

Considerations in designing an adult hearing screening programme

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A national hearing screening programme for the general adult population

Hearing loss is an important public health problem because of the large number of people involved and the negative consequences for affected, untreated people and their significant others (Chapter 1). Adult hearing screening has been proposed as a potential strategy to motivate adults to seek help early (Davis et al., 2007; Thodi et al., 2013; Yueh et al., 2003). In 2003, on the authority of the Dutch minister of Health, Welfare and Sports, the Advisory Council on Health Research reviewed the literature on adult hearing screening and concluded that before implementing a national adult hearing screening programme, more information is needed on its cost benefit ratio and on organisational strategies to optimise this ratio (Raad voor Gezondheidsonderzoek, 2003). More specific, the council recommended research to the cost-effectiveness of screening, the right time for screening, the best target population, the acceptability of screening, the willingness to participate, strategies to improve participation, and factors that limit the effectiveness. Since this thesis addresses several of these topics, it contains valuable information for the Dutch government.

We interviewed recently screened adults about their reactions to the hearing screening test (Chapter 2). The participants stated to have no difficulties with the acceptability of the screening. This was to be expected because the test was non-invasive and because they had done the test by their own free will. The screening did not cause severe harms although some participants expressed feelings of indignation because they felt unfairly labelled as hearing-impaired. They believed that the test validity was poor. Adults with a positive judgment on the test validity were more likely to accept the screen outcome. Thus, to minimise the harms and maximise the effectiveness of screening, effort should be put in convincing screen participants that the test is valid. Our findings suggest that one may deal with screen participants' concerns on the test validity by giving a clear explanation of how the test works, by offering the screening in a silent environment without distracting factors, and by offering immediate rescreening (using either the same or another screening test). It will be wise to explore potential doubts people may have about the validity of a particular screening test and to include measures that may remove these doubts before nationwide implementation of the screening programme. For example, people may have doubts about the validity of the internet test because they do not understand how the volume level of their computer boxes does not influence the test outcome. Such concern can be anticipated by addressing the topic in the screen invitation letter or on the website before the test starts. Also hearing aid dispensers who are currently offering hearing screening may be interested in Chapter 2 because knowing what reactions to screening are to be expected and why, gives them the opportunity to anticipate.

To identify potential targets for high-risk group screening, we performed an observational study to predictors of hearing acuity (Chapter 5). Predictors included in this study were age, gender, type of occupation, educational level, cardiovascular disease, diabetes, systemic inflammatory disease, hypertension, obesity, waist circumference, smoking, and physical activity level. Cross-sectional as well as longitudinal regression analyses were performed. In the age-stratified regression

models, only 11% to 21% of the interindividual variance in hearing thresholds was explained by the non-audiometric predictors, which suggests that interindividual differences in hearing thresholds are primarily attributed to genetic variation. The predictors that made a statistically significant contribution to the explanation of the interindividual variance in baseline and future hearing thresholds were higher age, male gender, manual occupation, and large waist circumference. The effects of the last two predictors were very small which makes them unsuitable as a base for target selection. The mean hearing thresholds of middle-aged and older men were found to be comparable to those of women who were approximately 8 to 9 years older, therefore, offering screening to women at a later age than to men may be considered in order to improve the cost-effectiveness of screening.

The observational study (Chapter 5) gave insight in the relationship between age and hearing thresholds but did not directly provide information on the right time for screening. To determine the right time for screening, we examined the effect of target age on the cost-effectiveness ratio of screening using a state transition model (Chapter 6). The effect of offering screening later to women than to men could unfortunately not be assessed with this model because gender-specific data on help-seeking and hearing aid uptake was unavailable. The model was used to calculate the costs per quality-adjusted life year (QALY) of current practice (no screening) and 76 adult hearing screening strategies. The screening strategies varied in the age at first screening (either 50, 55, 60, 65, or 70 years), the number of repeated screenings (up to five repetitions), the time interval between repeated screenings (either 5 or 10 years), and the type of screening which was either telephone screening, internet screening, screening at the practice of the general practitioner (GP) with a hand-held screening device, or screening at the GP practice with a standard audiometer. The two screenings at the GP practice were opportunistic strategies since the screenings were offered to people at the moment they visited the GP practice for whatever reason. For the telephone and internet screening, on the other hand, all adults from a certain age were invited by letter. In the Netherlands, screening is deemed cost-effective and may be considered for nationwide implementation if the costs are below € 20000 per QALY (Van den Berg et al., 2008). We found that all screening strategies were cost-effective compared to current practice. For each type of screening, the most cost-effective strategy was targeting the screening at people aged 50 with rescreening at ages 55, 60, 65, and 70. Opportunistic screening at the GP practice was generally more costly and less effective than telephone or internet screening. Internet screening was slightly more cost-effective than telephone screening.

Internet screening at age 50, repeated at ages 55, 60, 65, and 70 was the most cost-effective strategy, costing € 3699 per QALY (Chapter 6). At a threshold of € 20000 per QALY this strategy had a probability of 100% to be cost-effective compared to current practice and a probability of 69% to be more cost-effective than any other strategy. The internet test used in this study was the National Hearing Test (www.hoortest.nl) that was developed by Smits and colleagues (2006). It is a non-commercial fully automatic adaptive speech-in-noise test that uses digit-triplets as speech material. The test is highly accurate (Leensen et al., 2011). Advantages of the internet test with

regard to the test validity are that people can control the test environment (by removing distracting factors like environmental noise) and that they can redo the test as often as needed for them to believe the outcome. Other advantages of the internet test are that people do not have to leave their house for testing and that they can do the test at any time that suits them. Internet access hardly forms a barrier for internet screening nowadays in the Netherlands as 98% of adults aged between 45 and 55 years, 94% of adults aged between 55 and 65 years, and 85% of adults aged between 65 and 75 years have access to internet at their home (Statistics Netherlands, 2013).

Since internet screening at age 50, repeated at ages 55, 60, 65, and 70 was found to be cost-effective, generally harmless, and highly accessible, we consider it eligible for nationwide implementation. Mentioning the telephone version of the National Hearing Test in the invitation letter for internet screening should be considered to make screening accessible for the few adults without internet access as well. Before implementing this screening programme nationwide, we recommend a geographically localised pilot study of 1 year with internet screening at age 50 to verify whether the assumptions made in the cost-effectiveness model for the first year hold up. A control group should be included to gain insight in the additional value of the screening programme next to existing screening programmes. Outcome measures that should be evaluated at the end of the pilot include: screen participation; harms of screening; steps taken in help-seeking in relation to the screen outcome; rehabilitation decisions; hearing aid use by people who purchase hearing aids; and the effects of rehabilitation on hearing disability, hearing handicap, and quality of life. Gender differences in these outcome measures should be examined to inform the decision on whether or not to start offering screening to women at a later age than to men, which seemed a promising strategy to increase the cost-effectiveness of screening based on the gender difference in the risk for hearing impairment.

The findings in this thesis indicate that implementing a national adult hearing screening programme will be a cost-effective strategy to improve the wellbeing of the general adult population. Implementation of such a screening programme will have positive consequences for hearing care professionals as well because their clientele will probably increase, resulting in a higher turnover and higher profits.

Comprehensive counselling to prevent non-use of dispensed hearing aids

Chapter 3 gives insight in potential strategies to prevent non-use of dispensed hearing aids. Hearing aid dispensers may use our findings to optimise their services. An important strategy to prevent non-use of dispensed hearing aids is by offering comprehensive counselling and training during the hearing aid trial. Boas and colleagues (2001) found that a counselling programme was a cost-effective strategy to decrease non-use among new hearing aid owners. Our study identified two topics that should definitely be addressed in a counselling programme. First, the programme should address the limitations of hearing aids. People should be assisted to understand and accept the hearing aids' limitations. Secondly, the counselling programme should address hearing aid self-efficacy: people should become confident that they are able to

become successful hearing aid users. Someone's hearing aid self-efficacy can be measured at the time of hearing aid fitting, using the MARS-HA (measure of audiologic rehabilitation self-efficacy for hearing aids) questionnaire developed by West and Smith (2007). Knowing someone's level of hearing aid self-efficacy can assist the hearing care professional in determining whether or not the person needs intensive hearing aid self-efficacy training during the hearing aid trial in order to become a successful hearing aid user. By building hearing aid self-efficacy, adults will be more motivated to adjust to hearing aids, persevere when hearing aid difficulties arise, and apply more effort toward successful hearing aid use. Smith and West (2006) and Meyer and colleagues (2014) described a number of strategies for enhancing hearing aid self-efficacy, including role play and motivational coaching by hearing care professionals or significant others.

Market opportunities related to hearing care for elderly care home residents

Most residents of care homes for the elderly have a hearing loss, but only a minority of them owns hearing aids (Cohen-Mansfield & Taylor, 2004; Stumer et al., 1996; Tolson, 1997; Tsuruoka et al., 2001). A possibly lucrative business strategy for hearing aid dispensers to reach this large pool of potential clients is by offering in-house hearing screening and rehabilitation. The evaluation study that is reported on in Chapter 4 may be of interest to hearing aid dispensers because it gives insight in the size of the potential hearing aid client pool in residential care homes for the elderly in the Netherlands and because it shows the effect of offering an in-house hearing screening and rehabilitation programme on hearing aid sales. Assuming that screen participation among residents without previously fit hearing aids was independent of their audiometric hearing status, it could be calculated that 92% of the residents of the included care homes had a hearing loss of 35 dB or more (best-ear pure-tone average at 1, 2, and 4 kHz). Approximately 72% of the residents with a hearing loss, that is 66% of all residents, had no hearing aid(s) at the start of the programme. The study was performed in 2010 when a binaural hearing loss was required for (partial) hearing aid reimbursement. Since January 2013 also people with a monaural hearing loss are entitled to partial hearing aid reimbursement. Consequently, the pool of potential new hearing aid clients in care homes for the elderly might be even greater than 66% nowadays. The willingness to try hearing aids among the hearing impaired residents without a previously fit hearing aid was low (14%), as was the success rate of the hearing aid trials (46%). Compared to the large number of potential new hearing aid clients (66% of all residents), the actual number of new hearing aid owners at the end of the programme was disappointing (4% of all residents). This finding is important for hearing aid dispensers who consider offering hearing screening and rehabilitation in residential care homes for the elderly.

We also found that approximately one-fifth of the care home residents who already owned hearing aids were interested in consulting a hearing care professional and that two-thirds of them had their hearing aids adjusted or replaced during the programme. This reflects a high level of unmet need for aftercare. Hearing aid dispensers may

therefore consider to regularly visit care homes to offer hearing aid aftercare. However, taking into account the absolute number of hearing aid owners per care home, offering in-house aftercare might not be very profitable for hearing aid dispensers. Each care home housed on average 88 adults: 65 without and 23 with hearing aids. Four or five of the hearing aid owning residents were interested in consulting a hearing care professional and three of them chose for hearing aid adjustment or replacement. This finding informs hearing aid dispensers on the expected value of offering aftercare in care homes for the elderly.

The screening and rehabilitation programme that we organised in the care homes resulted in only a slight increase in hearing aid ownership among the residents with a hearing loss (from 28% to 33%). The low hearing aid uptake during the programme indicates that most of the oldest elderly without hearing aids do not choose for hearing rehabilitation by hearing aid fitting, not even when possible mobility barriers are eliminated. Gussekloo and colleagues (2003), who came to a similar conclusion, reported that the major reason for not starting rehabilitation was that most elderly were at the same time concerned with trying to improve other aspects of their functioning which they perceived as more problematic than their hearing loss. This is probably also the reason for the low programme effectiveness in our study since care homes typically house frail elderly suffering from multiple comorbidities (ActiZ, 2010). We expect that the programme's effectiveness would not have been much higher if communication training had been offered as an alternative to hearing aid fitting because learning new communication tactics also costs effort. Therefore, care home organisations willing to invest in improving the communication and social engagement of the residents are recommended to consider environmental changes, like utilization of sound absorbent materials in common rooms or changes in seating arrangements (Hickson, 2009; Looi et al., 2004; Pryce & Goberman-Hill, 2012; Tolson & McIntosh, 1997). While a screening and rehabilitation programme targeted at the individual is beneficial for only a minority of the present residents, environmental improvements might be beneficial for all present residents as well as for all future residents (Hickson, 2009). A market opportunity for hearing care professionals is offering consultancy services to care homes for the elderly regarding optimisation of the listening environment in the (common) rooms.