

# The Impact of Untreated Hearing Loss on Household Income



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## Abstract

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In a survey of more than 40,000 households utilizing the National Family Opinion panel, hearing loss was shown to negatively impact household income on-average up to \$12,000 per year depending on the degree of hearing loss. However, the use of hearing instruments was shown to mitigate the effects of hearing loss by 50%. For America's 24 million hearing-impaired who do not use hearing instruments, the impact of untreated hearing loss is quantified to be in excess of \$100 billion annually. At a 15% tax bracket, the cost to society could be well in excess of \$18 billion due to unrealized taxes.

## Introduction

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According to a recent national survey by the Better Hearing Institute<sup>1</sup>, more than 31 million Americans in non-institutional settings admit to a hearing loss. Only 37% are at retirement age. The majority are either at school age or in the work force. Only 23% of hard-of-hearing Americans are being helped with hearing instruments, which are the necessary treatment for 90-95% of people with hearing loss.

There is an extensive body of research concerning the impact of hearing loss on quality of life<sup>2-3</sup>. When we talk of quality of life, healthy hearing per se is not just to enhance aesthetic pleasure of acoustic sounds in a person's environment. Indeed, hearing loss has been shown to negatively impact nearly every dimension of the human experience including: physical health, emotional and mental health, perceptions of mental acuity, social skills, family relationships, self-esteem not to mention work and school performance. In a recent review of the literature<sup>4</sup>, Dr. Bridget Shield, Professor of Acoustics at London South Bank University, has shown that hearing loss is related to unemployment and underemployment. However, the majority of research clearly has focused primarily on people with severe to profound hearing loss. The literature is less clear on the impact of lower levels of hearing loss and how they impact effectiveness in the workforce, though some recent studies indicate that minimal hearing loss is detrimental to the learning of language skills among children<sup>5</sup>. In addition, while the link between hearing loss and employment has been established, for those receiving treatment for hearing loss, it is difficult discerning whether or not such treatment is associated with improvements in their economic prosperity.

The purpose of this paper is to quantify the relationship between treated and untreated hearing loss and income.

## Method

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In November 2004, a short screening survey was mailed to 80,000 members of the National Family Opinion (NFO) panel. The NFO panel consists of households that are balanced to the latest U.S. census information with respect to market size, age of household, size of household, and income within each of the nine census regions, as well as by family versus non-family households, state (*with the exception of Hawaii and Alaska*) and the nation's top 25 metropolitan statistical areas.

The screening survey covered only three issues: 1) physician screening for hearing loss, 2) whether the household had a person "*with a hearing difficulty in one or both ears without the use of a hearing aid*", and 3) whether the household had a person who was the owner of a hearing instrument. This short survey helped identify close to 16,000 people with hearing loss and also provided detailed demographics on those individuals and their households, which was reported in the first publication in this series<sup>1</sup>. The response rate to the screening survey was 66%. In January 2005, an extensive survey was sent to 3,000 random hearing instrument owners and 3,000 random people with hearing loss who have not yet adopted hearing instruments. The response rates for the detailed surveys were 75% and 77%, respectively.

The data presented in this article refer only to households as defined by the U.S. Bureau of Census; that is, people living in a single-family home, duplex, apartment, condominium, mobile home, etc. People living in institutions have not been surveyed; these would include residents of nursing homes, retirement homes, mental hospitals, prisons, college dormitories, and the military.

Detailed demographics of the hearing instrument owner population are documented in the first publication<sup>1</sup>, so they will not be repeated here. Hearing instrument owners responded to a seven page survey consisting of 188 questions or response scales in the following areas: hearing instrument owner demography, hearing loss measures, product features, customer satisfaction and usage, future behavior, factors influencing hearing instrument adoption and perceptions of hearing health providers. Non-owners also responded to a seven page survey covering non-owner demography, hearing loss measures, visitation with hearing health professionals and the medical profession, reasons for non-adoption of hearing instruments and future plans.

**Sample Selection.** From the screening phase, close to 16,000 people with hearing loss were identified. Excluding children and people in the household who were not the head of household or spouse of the head of household, the following sample sizes were achieved for this study:

- Aided - 1,891 households – where the head of household or spouse indicated that one or more had a hearing loss and that one or more wore a hearing instrument.
- Unaided - 1,954 households – where neither the head of household nor spouse wore a hearing instrument but reported that one or more had a hearing loss.
- Normal hearing - 39,420 households – where neither the head nor household or spouse reported they had a hearing loss.

**Hearing Loss Measures.** Since income is hypothesized to be related to degree of hearing loss, both aided and unaided subjects were asked to complete the following subjective measures of hearing loss: Consumers were segmented into one of ten groups (called deciles) based on their responses to four measures of hearing loss:

- Number of ears impaired (1 or 2)
- Score on the Gallaudet Scale<sup>6</sup>: An eight point scale in which the respondent indicated whether they can understand speech under the following conditions: “whisper across a quiet room”, “normal voices across a quiet room”, “shouts across a quiet room”, “loud speech spoken into their better ear”, “not able to understand loud speech in their better ear”; In addition, “tell noises from each other”, “hear loud noises at all”, “hear any sound or any noise”. An individual’s score ranged from 1-8. Typically they are classified into one of five groups (1-hear whisper, 2-hear normal voice, 3-hear shouts, 4-hear speech in loud ear, 5-can’t hear speech). What makes the Gallaudet scale of particular value is it has been validated against clinical information. The relationship between audiogram information (average dB loss better ear & standard deviation) per Gallaudet scale score was reported in the 1984 Hearing Industries Association report based on a 1970 study conducted by Schien, Gentile, and Haase (*reference not given*). The Gallaudet Scale has historically been used by the Centers for Disease Control in their quantification of the hearing-impaired population<sup>7</sup>.
- Score on the Unaided Abbreviated Profile of Hearing Aid Benefit (APHAB)<sup>8</sup> - an inventory of how difficult it is to hear without hearing instruments in 18 listening situations. The APHAB consists of 4 scales: ease of communication (EC), reverberation (RV), background noise (BN) and aversiveness of sounds (AV). We did not administer the AV subscale and we changed the scaling to 0% to 100% of the day in 10% increments. A factor analysis of BN, EC and RV, revealed that the APHAB was unidimensional; thus, the unaided APHAB score for each individual was the mean of the three subscales.
- Subjective hearing loss score – Mild to profound (a score of 1-4)

A factor analysis of the above subjective measures was performed revealing a single measure of hearing loss. Factor scores were computed and each household was placed into one of ten hearing loss groups where decile 1 = the mildest hearing loss – the lower 10% of people with hearing loss; and decile 10 = the most serious hearing loss – the top 10% of people with hearing loss. Normal hearing households were classified as “Normal”. The sample sizes for hearing-impaired households are shown in Table 1.

**Table 1. Sample Sizes-- households with hearing loss.**

Decile	Hearing Instrument Users	Non-users of Hearing Instruments	Total Hearing-Impaired
10%	31	352	383
20%	53	330	383
30%	96	286	382
40%	151	235	386
50%	187	210	397
60%	224	158	382
70%	237	132	369
80%	271	112	383
90%	310	80	390
100%	331	54	385
<b>Total</b>	<b>1,891</b>	<b>1,949</b>	<b>3,840</b>

The following variables were evaluated as possible predictors of household income:

- Household designation (7 point classification of household composition): husband and wife; male, no wife, child and/or other relative present; female no husband, child and/or other relative present; male living alone; female living alone; male living with non-relative; female living with non-relative.
- Marital status (2 point classification): currently married, currently not married.
- Age (12 brackets): ages 25-79 in 5 year increments & age 85+.
- Geography (9 regions): East No. Central, East So. Central, Middle Atlantic, Mountain, New England, Pacific, South Atlantic, West No. Central, West So. Central.
- Market size (4 city sizes based on where the household resides): < 50k, 50k-499k, 500k-2 million, >2 million.
- Hearing loss by group: ten aided samples, ten unaided samples, and 1 normal hearing loss sample for a total of 21 groups.

All demographic variables above were included in the model since they were significantly correlated with group membership. Education was not included in the model since there were no significant differences in educational level as measured in years between the three groups. The average years of schooling attained by group are as follows: Normal hearing group (12.75 years), unaided group (12.66 years), aided group (12.61 years).

## Results

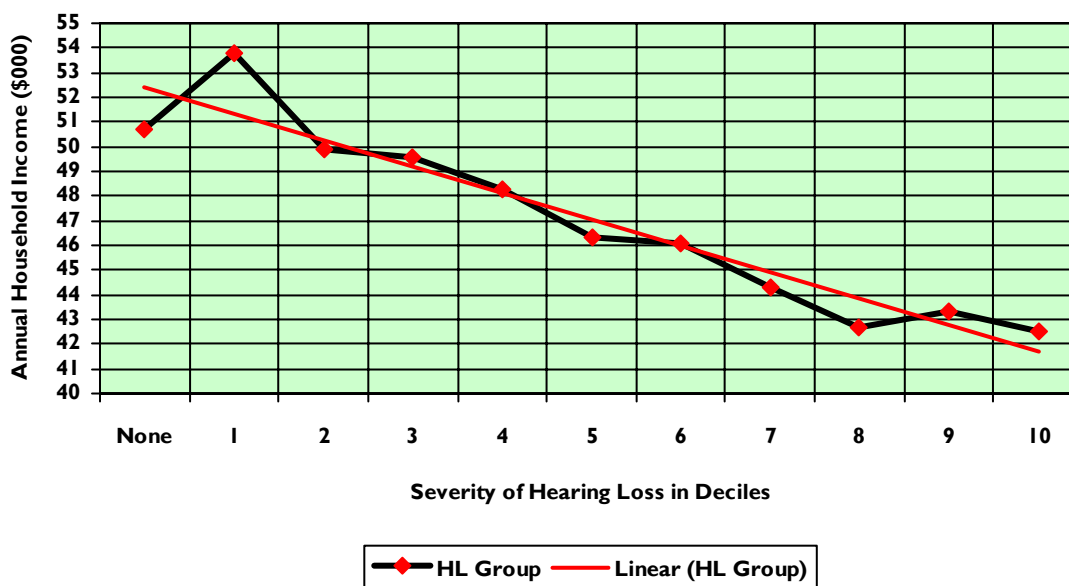
The overall model of household income using all predictor variables was significant ( $F=212.51$ ,  $df=49$ ,  $p<.0001$ ,  $R^2=.194$ ). All variables were significant at the  $p<.0001$  level as shown in table 2:

Table 2. ANOVA results. Prediction of Household Income.

Factor	df	F Value	Pr > F
Hearing loss by Group	20	4.23	<.0001
Market Size	3	318.65	<.0001
Geography	8	8.92	<.0001
Age	11	144.51	<.0001
Marital Status	1	68.59	<.0001
Household Designation	6	321.47	<.0001

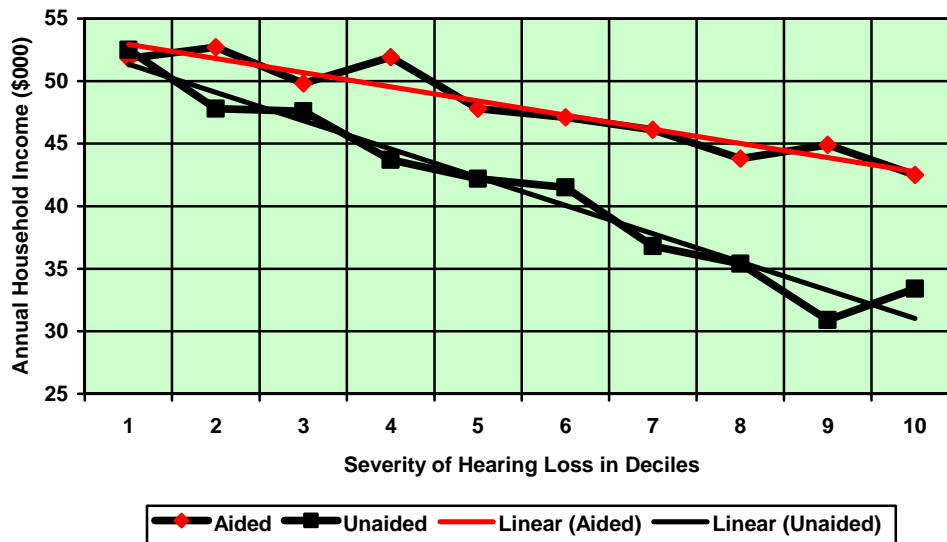
The least square means (*adjusting for the variables in Table 2*) for the 10 hearing loss groups and the single normal hearing group are plotted in Figure 1. The linear model expressing the relationship between hearing loss and income is approximately: \$53.2k - \$1.18k for every 10% increase in hearing impaired as measured in this study. In other words individuals with the most serious hearing loss (decile 10) could be expected to earn \$12,000 less per year than an individual with a mild (decile 1) hearing loss.

Figure 1. Relationship between hearing loss and household income.



Does the use of hearing instruments mitigate the impact of hearing loss on income? To answer this question the reader is referred to Figure 3 which plots the least square salary profiles for the hearing-impaired who use hearing instruments and for those who do not. These salaries are again adjusted for the demographic variables listed in table 2.

**Figure 2. Relationship between hearing loss and household income comparing aided and unaided people**

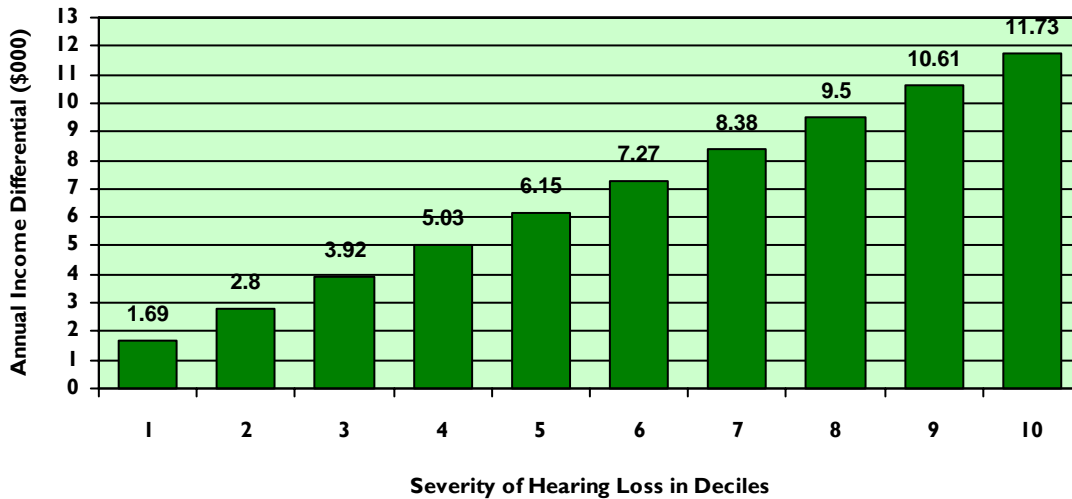


The unaided household income (linear model) = \$53.5k - \$2.25k (for every decile of hearing loss). While the aided household income (linear model) = \$54.1k - \$1.13k (for every decile of hearing loss). While both treated and untreated hearing loss groups show deterioration of income as their hearing loss worsens, the income decline is cut in half for hearing aid owners. For example, the difference between decile 1 (mild) and decile 10 (profound) incomes as shown in figure 2 model is as follows:

- Unaided income differential - \$20,300
- Aided income differential - \$10,200

Finally the difference between the unaided and aided linear models is shown in Figure 3 where the impact of non-treatment for hearing loss ranges from \$1.7k to \$11.7k per year depending on the severity of hearing loss; for sensitivity purposes we may not want to accept the difference at decile 1 since the least square means are virtually identical for the lowest 10% of the hearing loss population before linear smoothing. After decile 1 the treated and untreated profiles diverge at the rate of approximately \$1,000 for every 10% increase in hearing loss.

**Figure 3. Household income differential - aided versus unaided by severity of hearing loss (linear model)**



As shown in Table 3, the cost to society could be significant, since untreated hearing loss results in underachievement on the job. Currently 24.08 million people with admitted hearing loss do not use hearing aids in the U.S. If we segment the non-owner population into hearing loss decile group, it can be seen that the non-owner hearing loss is significantly lower than the hearing aid owner population hearing loss. For example 18.1% of non-owners are in the lower 10% of hearing loss in America. Now if we cross multiply population size by income differential we can arrive at:

- Estimated loss in income due to untreated hearing loss.
- Estimated Federal taxes not realized due to untreated hearing loss assuming a 15% tax bracket (simplified).

The estimated cost in lost earnings due to untreated hearing loss is \$122 billion while the cost to society in terms of unrealized Federal Taxes is \$18 billion. For sensitivity analysis one can assume no impact on the bottom 50% of the population with hearing loss. No matter what cut-off is accepted the impact on household income and unrealized Federal taxes will be significant.



**Table 3. Simulated household income loss and unrealized Federal Taxes from non-aided households**

Hearing loss in Decile	Current Distribution for non-owners	Population size in Millions	Annual Lost Income (\$Billions)	Annual Unrealized Federal Taxes (\$Billions)
10%	18.1%	4.36	\$07.36	\$1.10
20%	17.0%	4.09	\$11.46	\$1.72
30%	14.6%	3.53	\$13.81	\$2.07
40%	12.0%	2.90	\$14.58	\$2.19
50%	10.8%	2.59	\$15.92	\$2.39
60%	8.1%	1.95	\$14.16	\$2.12
70%	6.8%	1.63	\$13.64	\$2.05
80%	5.7%	1.38	\$13.11	\$1.97
90%	4.2%	1.00	\$10.61	\$1.59
100%	2.8%	0.67	\$07.80	\$1.17
<b>Total</b>	<b>100%</b>	<b>24.08</b>	<b>\$122.40</b>	<b>\$18.40</b>

## Conclusions

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Hearing is a critical sense for effective communication in the work force. Most employment situations require verbal communication in order to effectively engage in commerce and in dealing with the public; effective hearing is also critical to assure safety on the job. Without aided hearing, as this data and the literature shows, the hearing-impaired individual can be expected to suffer losses in compensation due to underemployment, may make mistakes on the job, experience higher rates of unemployment and in general may experience an overall reduction in quality of life (*i.e. anxiety, depression, social isolation, social paranoia, medical health, emotional stability, cognitive functioning, etc*) which may negatively impact job performance.

Most hearing health professionals are aware of individuals who delayed hearing loss treatment well past their working lives due to fear of stigmatization on the job. This author is personally aware of a CEO who indicated that he had delayed treatment for his hearing loss due to vanity until he made a critical error which personally caused him to lose a million dollar contract. We have also talked with individuals who suffered needlessly during their school years with “hidden” hearing loss. Unfortunately, untreated hearing loss is not hidden for it results in underachievement for nearly all who delay treatment while they are in the prime of their life. The tragedy is that untreated hearing loss impacts the individual and his or her family for the rest of his or her life in the form of lost wages, lost promotions, lost opportunities, and unrealized dreams, not to mention lower income in their retirement.

## References

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