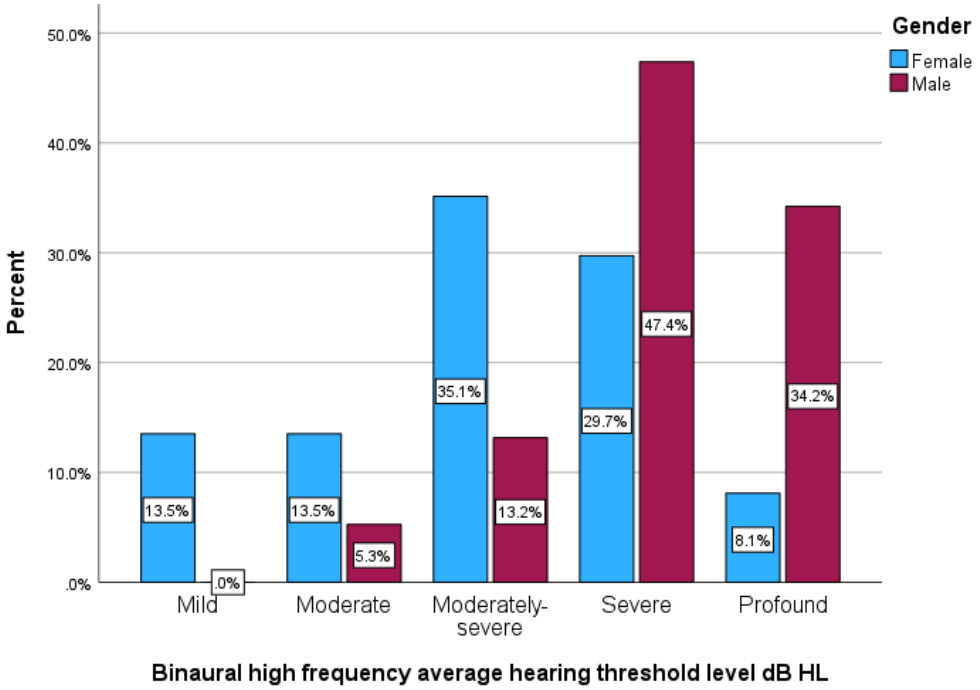


Figure Q7

Participants' low average hearing threshold (dB HL) of the better ear

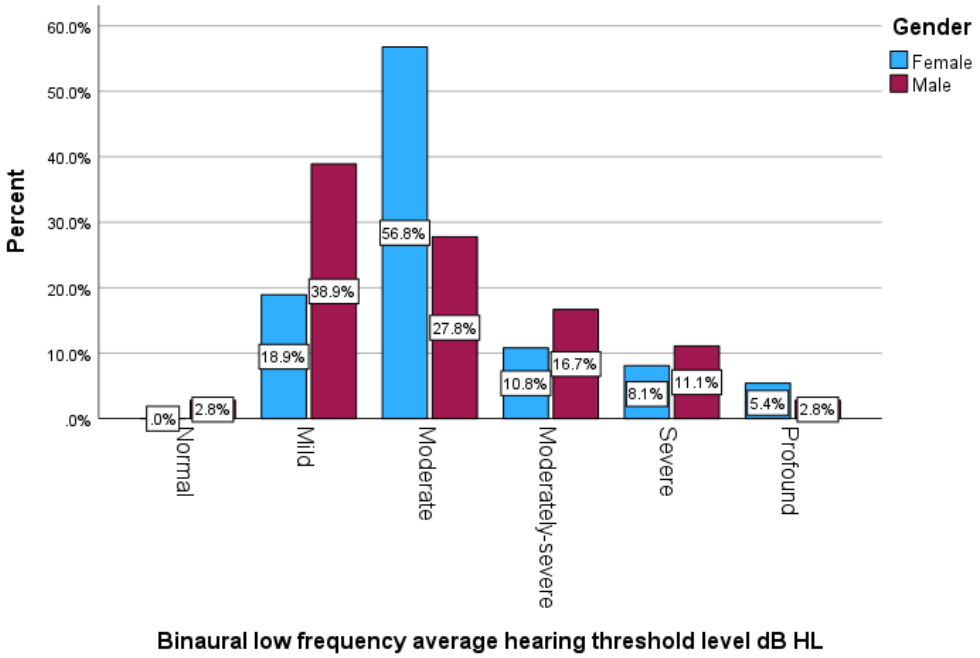


Figure Q5 illustrates that moderate HL in the better ear was the most prevalent type when calculating the average hearing threshold. This was particularly common among both females (n=21, 56.3%) and males (n=15, 41.7%). In contrast, profound HL was the least frequently observed, with only one case in each group (n=1, 2.7% for females and n=1, 2.8% for males). Moreover, it is important to note that one male participant had normal hearing based on the average hearing threshold of the better ear, due to his unilateral HL.

However, when the binaural high-frequency average hearing threshold (Figure Q6) was calculated and analysed, moderately-severe HL was the most common category among females (n=13, 35.1%), while severe HL was more prevalent among males (n=16, 44.4%). The least common type among females was profound HL, whereas among males, it was mild HL.

The binaural low-frequency average hearing threshold was also calculated (Figure Q7), revealing that moderate HL was the most common category among females (n=21, 56.8%), while mild HL was the most prevalent among males (n=14, 38.9%). The least common category in females was the normal hearing subgroup (n=0), whereas in males, both the profound and normal hearing groups were the least common, each with n=1 (2.8%).

Appendix R

Untreated HL vs no HL (target vs control) group analysis for HHIE scores – Null and Alternative Hypothesis

Null hypothesis

H_0: There is no statistically significant difference in HHIE scores between the target and the control group.

Alternative Hypothesis

H_1: There is a significant difference in HHIE scores between the untreated HL group and the no HL group.

Table R36

Hypothesis test summary for control and target group (HHIE scores)

Hypothesis Test Summary				
	Null Hypothesis	**Test**	**P-value**	**Decision**
1	The distribution of HHIE-S Total Emotional Score is the same across categories of Untreated hearing loss vs No hearing loss.	Independent-Samples Mann-Whitney U Test	**<.001**	Reject the null hypothesis.
2	The distribution of HHIE-S Total Social Score is the same across categories of Untreated hearing loss vs No hearing loss.	Independent-Samples Mann-Whitney U Test	**<.001**	Reject the null hypothesis.

3	The distribution of the HHIE- S raw score is the same across categories of Untreated hearing loss vs No hearing loss.	Independent-Samples Mann-Whitney U Test	**<.001**	Reject the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix S

Untreated HL vs no HL (target vs control) group analysis for SWLS scores – Null and Alternative Hypothesis

Null hypothesis

H_0: There is no statistically significant difference in SWLS scores between the target and the control group.

Alternative Hypothesis

H_1: There is a significant difference in SWLS scores between the target group and the control group.

Table S37

The Hypothesis test summary – SWLS scores

Hypothesis Test Summary

	Null Hypothesis	Test	P-value	Decision
1	The distribution of Satisfaction with life scale total score is the same across categories of Untreated hearing loss vs No hearing loss.	Independent-Samples Mann-Whitney U Test	0.492	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix T

Kruskal- Wallis Analysis using different age groups categories

Table T38

Kruskal- Wallis test: HHIE scores across different age groups

HHIE	Age group	Count	Mean	Median	Sd.	P-value
HHIE-S raw score	65-74	19	18.42	18.00	2.884	0.657
	75-84	43	15.44	14.00	1.644	
	85+	11	17.45	18.00	3.064	
HHIE-S Emotional Questions Score	65-74	19	6.53	**4.00**	6.28	0.652
	75-84	43	5.44	**4.00**	5.23	
	85+	11	6.91	**8.00**	5.09	
HHIE-S Social Questions Score	65-74	19	9.89	10.00	1.35	0.593
	75-84	43	8.60	8.00	0.85	
	85+	11	10.00	10.00	1.53	

Table T38 shows that the 65-74 age group has the highest perceived hearing handicap (mean HHIE-S score = 18.42), while the 75-84 age group has the lowest (mean= 15.44). However, the 85+ age group reports the highest hearing handicap in the emotional and social subscales (mean= 6.53, mean= 10). However, Kruskal-Wallis test results (p= .657, p= .652, p = .593) indicate no statistically significant differences in HHIE total, emotional, or social scores across age groups.

Appendix U

Hypothesis test summary for age and HHIE and SWLS scores

Table U39 below presents a hypothesis test summary, indicating that the null hypothesis is retained, suggesting no statistically significant difference between age groups in relation to the HHIE and SWLS scores.

Table U39

Hypothesis test summary

Hypothesis Test Summary				
	Null Hypothesis	Test	P-value[a,b]	Decision
1	The distribution of Satisfaction with life scale total score is the same across categories of Age group.	Independent-Samples Kruskal-Wallis Test	0.163	Retain the null hypothesis.
2	The distribution of Hearing handicap inventory for the elderly total score is the same across categories of Age group.	Independent-Samples Kruskal-Wallis Test	0.335	Retain the null hypothesis.
3	The distribution of HHIE Total Emotional Score is the same across categories of Age group.	Independent-Samples Kruskal-Wallis Test	0.643	Retain the null hypothesis.
4	The distribution of HHIE Total Social Score is the same across categories of Age group.	Independent-Samples Kruskal-Wallis Test	0.296	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix V

Hypothesis test summary for gender and SWLS and HHIE scores

Table V40 below presents a hypothesis test summary, indicating that the null hypothesis is retained, suggesting no statistically significant difference between genders in relation to the SWLS and HHIE scores.

Table V40

Hypothesis test summary

Hypothesis Test Summary

	Null Hypothesis	Test	P-value	Decision
1	The distribution of Satisfaction with life scale total score is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	0.209	Retain the null hypothesis.
2	The distribution of Hearing handicap inventory for the elderly total score is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	0.245	Retain the null hypothesis.
3	The distribution of HHIE Total Emotional Score is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	0.618	Retain the null hypothesis.

4	The distribution of HHIE Total Social Score is the same across categories of Gender.	Independent-Samples Mann-Whitney U Test	0.081	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix W

Hypothesis test summary for education and SWLS and HHIE scores

The hypothesis test summary for HHIE scores and SWLS across different levels of education can be found below (Table W41).

Table W41

Hypothesis test summary

Hypothesis Test Summary				
	Null Hypothesis	Test	P-value	Decision
1	The distribution of Satisfaction with life scale total score is the same across categories of Highest level of education.	Independent-Samples Kruskal-Wallis Test	0.495	Retain the null hypothesis.
2	The distribution of Hearing handicap inventory for the elderly total score is the same across categories of Highest level of education.	Independent-Samples Kruskal-Wallis Test	0.871	Retain the null hypothesis.

3	The distribution of HHIE Total Emotional Score is the same across categories of Highest level of education.	Independent-Samples Kruskal-Wallis Test	.954	Retain the null hypothesis.
4	The distribution of HHIE Total Social Score is the same across categories of Highest level of education.	Independent-Samples Kruskal-Wallis Test	.444	Retain the null hypothesis.

a. The significance level is .050.

b. Asymptotic significance is displayed.

Appendix X

Multiple linear regression model: Demographic variables with HHIE and SWLS scores

Table X42

Multiple linear regression model: HHIE- total score with gender, age group and education

Tests of Between-Subjects Effects

Dependent Variable: Hearing handicap inventory for the elderly total score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	760.300[a]	7	108.614	.869	.536
Intercept	9799.299	1	9799.299	78.366	<.001
Gender	129.828	1	129.828	1.038	**0.312**
Age group	575.308	4	143.827	1.150	**0.341**
Education	4.060	2	2.030	.016	**0.984**
Error	8127.920	65	125.045		
Total	28812.000	73			
Corrected Total	8888.219	72			

a. R Squared = .086 (Adjusted R Squared = -.013)

Table X43

Multiple linear regression model: HHIE- emotional score with gender, age group and education

Tests of Between-Subjects Effects

Dependent Variable: HHIE Total Emotional Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	128.596[a]	7	18.371	.583	.767
Intercept	1296.226	1	1296.226	41.156	<.001
Gender	15.467	1	15.467	.491	**.486**
Age group	106.663	4	26.666	.847	**.501**
Education	9.501	2	4.750	.151	**.860**
Error	2047.185	65	31.495		
Total	4756.000	73			
Corrected Total	2175.781	72			

a. R Squared = .059 (Adjusted R Squared = -.042)

Table X44

Multiple linear regression model: HHIE- social score with gender, age group and education

Tests of Between-Subjects Effects

Dependent Variable: HHIE Total Social Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	257.922[a]	7	36.846	1.219	.306
Intercept	3064.096	1	3064.096	101.335	<.001
Gender	72.134	1	72.134	2.386	**0.127**
Age group	131.866	4	32.966	1.090	**0.369**
Education	21.968	2	10.984	.363	**0.697**
Error	1965.420	65	30.237		
Total	8336.000	73			
Corrected Total	2223.342	72			

a. R Squared = .116 (Adjusted R Squared = .021)

Table X45

Multiple linear regression model: SWLS score with gender, age group and education

Tests of Between-Subjects Effects

Dependent Variable: Satisfaction with life scale total score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	355.053[a]	7	50.722	1.661	.134
Intercept	26057.449	1	26057.449	853.195	<.001
Gender	80.204	1	80.204	2.626	**0.110**
Age group	268.410	4	67.102	2.197	**0.079**
Education	18.990	2	9.495	.311	**0.734**
Error	1985.166	65	30.541		
Total	57464.000	73			
Corrected Total	2340.219	72			

a. R Squared = .152 (Adjusted R Squared = 0.060)

Appendix Y

Multiple linear regression model: Hearing-related variables with HHIE and SWLS scores

Table Y46

Multiple linear regression model: HHIE- total score with degree of HL and type of HL

Tests of Between-Subjects Effects					
Dependent Variable: Hearing handicap inventory for the elderly total score					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2993.937[a]	15	199.596	1.930	.039
Intercept	3057.342	1	3057.342	29.566	<.001
Average_HT_betterear	91.547	5	18.309	.177	.970
binaural_highfrequency_averagethreshold	824.229	4	206.057	1.993	**0.108**
binaural_lowfrequency_averagethreshold	670.099	5	134.020	1.296	**0.278**
Type of loss	99.026	1	99.026	.958	**0.332**
Error	5894.282	57	103.408		
Total	28812.000	73			
Corrected Total	8888.219	72			
a. R Squared = 0.337 (Adjusted R Squared = .162)					

Table Y47

Multiple linear regression model: HHIE- emotional score with degree of HL and type of HL

Tests of Between-Subjects Effects					
Dependent Variable: HHIE Total Emotional Score					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	560.107[a]	15	37.340	1.317	.223
Intercept	397.069	1	397.069	14.008	<.001
Average_HT_betterear	15.105	5	3.021	.107	**0.990**

binaural_highfrequency_average threshold	155.624	4	38.906	1.373	**0.255**
binaural_lowfrequency_average threshold	177.617	5	35.523	1.253	**0.297**
Type of loss	17.123	1	17.123	.604	**0.440**
Error	1615.674	57	28.345		
Total	4756.000	73			
Corrected Total	2175.781	72			

a. R Squared = .257 (Adjusted R Squared = 0.062)

Table Y48

Multiple linear regression model: HHIE- social score with degree of HL and type of HL

Tests of Between-Subjects Effects

Dependent Variable: HHIE Total Social Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	874.375[a]	15	58.292	2.463	.007
Intercept	848.040	1	848.040	35.834	<.001
Average_HT_betterear	54.643	5	10.929	.462	**0.803**
binaural_highfrequency_average threshold	200.037	4	50.009	2.113	**0.091**
binaural_lowfrequency_average threshold	162.516	5	32.503	1.373	**0.248**
Type of loss	27.695	1	27.695	1.170	**0.284**
Error	1348.967	57	23.666		
Total	8336.000	73			
Corrected Total	2223.342	72			

a. R Squared = .393 (Adjusted R Squared = 0.234)

Table Y49

Multiple linear regression model: SWLS score with degree of HL and type of HL

Tests of Between-Subjects Effects

Dependent Variable: Satisfaction with life scale total score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	300.390[a]	15	20.026	.560	.893
Intercept	7161.617	1	7161.617	200.121	<.001
Average_HT_betterear	130.578	5	26.116	.730	**0.604**
Binaural_highfrequency_averagethreshold	85.005	4	21.251	.594	**0.669**
Binaural_lowfrequency_averagethreshold	66.828	5	13.366	.373	**0.865**
Type of loss	12.023	1	12.023	.336	**0.564**
Error	2039.830	57	35.786		
Total	57464.000	73			
Corrected Total	2340.219	72			

a. R Squared = .128 (Adjusted R Squared = -0.101)