General introduction
- Harry, 50 years old: “Sports I prefer to do by myself. I just cannot hear the others and that bugs me... I prefer to do all things by myself now.” Anne, 55 years old: “Yes, one does become... alone somehow.”

- Jasmin, 65 years old: “Well, the hardest thing is that you, in large group settings with a lot of background noise around, frankly, I’d rather stay away. But I don’t do that, I still go, because, yes, I think to myself: ‘Maybe you can hear something.’ Better than nothing. But it stays hard.”

- Susannah, 67 years old: “Yes, you pull back a little bit, you become a bit insecure. And the older you get, the more this seems prominent... It [the hearing loss] didn’t bother me so much when I was younger, but now I think ‘Oh...’ [...] I would have loved taking courses in English, or painting. But I don’t have the guts. Then people go and talk to me and then I think: ‘Oh God.’ No, then I’d rather not... You are a bit anxious.”

- Louis, 62 years old: “I tried to stop those little devices for years, because I felt like, yes, you immediately become an old man when you do that. But once I had decided it for myself and I also told others, you only gets positive reactions. People think it’s a really good thing that you do it. That I really found striking.”

- Anne, 55 years old: “People speak so unclearly on the phone [...] People don’t take the time to talk clearly. It isn’t such a big deal to say it again and talk more slowly, is it? I am often irritated, and sometimes depressed. Then I think: ‘God.’ Yes, sometimes I am depressed because I can’t hear well.”

- Jake, 42 years old: “When I’m at a party, then I’m the one playing with the children. Usually, it was grandpa doing this, which I totally understand now! [laughs] [...] The social handicaps as any hearing-impaired person must experience, I’m afraid, yes, I recognize those. That’s major.”

Quotations from adults with hearing loss participating in a focus group on functioning with hearing loss.¹

HEARING LOSS: A HIGHLY PREVALENT CONDITION AMONG (OLDER) ADULTS

The quotations above provide a brief but typical range of examples of how adults’ lives can be affected by hearing difficulties. Hearing loss is highly prevalent among adults. A variety of hearing loss definitions are employed throughout the literature (Duijvestijn et al., 1999). Even when applying a rather strict definition², it appears that around 528 million, or 8% of all adults worldwide suffer from significant bilateral hearing loss (Stevens et al., 2013). This makes adult-onset hearing loss the most prevalent disabling condition worldwide (WHO, 2008). The bulk of the cases, i.e., 80%, are found among older persons (Davis, 1990).

¹ VU University Medical Center Amsterdam, the Netherlands, spring 2011. Participant names were altered for privacy purposes. Context: the ICF Core Sets for Hearing Loss project (Danemark et al., 2010). See Chapter 5.
² Average hearing level of 35 decibel or more in the better ear, across frequencies 0.5, 1, 2, and 4 kHz.
Age-related hearing loss (ARHL), or presbyacusic, is a term used to describe the insidious, progressive, bilateral, and symmetrical impairment of hearing functions of sensorineural origin associated with aging (Gates & Mills, 2005). It generally kicks in around the age of fifty (Davis, 1995; 1997; Gommer & Poos, 2010; Wiley et al., 2008). This is clearly reflected in the prevalence rates: around 30% of adults aged 55 years and over, around 60% of adults in their seventies, and around 90% of adults aged 80 years and over have a significant bilateral hearing loss (Cruickshanks et al., 1998b; Duijvestijn et al., 1999). Smits et al. (2006) calculated that in 2001, over 1.2 million Dutch older persons (aged 60 years and over) had an insufficient or poor ability to recognize speech in noise. This represented 43% of the total Dutch older population at that time. Based on a Dutch survey conducted in 2007, it was estimated that of all persons aged 75 years and over at that time, over 440.000 (41%) reported significant problems in group conversations and over 106.000 (10%) reported problems in one-on-one conversations (Gommer & Poos, 2010).

The number of adults with hearing loss is expected to increase even further in the future because of the increasing life expectancy and the aging of the baby boomer cohort. In the Netherlands, life expectancy at birth in 1981 was 72.7 years for men and 79.3 years for women, whereas in 2011 this had increased to 79.2 years and 82.9 years, respectively (Statistics Netherlands, 2012). It is expected that life expectancy will further increase to 83.8 years for men and 88.1 years for women in 2050 (RIVM, 2010). The proportion of Dutch adults aged 65 years and over in 1980 was 12%, and increased to 16% in 2011, the latter representing a total of almost 2.6 million persons. This proportion is estimated to expand to almost a quarter (24%) of the total Dutch population by 2050 (Statistics Netherlands, 2012).

AGE-RELATED HEARING LOSS

The traditional audiological hallmark of ARHL is a pronounced sensitivity loss in the high frequencies of the hearing range which later also affects lower frequencies (Gates & Mills, 2005). Initially, mainly speech understanding in noisy and reverberant places is affected. Normal speech covers a frequency range of 0.25-6 kilohertz and an intensity range of 40-70 decibel (dB) sound pressure level (SPL). Certain consonants are characterized by high frequencies and low intensity levels, such as ‘t’, ‘p’, ‘h’, and ‘s’. Audibility of consonants is critical to understanding speech. Since the high frequency consonants will not be heard, speech will be perceived in a distorted fashion, and this will be exacerbated in a noisy or reverberant room (Fook & Morgan, 2000). Once the hearing loss progresses and extends to lower frequencies, eventually all speech components will be affected. Also sound localization and central (i.e., upstream of the cochlea) processing of auditory information
become increasingly impaired in ARHL, further adding to impaired speech perception (Gates & Mills, 2005; Pichora-Fuller & Souza, 2003). Central auditory functions are required to evaluate pitch, loudness, and duration of acoustical signals, and for speech processing also cover more global cognitive functions such as speed of information processing, attention, and working memory (Pichora-Fuller & Souza, 2003; Rönnberg et al., 2008; Wingfield & Tun, 2007).

While some use the term ARHL to refer to the hearing loss that is caused by an intrinsic, genetically controlled aging process only (Fook & Morgan, 2000), others view it as a mixture of acquired auditory stresses, trauma, and otological diseases superimposed upon the aging process (Gates & Mills, 2005; Van Eyken et al., 2007). Various studies considered smoking, alcohol abuse, diabetes, and cardiovascular conditions as potential risk factors for hearing loss. These however showed mixed results: some studies identified them as significant risk factors whereas others did not (Brant et al., 1996; Cruickshanks et al., 1998a; Frisina et al., 2006; Rosenhall et al., 1993; Zhan et al., 2011; Kiely et al., 2012). A limited number of these studies used longitudinal data, while a longitudinal design is generally regarded as the best approach to evidence causal relationships (Evans, 1995). In addition, many studies investigated one or only a few potentially influencing factors, precluding any conclusions on the relative contribution of each of the factors. Moreover, this approach prevented a clear differentiation between actual predicting factors and confounding factors. The mixed results combined with the methodological limitations outlined indicate an important gap in current knowledge on the determinants of ARHL.

**Decline in speech-in-noise recognition**

Various studies attempted to model average age- and gender-specific hearing loss trajectories using pure tone threshold data from large longitudinal population-based older samples. Generally, these studies found faster declines for relatively older old (e.g., Kiely et al., 2012) and men (e.g., Chao & Chen, 2009; Pearson et al., 1995) as opposed to younger old and women. However, some found frequency-specific faster declines in women (Wiley et al., 2008; Kiely et al., 2012), or found no age (Keay & Murray, 1988) or gender differences (Cruickshanks et al., 2003; Gates et al., 1990) at all.

Although pure tone audiometry is still considered the gold standard assessment for hearing loss, the relationship with daily life functioning is generally only fair (e.g., Demeester et al., 2012; Engdahl et al., 2013). This seems to hold especially for self-reported speech understanding in background noise (Kramer et al., 1996) and speech understanding in group conversations (Gatehouse & Noble, 2004). Further, pure tone audiometry does not reflect the declining central auditory processing functions that occur
with aging (Pichora-Fuller & Souza, 2003). On the contrary, tests assessing the ability to recognize speech in noise may tap into these to some extent. Moreover, they hold high validity from the patient perspective. As shown in Jasmin’s citation, hearing in a large group or with a lot of background noise was ‘the hardest thing’. This is also reflected in scientific evidence: difficulty in understanding speech in noise is one of the most frequently-reported disabilities in hearing-impaired persons (Stark & Hickson, 2004), and is generally viewed as the most limiting disability (Kramer et al., 1998). Nevertheless, longitudinal trajectories of decline in speech-in-noise recognition and the factors affecting it have scarcely been investigated. The few studies that did so often included very small samples (e.g., Divenyi et al., 2005), and only one study examined a few potentially influencing factors (Dubno et al., 2008). This gap in the available research on ARHL is an important focus in the first part of this thesis (Chapter 2).

HEARING LOSS AND PSYCHOSOCIAL HEALTH

The quotations by Harry, Anne, Susannah, and Jake suggest that adults with hearing loss experience feelings of loneliness, depressed mood, and feelings of anxiety because of their hearing loss. Depression, loneliness, and anxiety are three common disturbances in late life that have been associated with poor quality of life and wellbeing (Blazer, 2003; Dykstra, 2009; De Beurs et al., 1999), and, for depression and loneliness, even with mortality (Holwerda et al., 2007; 2012; Penninx et al., 1997; 1999; 2001).

When reviewing the scientific literature, it is clear that studies reporting on the association between hearing and anxiety in population-based older samples are largely absent. In contrast, there is a large body of literature on the associations of hearing difficulties with loneliness and depression. These, however, show conflicting evidence: while some studies reported significant associations (Kramer et al., 2002; Saito et al., 2010; Wallhagen et al., 1996), others found none (Berg et al., 1981; Chou, 2008; Lee et al., 2010; Nachtegaal et al., 2009). Further, the studies performed thus far hold methodological limitations. An important one is that the large majority of the studies used a cross-sectional design, limiting any strong conclusions to be drawn about causality (Evans, 1995).

Subgroup-specific effects

Another limitation is that most studies did not take into consideration that effects of hearing loss on psychosocial health could be subgroup-specific. In other words, they scarcely examined whether the magnitude or direction of the effect that hearing loss has on psychosocial health was different for different subgroups of the older population. This
CHAPTER 1

could result in psychosocial effects being stronger for one subgroup than for another, or psychosocial effects being present in one subgroup while being absent in another (e.g., in men vs. women). In epidemiology, this is referred to as effect modification, moderation, or interaction by a particular variable (Kamangar, 2012). Especially these subgroup-specific effects may be the reason for mixed results in previous research.

The given quotations already suggest that each participant experienced the impact of consequences differently, and coped with them differently. Research indeed indicates that there are age, gender, and socio-economic differences in problem awareness of hearing loss and the use of compensating communication strategies (Erdman & Demorest, 1998a;b; Garstecki & Erler, 1999). For instance, it is known that men are less aware of their hearing loss, more often deny their auditory difficulties, and use non-verbal communication strategies (e.g., lipreading, sitting close to the speaker) less often than women (Garstecki & Erler, 1999; Hallberg et al., 2008). Further, use of hearing aids has shown to improve social functioning, emotional functioning, and communication functioning, and can prevent depressive symptoms (Gopinath et al., 2009; Mulrow et al., 1990; 1992; Chisolm et al., 2007).

Thus far, only a few studies considered the possibility of effect modification and then mainly investigated this for gender and age in cross-sectional association models (Chen, 1994; Ives et al., 1995; Nachtegaal et al., 2009; Saito et al., 2010; Tambs, 2004). The interaction effects were never tested in longitudinal models and mostly did not include other potentially relevant variables such as hearing aid use, comorbidity of chronic diseases, socioeconomic status, partner status, and cognitive functioning. Exploring subgroup-specific psychosocial effects of hearing loss is an important focus in this thesis. Subgroup-specific effects were investigated for the relationships between hearing loss and three outcomes: depression, loneliness, and anxiety (Chapters 3 and 4).

Rate of hearing decline

ARHL is characterized by decline in hearing ability. To our knowledge, only one longitudinal study took into account the degenerative nature of hearing loss as a potential factor influencing a person’s psychosocial health. This study by Corna et al. (2009) suggested that a particularly a decline in older persons’ self-reported hearing status was associated with a decrease in their psychological health. They compared the declining group to a group whose hearing status had remained stable (no reported problems) over a period of 6 years. However, it is know that large inter-individual variation usually exist in longitudinal patterns of hearing decline (Pearson et al., 1995). The question whether the rate of hearing decline affects psychosocial health has remained unanswered: does faster
decline in hearing status result in more psychosocial strain than slower decline? In this thesis, we hypothesize that when an older person’s hearing deteriorates slowly it may require only small behavioural and emotional adjustments, whereas relatively fast decline may require more rigorous adjustments. In the former case, automatic adaptation may play a more prominent role, while in the latter case, active coping may be required more strongly. As a consequence, we expect that the chances that the overall adjustment is less successful and leads to more psychosocial distress in the case of a fast decline are larger. However, it could also be that in more advanced stages of ARHL, there is reduced responsiveness to the effects of hearing loss, a phenomenon that has been observed in various chronic functional impairments (Bevan, 1965), including age-related vision loss (Schilling & Wahl, 2006; Schilling et al., 2011). To investigate this, baseline hearing status could be tested as an effect modifier. The examination of the psychosocial effects associated with the rate of hearing decline is of focus in Chapter 4 of this thesis. Effect modification by baseline hearing status and by various other factors is also addressed in this Chapter.

HEARING LOSS AND THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING, DISABILITY AND HEALTH

Once ARHL has progressed to noticeably impairing, older adults’ lives can be impacted greatly. Naturally, the latter also holds for adults with other types of hearing loss (conductive, mixed), or for adults who are hearing-impaired since birth or childhood. As is clear from the quotations at the beginning of this Chapter, there is a wide range of daily life activities and life situations that can be negatively affected by hearing loss.

Hearing loss is often described psycho-acoustically by pure tone or speech intelligibility thresholds. While these are useful for measuring specific functions, they appear to be less useful to predict consequences of hearing loss on daily activities and involvement in life situations (e.g., Houtgast & Festen, 2008; Kramer et al., 1996; Rowland et al., 1985; Saunders et al., 2004). As is further illustrated by the statements, there are many contextual factors within or outside the individual that can influence a person’s functioning with hearing loss. Examples are hearing aids, the acoustical environment, significant others, and hearing loss stigma (Garstecki & Erler, 1999; Gatehouse & Noble, 2004; Hétu, 1996; Kramer et al., 1995; Mulrow et al., 1990; Wallhagen, 2010). These should additionally be mapped in order to yield a complete understanding of a person’s functioning in his/her personal situation. Various self-report questionnaires can and are used to assess functioning with hearing loss and influencing contextual factors (e.g., see Bentler & Kramer (2000) for an overview of questionnaires used in aural rehabilitation).
International Classification of Functioning, Disability and Health

However, currently, there is no consensus among hearing professionals as to which instruments should be used to map a person’s functioning with hearing loss holistically, and, more fundamentally, which aspects of functioning should be covered then. A possible framework to describe the complex interplay of factors associated with a person’s functioning is the International Classification of Functioning, Disability and Health (ICF; World Health Organization, WHO, 2001).

According to the ICF, a person’s functioning and disability is conceived as a dynamic interaction between the health condition and contextual factors (World Health Organization, 2002). As is illustrated in Figure 1, the ICF identifies three levels of human functioning: functioning in terms of the person’s body (Body functions and Body structures), the whole person (Activity), and the whole person in a social context (Participation).

Body structures are anatomical parts of the body (e.g., the cochlea), while Body functions refer to the physiological functioning of body systems (e.g., speech discrimination). Activities refer to the execution of a task or action by an individual (e.g., conversing with many people) and Participation refers to involvement in life situations (e.g., work, socializing). The ICF further states that a person’s functioning can be influenced by Contextual factors (Environmental and Personal factors). Environmental factors make up the physical (e.g., hearing aids), social (e.g., friends), and attitudinal (e.g., stigma)
environment in which people live and conduct their lives, while Personal factors relate to the intrinsic part of the individual (e.g., gender, comorbidity, marital status, coping styles).

All limitations in structures and functions are referred to as Impairments, while difficulties experienced in Activities and Participation in life situations are referred to as Activity limitations and Participation restrictions, respectively. Functioning is the umbrella term for all body functions, activities, and participation, while Disability is the umbrella term for all Impairments, Activity limitations, and Participation restrictions.

ICF Core Sets for Hearing Loss

The ICF could be a suitable tool to operationalize the essential aspects of functioning and disability of adults with hearing loss. Although some efforts have been made toward the adoption of the ICF in scientific and clinical audiological work (e.g., Stephens et al., 2001; Hickson & Scarinci, 2007), general knowledge of the ICF and its use in daily clinical practice are not yet widespread. Possibly, this is due to the large number of ICF category codes that are available (i.e., over 1400), many of which may be irrelevant for hearing loss specifically. This could obscure the parts of the model that are relevant. Therefore, in 2010, the ICF Core Sets for Hearing Loss project was initiated by Danermark, Granberg, and colleagues in collaboration with the WHO ICF Research Branch (Danermark et al., 2010). A Core Set is defined as ‘a selection of categories from the full ICF classification that provides a user-friendly tool for describing functioning and disability that has been developed by means of a scientifically-structured process’ (ICF Research Branch, 2012).

WHO prescribes a rigorous scientific procedure to develop Core Sets, assuring that the perspectives of researchers, care professionals, and patients are all represented. Chapter 5 of this thesis reports on one of the preparatory studies of the Core Sets project. It concerns a focus group study among adults with hearing loss. The aim was elucidate the patient perspective: what range of aspects of their functioning, disability, and their context do they find relevant?

HEARING LOSS IN ADULTS: POSSIBLE INTERVENTIONS FOLLOWING HEARING SCREENING

As shown by his excerpt, Louis had “tried to stop” hearing aids for years. Unfortunately, this is true for the majority of older persons. Adults experiencing hearing difficulties are,

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3 Project coordination: Swedish Institute for Disability Research (SIDR), Örebro University and Audiological Research Centre, Örebro University Hospital, Örebro, Sweden.
on average, in their mid-seventies and wait ten years before they seek help and accept amplification (Davis, 1995; Davis et al., 2000).

The high number of adults with delayed diagnosis and treatment suggest that a proportion of the disease burden can be prevented if hearing loss were detected and treated earlier. Moreover, rehabilitation at older ages may be complicated by contextual factors such as cognitive impairment, manipulative problems (for hearing aid handling and maintenance), and institutionalization (Gates & Mills, 2005; Singh et al., 2013; Wallhagen et al., 2006). Further, families and friends of the hearing-impaired person could benefit from earlier intervention, as it is known that they are also burdened by the hearing loss of their loved one (Scarinci et al., 2009a;b). Lastly, services could benefit as they would not have to spend so much time in enabling very old patients to use hearing aids (Davis, 2003). Implementation of adult hearing screening programs including adequate interventions for screen-positives may be a solution to overcome these problems.

**Hearing aids**

Is hearing aid fitting the only intervention that should be considered for screen-positives? Hearing aid use has been associated with reduction in hearing loss disability, improvement in disease-specific quality of life, and, to a lesser extent, with improvement in generic quality of life (Malinoff & Weinstein, 1989; Mulrow et al., 1990; 1992; Stark & Hickson, 2004; Chisolm et al., 2007). Despite these favourable effects, various studies indicate that only a minority of the patients with potentially aidable hearing loss owns a hearing aid, fewer actually use it, and yet fewer are satisfied with it. Gates et al. (1990) and Chia et al. (2007) for instance found that about one third of the older adults with hearing impairment owns a hearing aid. Others found that around 15% of the older hearing-impaired adults use a hearing aid (Popelka et al., 1998). Smits et al. (2006) found that even in a group of older persons with poor hearing, only 42% owned a hearing aid. Further, recent research by Kochkin (2010) shows that 17% of the hearing aid owners is dissatisfied with its overall benefit, 9% is neutral, and 74% is satisfied about it. This study further reports that 12% of the hearing aids were in the drawer. Gates et al. (1990) found an abandonment proportion of 22%.

Obviously, there are barriers to uptake and use. These are partly known, and include amongst others: hearing loss/hearing aid stigma, wrong expectations of hearing aid benefits, low self-reported hearing disability, and low wearing comfort (Fook & Morgan, 2000; Knudsen et al., 2010; Meyer & Hickson, 2012; Wallhagen, 2010). Further complicating factors are that hearing aids provide amplification but do not fully restore
normal hearing, and hearing aids need a long learning and adjustment period allowing the brain to adapt to new sound quality (Gates & Mills, 2005; Wallhagen et al., 2006).

**Adult hearing screening recommendations**

Around 2008, no centrally coordinated, systematic, national adult hearing screening program had been implemented in a Western country. Various professional institutions did recommend professionals to screen for hearing loss in older adults, though. For instance, the US Preventive Service Task Force (1996) recommended periodical hearing loss screening, but left the frequency to the clinician’s discretion. The Canadian Task Force on Preventive Health Care (1994) and the American Academy of Family Physicians recommended screening during older adults’ periodic health examination. The American Speech-Language-Hearing Association (1997) advised to screen every three years after age 50 (for an overview, see Yueh et al., 2003).

In the United Kingdom, the UK National Screening Committee advised health care policy makers in 2009 not to implement systematic adult hearing screening yet (UK National Screening Committee, 2009). The committee judged there to be too little convincing evidence that many hearing-impaired persons would benefit substantially from screening and subsequent hearing aid fitting. Similarly, in the Netherlands, the Dutch Health Council had concluded in 2003 that, for the time being, no systematic hearing screening in older adults was recommended: the proper age of screening was still unclear, the readiness to participate in screening was too unsure, and it was unknown to what extent the poor image of hearing aids would be an obstacle (Gezondheidsraad, 2003). This advice was adopted by the Dutch College of General Practitioners (NHG), and is applied accordingly in the guideline on hearing impairment since (Boomsma et al., 2007).

**AHEAD III**

Nonetheless, many hearing professionals believed that carefully designed and evidence-based screening programs including accurate detection and adequate intervention hold the key to successful prevention. This led to the initiation of the European coordination action project AHEAD III in 2008 by Dr. Ferdinando Grandori. AHEAD III is an abbreviation for Assessment of Hearing in the Elderly: Aging and Degeneration - Integration through Immediate Intervention[^4]. An important goal was to collect and describe current

[^4]: http://www.ahead.polimi.it
knowledge on adult hearing loss screening programs, including the possible post-screening interventions.

The AHEAD III work package on Interventions recognized that the large underuse of hearing aids called for consideration of alternative intervention options. This notion corresponded to the increasing awareness within the international audiological field that standard aural rehabilitation should be holistic, i.e., considering a person’s total functioning, disability, health, environment, and quality of life, with rehabilitation chosen accordingly (Boothroyd, 2007; Kiessling et al., 2003; Stephens & Kramer, 2010). There is a range of non-instrumental interventions available to address this (e.g., see Laplante-Lévesque et al., 2010). Examples are communication programs, including training in speechreading, communication strategies, and personal adjustment (Gagné & Jennings, 2008). Communication programs may serve as viable alternatives or additions to a hearing aid fitting, also in the screening setting. However, thus far, it is unclear which of these or other alternative interventions have ever been offered in an adult screening program. Reviewing the scientific literature on adult hearing screening programs may provide us with valuable insights into the possibilities of post-screening intervention. It may also reveal important niches with regard to intervention options. This is the final research topic addressed in this thesis (Chapter 6).

EPIDEMIOLOGY: THE LONGITUDINAL AGING STUDY AMSTERDAM

All the quantitative findings of this thesis (i.e., Chapters 2, 3, and 4) were obtained using data from participants of a large, prospective Dutch cohort study: the Longitudinal Aging Study Amsterdam (Deeg et al., 1993; Huisman et al., 2011). LASA includes a population-based sample of older (55 years and over) adults. It is an ongoing cohort study on the predictors and consequences of changes in autonomy and wellbeing in an aging population. In this thesis, hearing status was considered both as a predictor (of psychosocial health) and as an outcome (of contextual predictors).

LASA started in 1992 and has a follow-up measurement every three to four years. From the 2001/2002 measurement onwards, hearing status was measured by means of two methods: through self-report (McWhinnie, 1979) and through a digit triplet speech-in-noise test\(^5\) (SNT; Smits et al., 2004). The hearing and psychosocial data used in this thesis originated from three subsequent measurements, i.e., from the 2001/2002, the 2005/2006, and the 2008/2009 measurement. These covered a total follow-up of seven

\(^5\) This test (Nationale Hoortest) is also publicly available online (http://www.hoortest.nl) or by telephone (0900-4560123).
years. All the principal statistical analyses in this thesis concerned longitudinal analyses. In Chapters 2 and 4, data of all three measurements were used. In Chapter 3, data of the first two measurements were used.

OUTLINE OF THIS THESIS

Chapter 2 focuses on the decline in older adults’ ability to recognize speech in noise as measured by the SNT. The average decline per annum is modeled and it is examined whether age-specific and gender-specific trajectories are present. Further, we investigate whether demographic, health-related, environmental, and cognitive factors influence the change in this ability.

In Chapter 3 the longitudinal associations between the two hearing status measures and various outcomes of older adults’ psychosocial health (i.e., emotional loneliness, social loneliness, and depression) are reported.

In Chapter 4 the rate of decline in hearing status (as measured by the SNT) is the determinant under study. We examine whether the rate of decline in hearing is associated with the rate of decrease in psychosocial health (here: emotional loneliness, social loneliness, depression, and anxiety). In both Chapter 3 and 4 special focus is on the exploration of subgroup-specific effects with regard to demographic, cognitive, and health-related characteristics.

In Chapter 5 we provide in-depth insight into the range of factors that adults with hearing loss report as relevant in their functioning and disability with hearing loss. The findings will contribute to the development of the ICF Core Sets for Hearing Loss. A qualitative research approach was applied here.

In Chapter 6 we provide a systematic descriptive review of the various interventions that were offered to screen-positive hearing-impaired adults that have been described in the scientific literature.

Finally, in Chapter 7 the results of the individual Chapters are put into context: we discuss the overall findings of this thesis, reflect on the applied methodology, and elaborate on the implications for future research and clinical practice.
REFERENCES


CHAPTER 1


