

*Summary and Conclusions*

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# Hearing Aids for Adults

Benefits and Costs

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Summary and Conclusions of the SBU Report on:

# Hearing Aids for Adults

Benefits and Costs

May 2003

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# SBU Summary and Conclusions

## Introduction

In Sweden, an estimated 560 000 adults have hearing impairments severe enough to require a hearing aid. Approximately 270 000 adults have hearing aids, whereof more than 50 per cent use their aid regularly.

This report presents findings from a systematic and critical review of the scientific literature on the costs, risks, and benefits of using hearing aids to treat hearing loss.

The literature search focused on answering four questions:

- How common is hearing loss in the adult population, and what is the distribution among age groups and between men and women?
- At what level of hearing loss can hearing aids be of sufficient benefit to motivate testing and prescribing these devices?
- What is known about the value of the various technical features in modern hearing aids?
- What are the costs for audiological testing and hearing aid dispensing in Sweden?

The report mainly addresses the most common types of individual hearing devices, namely acoustic (conventional) hearing aids which amplify sound and transmit the signals via the auditory canal and middle ear to the inner ear. The literature review also aims at identifying the benefits of using hearing aids to treat hearing impairment in both ears.

The most common type of hearing impairment is sensorineural impairment caused by injury to the inner ear (in the cochlea and the nerve fibers from the cochlea to the brain stem). Sensorineural hearing impairment has both a quantitative and qualitative impact on hearing ability. Quantitative hearing loss

means that many sounds are not heard at all. Qualitative hearing loss means that audible sounds are distorted. Generally, patients with very severe hearing impairment do not comprehend sounds. The most common course of hearing loss involves slow deterioration in hearing that begins during adulthood. Often, the individual affected does not notice a loss in hearing before it becomes serious or is noticed by someone else. Hearing loss can lead to a poorer quality of life due to a reduction in social activity, greater isolation, a sense of being an “outsider”, and in some cases symptoms of depression.

## Project Methods

The literature review was initiated by searching for previously published systematic reviews on the prevalence of hearing impairment, the benefits of hearing aids, and health economics. English language literature in these areas was then searched using MEDLINE. No other literature databases were searched. In addition to the database search, reference lists in relevant publications were also searched, and project members contributed references with which they were familiar. The MEDLINE search covered publication dates through December 2002.

A special protocol was used to review articles addressing the prevalence of hearing impairment and the benefits of hearing aids. The review was carried out by two members of the Project Group, independently of each other, and addressed the following questions:

- Did the study design use methodology suited to the purpose, and did it include an appropriate sample of participants?
- Were the participants and surveyors knowledgeable about the technical performance of the hearing aids being compared (ie, was the study blinded)?
- Did the study clearly report on dropout, and could dropout have skewed the results?
- Were appropriate statistical methods used to analyze the data?

- Was statistical power calculated prior to the start of the study?
- Were established methods used to measure the prevalence of hearing impairment and the effects of hearing aids?

Depending on the answers to these questions, the reviewers determined whether the article/study presented high-grade, moderate-grade, or poor-grade evidence.

The following scale provided the structure for grading evidence used to answer the four literature review questions:

*Evidence Grade 1:* Good scientific evidence.

At least two studies present high-grade evidence or there is at least one good, systematic review.

*Evidence Grade 2:* Fair/moderate scientific evidence.

One study presents high-grade evidence and at least two studies present moderate-grade evidence.

*Evidence Grade 3:* Poor scientific evidence.

At least two studies present moderate-grade evidence.

*Evidence Grade 4:* No/insufficient scientific evidence.

No studies present acceptable scientific evidence.

## Results

### Prevalence of Hearing Loss in the Adult Population

The prevalence of hearing loss in adults was estimated using pure tone audiograms<sup>1</sup>.

The Swedish studies that used pure tone audiograms to survey the prevalence of hearing problems are not necessarily representative of the entire population. However, the outcomes from studies performed in other countries are similar to the results from the Swedish studies. Using these studies as a point of departure, it is estimated that 1.2 million people aged 18 years and older have mild hearing loss, 495 000 have moderate hearing loss, and 120 000 have severe or profound hearing loss. Not everyone with a hearing loss can benefit from a hearing aid.

The prevalence of hearing loss increases rapidly from age 50

years and upward. Of those in Sweden with moderate to profound hearing loss, somewhat over 400 000 are aged 70 years and older. Nearly everyone aged 80 years and older has some degree of hearing loss. However, there is no clearly identified difference between men and women regarding the prevalence of hearing loss. The definition used for hearing loss is, however, not ideally suited to comparisons since women have somewhat worse hearing than men at low frequencies while men have worse hearing than women at high frequencies.

### **Benefits of Hearing Aids at Different Levels of Hearing Loss**

Hearing aids improve a person's ability to comprehend speech, even in noisy environments. A hearing aid, however, does not normalize the ability to hear. This applies particularly to hearing impairment caused by problems in the inner ear (cochlea), which is the most common reason for impaired hearing. It is important that those who receive hearing aids also receive basic information concerning how the aid works. They should also be given the opportunity to return for further advice and adjustment of their hearing aid. This is important from several standpoints, even to assure that users' expectations regarding the benefits of a hearing aid are realistic.

Hearing aids can be beneficial in mild hearing loss, but probably only for some individuals, and in situations where background noise is not excessive. Hence, the decision to use a hearing aid should be made only after the potential user has had an opportunity to test the device in challenging situations.

Hearing aids are of greatest benefit for those with moderate hearing loss. In cases of severe and profound hearing loss, hearing aids are necessary to be able to comprehend speech. However, studies are insufficient to show the benefits of hearing aids in individuals with severe or profound hearing impairment.

Instruments are lacking that can answer the important question: At what level is hearing loss serious enough that hearing aids



can be of sufficient benefit to motivate the testing and prescription of these devices?

### **Benefit of Various Technical Functions of Hearing Aids**

The literature was also evaluated with regard to whether or not there are differences in the benefits of devices using linear or non-linear amplification, between devices based on analog or digital amplification, or devices equipped with omnidirectional or directional microphones. There are no confirmed differences in benefits between linear and non-linear amplification according to speech testing in a laboratory environment. However, several studies have shown advantages with non-linear hearing aids, according to the users, in terms of sound quality and benefits in daily life. Furthermore, there is no evidence that digital hearing aids are superior or inferior to analog devices based on speech testing, sound quality measurements, and subjective benefit measures. Five studies were found that addressed hearing aids with omnidirectional and directional microphones, respectively. Two of these studies show improved hearing capacity from hearing aids with directional microphones, based on speech testing and subjective benefit measures.

It is important to note that the comparisons between different types of hearing aids and different technologies nearly always compare the latest generation of hearing aids with the next most recent generation. Hence, the differences are seldom dramatic.

### **Benefits of Two Hearing Aids Versus One Hearing Aid**

For years, it has been discussed whether two hearing aids should be fitted for patients with impaired hearing in both ears, or whether it is sufficient to use a single hearing aid. Acoustic and hearing physiology observations suggest that two hearing aids can be superior to one when hearing is impaired in both ears. There is support from laboratory studies that two hearing aids can provide better speech comprehension than a single hearing aid. However, there is no support from controlled clinical trials to show whether two hearing aids are superior to one.

## **Risk for Injury and Complications**

The use of hearing aids can be accompanied by complications such as inflammation of the auditory canal. This type of inflammation can be caused by poorly fitted inserts, allergic reactions from the plastic components used in the device, or excessive wax production in the ear. One possible complication concerns the risk for noise-induced hearing loss if the acoustic gain of the hearing aid is too high. There is no scientific evidence that hearing aids themselves create a risk for further impairing hearing in users with mild and moderate hearing loss – provided that appropriate fitting procedures are followed. In people with severe hearing loss, one cannot exclude the possibility that hearing loss may be exacerbated due to hearing aid amplification (even if appropriate routines are followed). However, the documentation supporting this claim is weak.

## **Need, Access to, and Use of Hearing Aids in Adults**

It has been estimated that approximately 560 000 adults in Sweden can benefit from hearing aids. This estimate is based on studies that have used pure tone audiograms to determine the number of individuals with various degrees of hearing impairment, and a Swedish study including hearing checkups and a needs' assessment among the elderly in Göteborg. It is not known how many of these individuals actually have hearing aids. Based on information from a study of living conditions in Sweden (the ULF study from Statistics Sweden), an estimated 270 000 adults have hearing aids. In the best case scenario, ie, if each of these 270 000 individuals belong to the 560 000 adults who would benefit from a hearing aid, then approximately one half of those who could benefit from a hearing aid would actually have access to one.

Only about one half of those with hearing aids report that they use them “often” or “always”. This information comes from responses to a question in the ULF study. There are no Swedish studies addressing the factors that determine when, and how

much, a hearing aid is used.

A dominant request among users of hearing aids is that this technology should work better in the situations where one experiences the greatest difficulty in hearing, namely environments with a considerable background noise. In many cases the background noise consists of people talking. Even if hearing aids enhance the possibilities to perceive sounds and understand speech, they do not provide normal hearing, mainly because they cannot differentiate sound that the user wants to hear from the background noise that the user does not want to hear.

### **Volumes and Costs for Hearing Aids**

Slightly over 58 000 people aged 18 years and older are estimated to have received hearing aids during 2002. Of this group, 39 000 people received hearing aids in one ear and 19 000 people in both ears. During a 12-month period between 2001 and 2002, hearing centers in Sweden purchased 77 500 hearing aids at a cost of approximately 287 million Swedish kronor (SEK). The combined costs for audiological testing and prescribing of hearing aids in 2002 was approximately 562 million SEK. This represents an average cost of approximately 10 000 SEK per person who received a hearing aid. There are wide differences among the county councils concerning the number of hearing aids purchased per inhabitant and in the choice among different types of devices. Some county councils purchased less than half as many hearing aids per inhabitant compared to other county councils. This cannot be explained by the differences in the age distribution or the prevalence of hearing loss. Most likely the difference is due to variations in practice. This is supported by the observation that the percentage of all devices purchased for placement in the auditory canal is four times higher in the county councils where the percentage is highest (10 per cent and more than 40 per cent, respectively). Since we have insufficient information about the level of hearing loss and functional impairment among those receiving hearing aids, it is not possible to draw conclusions on the optimum distribution based on need.

# Conclusions

- ❑ An estimated 1.2 million people in Sweden aged 18 years and older have mild hearing loss, 495 000 have moderate hearing loss, and 120 000 have severe or profound hearing loss. The prevalence of hearing loss increases rapidly at age 50 years and older. Of those in Sweden with moderate to profound hearing loss, somewhat over 400 000 are aged 70 years and older. There is no obvious difference between women and men as regards the prevalence of hearing impairment (Evidence Grade 1).
- ❑ Hearing aids mainly benefit those with moderate to severe hearing loss (Evidence Grade 1). Hearing aids amplify sound and can improve the user's ability to understand speech, even in noisy environments, but they do not provide normal hearing (Evidence Grade 1).
- ❑ With mild and moderate hearing loss, there is no risk that hearing aids cause permanent hearing loss if appropriate fitting routines are followed. There is insufficient evidence to assess the risk that hearing aids may cause hearing impairment in severe cases if appropriate routines are followed (Evidence Grade 3).
- ❑ In comparisons between older, less complex types of signal processing (linear hearing aids) and more advanced signal processing (non-linear hearing aids), no significant differences have been demonstrated in speech testing in a laboratory setting (Evidence Grade 2). Several studies, however, show the advantages of non-linear hearing aids in regard to sound quality and benefits in daily life, according to users (Evidence Grade 2).

- ❑ In recent years, there has been a shift from analog to digital technology in hearing aid amplification. There is no evidence that hearing aids with digital amplification are superior to modern hearing aids using analog amplification (Evidence Grade 2). Hearing aids usually use an omnidirectional microphone, but they can also be equipped with a directional microphone. Some users notice the difference, and use a directional-microphone device in noisy environments while they often prefer omnidirectional microphones in quieter environments (Evidence Grade 3).
- ❑ Acoustic and hearing physiology factors suggest that two hearing aids may be superior to one in people with hearing loss in both ears. However, no clinical trials have shown that two hearing aids are superior to one hearing aid in the user's daily life situation (Evidence Grade 3).
- ❑ Approximately 560 000 adults are estimated to have sufficient degree of hearing loss to derive benefit from a hearing instrument. Approximately 270 000 people have hearing aids. Slightly more than half of this group report that they use their hearing aid "often" or "always" (Evidence Grade 3). The reasons most frequently given for not using hearing aids are that they do not provide sufficient benefit, particularly in environments with disturbing background noise, and also that using the device embarrasses the user (Evidence Grade 3).
- ❑ An estimated 58 000 people aged 18 years and older received hearing aids in Sweden during 2002. Of this total, 39 000 received a hearing aid in one ear and 19 000 received hearing aids in both ears. During the year, hearing centers purchased 77 500 hearing devices at a cost of 287 million SEK. The total cost for audiological testing and for purchasing and fitting hearing aids is estimated at 562 million SEK. This yields an average cost of approximately 10 000 SEK per person

receiving a hearing aid. There are wide variations among county councils as regards the number of hearing aids purchased per inhabitant and the type of device. Since we have no information on the degree of hearing loss and functional impairment in those receiving hearing aids, it is not possible to draw any conclusions concerning the volume which best corresponds to the need.

- The need for further scientific studies is substantial. The most pressing research questions include:
  - In what way can hearing aids help improve speech comprehension in noisy environments?
  - How great are the benefits of hearing aids at various levels of hearing loss?
  - When does the need to hear become strong enough for a person to use a hearing aid?
  - Are the benefits of using two hearing aids, in the user's daily life situations, superior to the benefits of using a single device?

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<sup>1</sup>A pure tone audiogram shows hearing threshold at different sound frequencies. A hearing threshold is the lowest volume at which a sound with a particular frequency can be perceived. Hearing thresholds are reported in decibels (dB). The results from an audiogram are usually summarized as a mean value for hearing thresholds at several key frequencies. This report uses mean values for the hearing threshold at four frequencies: 500, 1000, 2000, and 4000 Hz. These frequencies are important to be able to comprehend human speech. The degree of hearing impairment is classified into mild (mean value of 21–39 dB), moderate (mean value of 40–64 dB), and severe or very severe hearing impairment (mean value  $\geq$  65 dB).



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The Swedish Government has given SBU the following responsibilities:

- SBU shall evaluate the methods used in health care by systematically and critically reviewing the scientific evidence in the field.
- SBU's assessments shall cover the medical aspects and the ethical, social, and economic consequences of disseminating and applying medical and dental technologies.
- SBU's assessments shall be compiled, presented, and disseminated in such a way that all affected parties have access to the information.
- SBU shall contribute, through informational and educational initiatives, toward ensuring that the knowledge gained is used to rationally utilize available resources in health care.
- SBU shall draw on national and international experience and research findings in the field and shall serve as a focal point for health technology assessment in Sweden. This effort shall be managed in a way that secures success and respect for the organization, both domestically and internationally.

## **Hearing Aids for Adults – Benefits and Costs**

The SBU report, “Hearing Aids for Adults – Benefits and Costs”, is based on a systematic and critical review of the scientific literature.

The Summary and Conclusions of the updated report, presented in this booklet, have been approved by the SBU Board of Directors and the SBU Scientific Advisory Committee.