An Increasing Prevalence of Hearing Impairment and Associated Risk Factors over Three Decades of the Alameda County Study

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Introduction

Hearing impairment is significantly associated with multiple negative outcomes including depression, loneliness, altered self-esteem, and diminished functional status. It is thus a significant public health issue.

Known causes of hearing loss are multiple. Hearing impairment increases with age, and the most common loss occurs at higher frequencies, making speech especially difficult to understand when there is background noise. Noise itself is considered one of the most common causes of hearing loss in industrial countries, and data support an association between hearing loss and service/blue collar occupations in the United States; however, the impact of noise may become less with age. Other causes include pharmacotherapeutic agents, industrial chemicals, rapid changes in ambient pressure, and a number of medical conditions. In this study we sought to quantify changes in the prevalence of hearing impairment over the last three decades in a representative sample of older adults and to investigate potential risk factors.

Methods

The subjects were participants in the Alameda County Study, a longitudinal investigation of health and mortality started in 1965. The original 6928 subjects, who were selected by a random household survey in Alameda County, California, have been followed regardless of subsequent location.

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For the first three surveys (conducted in 1965, 1974, and 1983), hearing impairment was measured with a simple yes/no response to the question, "Do you have trouble hearing (even with a hearing aid)?" In 1994 the question was asked in two parts: "Have you ever had trouble hearing (even with a hearing aid)?" and then, if yes, "Have you had it in the last 12 months?" Only those answering yes to both questions are counted as hearing impaired in 1994.

Hearing impairment prevalence rates are calculated for those aged 50 years and older and include 5108 participants who responded in any of four survey periods. Most are included in more than one period. To remove the effects of aging, results are age-adjusted to the 1994 survey population by the direct method. The trend in gender differences in impairment was assessed with a logistic model with a gender-by-time-period interaction term.

The incidence analyses examine 2470 subjects who reported no hearing impairment in 1974 and who survived to 1994. Of these, 346 reported hearing impairment in 1994. Risk factors are from 1974. For occupational noise exposure we compared those classified by the 1970 census as craftsmen, operatives, or foremen with those working in other occupations. Occupational data were available for men only. For potential ototoxic drug exposure (e.g., diuretics, antibiotics) we selected three reported symptoms likely to be associated with their use: pain in the heart or tightness or heaviness in the chest; trouble breathing or shortness of breath; and constant coughing or frequent heavy chest colds. Subjects reporting having any of these symptoms over the past 12 months were compared with those reporting none. We also compared subjects who reported having had an operation involving a 3-day hospital stay in the last 8 years or having been admitted to a hospital for any reason with those not reporting these events. Exercise was measured by comparing those who often engaged in at least one of four types of exercise (walking, swimming, active sports, or physical exercise) with those who did not often engage in any exercise. Incidence analyses use logistic regression and control for age, ethnicity, gender, and income.

Results

Age-adjusted hearing impairment prevalence rates over the four follow-up interviews, shown in Figure 1, demonstrate a near doubling in prevalence from 1963 to 1994. Rates for both sexes have increased, but the increase was greater for men ($P = .08$ for the gender-by-time-period interaction text).

Figure 2 presents the proportional increase in hearing impairment between 1963 and 1994 for four age groups; it is clear that the increase has been much more pronounced among those under age 70.

Results of the incidence analyses are shown in Table 1. Significant risk factors include:

### Table 1—Adjusted Odds Ratios for 1974 Predictors of 1994 Incident Hearing Impairment among 2470 Adults Aged 50 to 101 Years: Alameda County Study, 1994

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Adjusted OR (95% CI)$^2$</th>
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<tbody>
<tr>
<td>Occupation: craftsman, operative, or foreman</td>
<td>1.45 (1.01, 2.08)</td>
</tr>
<tr>
<td>Admit to hospital in last 8 y</td>
<td>1.42 (1.09, 1.85)</td>
</tr>
<tr>
<td>Operation requiring hospital stay in last 8 y</td>
<td>1.36 (1.05, 1.78)</td>
</tr>
<tr>
<td>Any of 3 medical symptoms$^3$ in past 12 mo</td>
<td>1.34 (1.01, 1.76)</td>
</tr>
<tr>
<td>Exercise: walking, swimming, sports, other physical exercise</td>
<td>0.69 (0.54, 0.88)</td>
</tr>
</tbody>
</table>

$^a$Odds ratios (ORs) and confidence intervals (CIs) are based on logistic regression models with adjustments for age, ethnicity, gender, and income. 
$^b$Men only (n = 1046). 
$^c$Pain in the heart or tightness or heaviness in the chest; trouble breathing or shortness of breath; and constant coughing or frequent heavy chest colds.
include working as a craftsman, operative, or foreman (data available for men only); admittance to a hospital for any reason in the last 8 years; having had an operation involving a 3-day hospital stay in the last 8 years; and reporting any of the three medical symptoms. Exercise was protective.

Discussion

These data document a progressive increase in hearing impairment over the last three decades. In fact, because the question asked about having trouble "even with a hearing aid," these prevalence rates may be conservative. And if true, they have important public health implications. The minor change in the question's wording in 1994 cannot be responsible for the findings because a similar increase occurred between 1965 and 1974, when the question remained the same. In addition, the gender and age differences in rate of increase make it unlikely that the observed increase is caused by increased awareness of hearing loss as a problem. Because the increase in impairment occurred mainly in subjects younger than age 70, it is also unlikely that these findings simply reflect that Americans are growing older and sicker. In accord with our findings, age-specific hearing impairment rates reported from the National Health Interview Survey reveal a large increase in hearing impairment between the early 1960s and 1993 for those aged 45 and older, a larger increase for men than for women, and proportionally larger increases for those aged 45 through 74 than for those over 75.12,22,23

Why should there be such an increase? These data do not allow us to answer this question, although several risk factors were identified. Whether general noise levels have increased over the last three decades is unclear. Noise complaints in England and Wales have increased, but much environmental noise may not be at a decibel level (approximately 85dB or higher) that damages hearing and thus probably creates stress rather than hearing impairment.24 Because of their age, the Alameda County subjects are not likely to have had much exposure to rock concerts or earphone-type portable music players. However, the effect of noise is cumulative, so that leisure time exposure would be additive to job-related noise exposure.8 Other data indicate that hearing-impaired adults often attribute their hearing loss to occupational or environmental noise exposure.10

In terms of ototoxic drug exposure, the use of ototoxic agents such as antibiotics and diuretics has increased since 1965. The three categories of risk factors that we identified (specific symptoms, operation, and hospitalization) could involve the use of such drugs. Exercise, on the other hand, may be beneficial because of its overall health effect and its relationship to lower incidence of cardiovascular and pulmonary conditions.

From a public health perspective, these data suggest that more attention should be paid to the identification of hearing impairment so that appropriate interventions can be initiated. Current technological advances have refined hearing testing and hearing aids so that many persons who have hearing impairments can receive assistance. In addition, further longitudinal research is needed both to monitor this trend and to identify potentially correctable causes of hearing impairment.

Acknowledgment

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References
