

The Impact of Tinnitus on Quality of Life in Older Adults

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Abstract

Few population-based data exist to assess the impact of tinnitus on quality of life. As part of the Epidemiology of Hearing Loss Study, self-reported data on tinnitus and quality of life were obtained by interview at the first follow-up examination (1998–2000; N = 2800; ages 53–97 years). The Medical Outcomes Study Short Form Health Survey (SF-36) was used to assess quality of life. Adjusted mean SF-36 scores decreased (worsened) with increasing tinnitus severity (None, Mild, Moderate, Severe) for the Role-Physical, Bodily Pain, Vitality, and Mental Health domains, and the Physical Component Summary scale (F-tests for linear trend, $p < .05$). Scores tended to be lower for those who first reported tinnitus at the follow-up (five-year incidence of tinnitus) compared to those who reported tinnitus at the baseline and follow-up examinations (prevalent tinnitus). This study documents clear associations between tinnitus and reduced quality of life in this large cohort of older adults.

Key Words: Hearing disorders, quality of life, tinnitus

Abbreviations: EHLS = Epidemiology of Hearing Loss Study; MCS = Mental Component Summary scale; NSAID = non-steroidal anti-inflammatory drug; PCS = Physical Component Summary scale; SF-36 = Medical Outcomes Study (MOS) Short Form Health Survey

Sumario

Existen pocos datos con base poblacional para evaluar el impacto del acúfeno sobre la calidad de vida. Como parte de un Estudio de Epidemiología de los Trastornos Auditivos, se obtuvieron datos de auto-reporte sobre el acúfeno y la calidad de vida por medio de entrevistas en el primer examen de seguimiento (1998-2000; N = 2800; edades: 53-97 años). La Encuesta de Salud de Fórmula Corta (SF-36) del Estudio de Resultados Médicos (MOS) fue utilizado para evaluar la calidad de vida. Los puntajes medios ajustados de la SF-36 disminuyeron (se deterioraron) conforme aumentó la severidad del acúfeno (Ninguno, Leve, Moderado, Severo) en las áreas de Papel Físico, Dolor Corporal, Vitalidad, y Salud Mental, y de acuerdo a la Escala Resumen de

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Componente Físico (Prueba F para tendencias lineales, $p < 0.05$). Los puntajes tendieron a ser más bajos para aquellos que reportaron el acúfeno en la cita de seguimiento (una incidencia de cinco años del acúfeno) comparados con aquellos que reportaron el acúfeno al inicio y en el seguimiento (acúfeno prevalente). Este estudio documenta una clara asociación entre el acúfeno y una reducción en la calidad de vida, en esta grande cohorte de adultos mayores.

Palabras Clave: Trastornos auditivos, calidad de vida, acúfeno o tinnitus

Abreviaturas: EHLS = Estudio de Epidemiología de Trastornos Auditivos; MCS = Escala Resumen de Componente Mental; NSAID = droga anti-inflamatoria no esteroidea; PCS = Escala Resumen de Componente Físico; SF-36 = Encuesta de Salud de Fórmula Corta del Estudio de Resultados Médicos (MOS)

Tinnitus is the sensation of sound in the ears or head without external stimulation, generally perceivable only by the person who is experiencing it. Tinnitus is considered a symptom, not a disease. However, in most cases, the underlying cause is impossible to determine. The negative impact of tinnitus may be reduced through tinnitus retraining therapy (Jastreboff and Jastreboff, 2004), cognitive-behavioral therapy (Tyler et al, 2004), hearing aids or tinnitus instruments (Sheldrake and Jastreboff, 2004), or antidepressants (Robinson et al, 2004).

Tinnitus is a common condition among older adults. Hoffman and Reed (2004) compared the prevalence of self-reported tinnitus from several large epidemiologic studies. For those aged 50 years and older, prevalence estimates ranged from 7.6% (1994–1995 US National Health Interview Study Disability Supplement) to 20.1% (Nord Trendelag, Norway Hearing Loss Study).

Tinnitus can have a significant effect on quality of life. In its more severe forms, tinnitus can be accompanied by depression, anxiety, concentration difficulties, insomnia, or headaches (Tyler and Baker, 1983; Scott et al, 1990; Folmer et al, 2001; Nagler, 2003). Several studies have assessed the impact of tinnitus on quality of life through its relation to lifestyle or function (Sourgen and Ross, 1998; Bauch et al, 2003), psychological or psychosomatic symptoms (Scott et al, 1990; Sourgen and Ross, 1998; Erlandsson and Hallberg, 2000; Folmer et al, 2001; Bauch et al, 2003; Lynn et al, 2003) or perceived

handicap (Bauch et al, 2003; Lynn et al, 2003).

The Medical Outcomes Study (MOS) Short Form Health Survey (SF-36) is a questionnaire used to assess physical and mental aspects of quality of life (Ware et al, 1993). Two studies have used the SF-36 to measure the impact of tinnitus on quality of life. Davis and Roberts (1996) reported on results from the 1994 Trent Lifestyle Survey, a mail survey in the Trent Region, UK. Respondents were asked about tinnitus lasting five minutes or longer, and were classified into one of three groups: (1) No Tinnitus, (2) Tinnitus Some of the Time, (3) Tinnitus Most of the Time. Among 8,481 respondents to the mail survey, SF-36 scores on all six domains examined (General Health Perceptions, Physical Functioning, Social Functioning, Mental Health Index, Bodily Pain, and Vitality) decreased (worsened) with increasing frequency of tinnitus after adjusting for age, gender, occupational group and reported hearing disability. The Bodily Pain domain demonstrated the strongest association with tinnitus classification.

Another study using the SF-36 (Wilson et al, 2002) reported on a group of 200 consecutive new patients (“tinnitus sufferers”), aged 19–88 years, referred to a specialist tinnitus clinic in Wales, UK, and found that for all eight domains of the SF-36, unadjusted mean scores were below norms for the general UK population aged 18–64 years (Jenkinson et al, 1993). While SF-36 normative data from the United Kingdom (Jenkinson et al 1993) and the United States (Ware et al, 1993)

are similar, it is possible that geographic or cultural differences in the impact of tinnitus on quality of life may exist. However, no population-based data are available from the United States on the impact of tinnitus on quality of life. The purpose of this study was to assess the impact of tinnitus on quality of life as measured by the SF-36 in a large cohort of older adults in the United States.

METHOD

Subjects

The Epidemiology of Hearing Loss Study (EHLS) is a population-based study of hearing loss in adults 48 to 92 years of age at baseline (Cruickshanks et al, 1998). Figure 1 illustrates study participation. During 1987 to 1988, residents of the city or township of Beaver Dam, Wisconsin, who were 43 to 84 years of age ($N = 5924$), were identified through a private census and invited to participate in a study of age-related ocular disorders (The Beaver Dam Eye Study, 1988–1990, $N = 4926$; Klein et al, 1991). All who participated in the baseline eye examination and were alive as of March 1, 1993, were eligible to participate in the baseline examination of the hearing study (EHLS, $N = 4541$). Of those eligible, 3753 (82.6%) participated (1993–1995); 42.3% of the participants were male. The mean age of participants was 65.8 years (range 48–92 years).

A follow-up examination was conducted five years later (1998–2000). Of 3407 eligible, 2800 participated (82.2%); 41.4% of the participants were male. The mean age at follow-up was 69.3 years (range 53–97 years). The data for the present study were collected during the follow-up examination. The study was approved by the Human Subjects Committee of the University of Wisconsin–Madison. Informed consent was obtained from each participant at the beginning of the examinations.

Procedure

A questionnaire about medical history (including tinnitus) and occupational and leisure time noise exposure was administered as an interview. Of the 2800 participants, 20 were unable to complete the interviews due

to cognitive impairment. Tinnitus data were missing for an additional 31 participants. Consequently, these analyses are restricted to the 2749 with self-reported tinnitus data.

At both the baseline and five-year examinations, participants were asked, “In the past year have you had buzzing, ringing, or noise in your ears?” Examiners were instructed to record “no” if a participant reported hearing an odd or unusual noise on a single occasion in the past year. For the purposes of these analyses, tinnitus was defined as a “yes” response to this question.

Participants responding positively to this question were then asked, “How severe is this noise in its worst form? (Mild/Moderate/Severe/Unknown).” Two questions were added at the five-year examination: “How annoying do you find this noise? (None/Slightly/Moderately/Severely/Unknown),” and “Does this noise usually last longer than

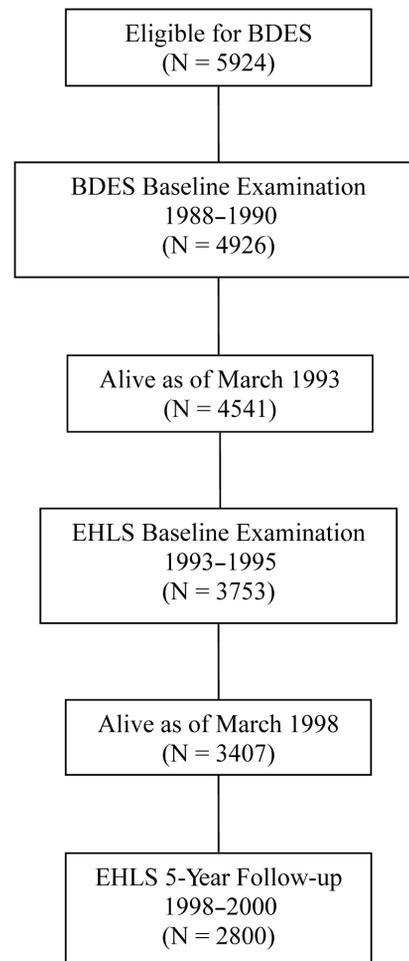


Figure 1. Study participation. BDES = Beaver Dam Eye Study; EHLS = Epidemiology of Hearing Loss Study.

5 minutes? (No/Yes/Unknown).”

Health-related quality of life was ascertained using the Medical Outcomes Study Short Form Health Survey (SF-36; Ware et al, 1993) administered as an interview. The SF-36 questions assess function, well-being, disability, and personal evaluation for both physical and mental health. The individual questions are grouped into eight domains to measure the following health constructs: (1) Physical Functioning, (2) Role-Physical, (3) Bodily Pain, (4) General Health Perceptions, (5) Vitality, (6) Social Functioning, (7) Role-Emotional, and (8) Mental Health. The scores calculated for each domain range from 0 to 100, with increasing scores indicating better quality of life. The eight domains can also be combined into two summary scales: the Physical Component Summary scale (PCS) and the Mental Component Summary scale (MCS), which have been shown to be accurate summary measures of the eight domains (Ware et al, 1994). Physical Functioning, Role-Physical, and Bodily Pain scores contribute the most to the PCS, while the Mental Health, Social Functioning, and Role-Emotional domains contribute the most to the MCS (Ware et al, 1994). Vitality correlates with both the MCS and PCS. All scores were calculated according to the recommended guidelines and algorithms (Ware et al, 1993; Ware et al, 1994).

Audiologic tests included pure-tone air- and bone-conduction audiometry. Audiometric equipment and procedures have been described elsewhere (Cruickshanks et al, 2003). Examiners were trained by two certified audiologists (TLW, TST) to perform hearing testing following standardized study protocols.

Sociodemographic and health characteristics examined for their potential association with both quality of life and reported tinnitus severity included age, sex, current use of antidepressant medications, regular use of aspirin (at least twice a week for more than three months), history of arthritis, history of cancer (excluding skin cancer), history of cardiovascular disease (myocardial infarction, stroke, angina), history of head injury (skull fracture, concussion, broken nose, loss of consciousness due to a head injury, whiplash or other serious neck injury), history of ear infection in the past year, history of emphysema, hearing loss (average of air-

conduction hearing thresholds at .5, 1, 2, and 4 kHz >25 dB in either ear), history of sinus infection, smoking status (never, past, current), and reported number of sleep problems (out of three). The sleep problems assessed were (1) difficulty getting to sleep, (2) waking up and having a hard time getting back to sleep, and (3) waking up repeatedly. A participant was considered to be positive for one of these “insomnia traits” if they indicated the problem occurred “often” or “almost always” (Schubert et al, 2002).

Statistical analyses were completed with SAS 8.1 software (SAS Institute Inc., 1999, Cary, NC). The unadjusted association between sex and tinnitus severity was tested with the chi-square test for general association. The unadjusted association between tinnitus severity and use of antidepressant medication was tested with the Mantel-Haenszel chi-square test. The Spearman rank-order correlation was used to assess the association between severity and annoyance ratings among those with tinnitus. Factors potentially associated with both quality of life and reported tinnitus severity were included in analysis of covariance models in order to more accurately assess the independent association of tinnitus severity with quality of life. Linear trends in SF-36 scores by tinnitus severity were tested with F-tests from these models. Comparisons of the adjusted SF-36 scores by tinnitus severity were conducted using *t*-tests of least squares means.

RESULTS

Comparisons of baseline characteristics between participants and nonparticipants in the five-year follow-up examination have been discussed elsewhere (Cruickshanks et al, 2003). In brief, at baseline, nonparticipants in the five-year follow-up (living and deceased) were more likely to (1) be older, (2) be smokers, (3) have hearing loss, and (4) have less education than participants.

Sociodemographic and health characteristics of the 2749 participants included in these analyses are shown in Table 1. About half (51.7%) of the participants had at least a mild hearing loss, and about half (49.1%) reported at least one sleep problem. A history of sinus infection was reported by 39.3% and a history of head injury by 26.0%. Nine

Table 1. Characteristics of 2749 Participants of the Epidemiology of Hearing Loss Study (1998–2000)

Characteristic	n*	Percent†
Age group (years)		
53–59	600	21.8
60–69	915	33.3
70–79	803	29.2
80–97	431	15.7
Sex		
Female	1606	58.4
Male	1143	41.6
History of arthritis		
History of cancer (excluding skin cancer)		
History of cardiovascular disease	436	16.6
History of emphysema	87	3.3
History of head injury	708	26.0
History of sinus infection	1068	39.3
Hearing loss	1364	51.7
Regular aspirin use	1052	40.0
Current antidepressant medication use		
Ear infection in past year	238	9.0
	96	3.5
Number of sleep problems		
0	1377	50.9
1	714	26.4
2	346	12.8
3	266	9.8
Smoking status		
Never	1257	47.7
Past	1118	42.5
Current	258	9.8
Tinnitus in past year		
Tinnitus annoyance		
No tinnitus	2074	75.6
None	229	8.3
Slight	257	9.4
Moderate	147	5.4
Severe	38	1.4
Tinnitus severity		
No tinnitus	2074	75.6
Mild	411	15.0
Moderate	213	7.8
Severe	45	1.6
	N‡	Mean (SD)
Hearing thresholds (dB HL, worse ear)		
500 Hz	2640	21.3 (19.2)
1000 Hz	2640	24.1 (20.1)
2000 Hz	2639	31.0 (23.2)
3000 Hz	2623	41.6 (25.0)
4000 Hz	2640	48.6 (25.6)
6000 Hz	2624	55.3 (25.3)
8000 Hz	2626	62.1 (24.8)

*For some characteristics, the denominator is less than 2749 due to missing values; †Percentages may not add to 100.0% due to rounding; ‡97 of the 2749 participants were interviewed without examination. Twelve others were unable to complete the audiometric testing, six of which were nursing home patients.

percent of the participants were taking antidepressant medication. Tinnitus, broadly defined here as “buzzing, ringing or noise in your ears” in the past year, was reported by 24.6% of participants. In a separate question, most (75%) participants reporting tinnitus indicated that their tinnitus usually lasted longer than five minutes. Men were more likely to report tinnitus than women (28.0% versus 22.0%, $p < .001$), but there was no difference in tinnitus prevalence by age group. Tinnitus was reported to be at least moderate in severity by 9.4%.

The relation between tinnitus severity and annoyance is shown in Table 2. For some participants, tinnitus severity and annoyance ratings were quite different, although the Spearman rank-order correlation between severity ratings and annoyance ratings was 0.51. There were no significant sex or age group differences in how participants rated their tinnitus severity or annoyance.

When restricted to comparable age groups (55 years and older), SF-36 scores from the present population averaged about eight points higher than the norms presented in Ware et al (1993) for the eight domains. Additional comparisons between scores for the two populations have been presented and discussed elsewhere (Schubert et al, 2002; Dalton et al, 2003).

Mean SF-36 scores, adjusted for both age and sex, are shown by severity of tinnitus in Table 3. For all domains and both summary scales, scores declined with increasing tinnitus severity (F-test for trend, $p < .05$). Two domains, Role-Physical and Bodily Pain, demonstrated a very large difference in scores between those without tinnitus and those with severe tinnitus (differences of 22.7 and 18.4, respectively).

Mean SF-36 scores that are adjusted for additional confounding variables are shown by severity of tinnitus in Table 4. Mean scores were adjusted for age, sex, current antidepressant use, hearing loss, number of sleep problems, smoking status, and history of arthritis, cancer, cardiovascular disease, ear infections, emphysema, head injury, or sinus infections. All mean scores were lower than those in Table 3. Mean scores for the Role-Physical, Bodily Pain, Vitality, and Mental Health Index domains declined with increasing tinnitus severity, as did mean scores for the Physical Component Summary scale (F-test for trend, $p < .05$). Declines in

Table 2. Tinnitus Annoyance Ratings by Severity Rating (Epidemiology of Hearing Loss Study, 1998–2000)

Annoyance Rating	Severity Rating n (%)			
	No Tinnitus	Mild	Moderate	Severe
No tinnitus	2074 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
No annoyance	–	193 (47.1)	33 (15.6)	2 (4.4)
Slight	–	174 (42.4)	75 (35.4)	7 (15.6)
Moderate	–	42 (10.2)	88 (41.5)	16 (35.6)
Severe	–	1 (0.2)	16 (7.6)	20 (44.4)
Total	2074 (100.0)	410 (100.0)	212 (100.0)	45 (100.0)

mean scores from those with no tinnitus to those with severe tinnitus ranged from 1.4 (General Health Perceptions) to 16.8 (Role-Physical). For the Role-Physical and Bodily Pain domains, mean SF-36 scores were significantly lower for those with severe tinnitus than for those with moderate, mild, or no tinnitus (*t*-tests of least squares means, $p < .05$). An alternative form of the models in Table 4 were run that substituted two pure-tone averages (low frequency, using 500, 1000, and 2000 Hz; and high frequency, using 3000, 4000, 6000, and 8000 Hz) for the single hearing loss variable in the models. The results (not shown) were virtually identical to those shown in Table 4.

With one exception (Bodily Pain), adjusted mean SF-36 scores were lower for those who first reported tinnitus at the five-year follow-up (incident tinnitus) compared to those who reported tinnitus at both the baseline and five-year follow-up examinations (prevalent tinnitus) (Table 5), but the difference was significantly different only for the Physical Functioning domain ($p = .02$). For every domain, mean scores were lower for

those who first reported tinnitus at the five-year follow-up compared to those not reporting tinnitus at either examination, with differences reaching significance for the Bodily Pain, Mental Health, Physical Functioning, Role-Physical, and Vitality Index domains, and for the Physical Component Summary scale.

The prevalence of current antidepressant use increased with severity of tinnitus. Specifically, 8.2% of participants without tinnitus were taking antidepressant medication, compared to 9.4%, 13.9%, and 20.0% of those with mild, moderate, or severe tinnitus, respectively. The Mantel-Haenszel chi-square test for linear trend was highly significant ($p < .001$).

DISCUSSION

Eight SF-36 domains and two summary scales were assessed as to their association with tinnitus severity. When adjusted for age and sex, mean scores declined with increasing tinnitus severity for all

Table 3. Age- and Sex-Adjusted Mean SF-36 Scores by Severity of Tinnitus (Epidemiology of Hearing Loss Study, 1998–2000)

SF-36 Domains	Tinnitus Severity			
	No Tinnitus (n = 2074)	Mild (n = 411)	Moderate (n = 213)	Severe (n = 45)
Physical Functioning*	74.2	70.3	69.6	64.7
Role-Physical*†	76.8	72.2	68.9	54.1
Bodily Pain*†	73.2	69.8	66.5	54.8
General Health Perceptions*	70.7	68.8	66.2	64.9
Vitality*	63.4	60.9	58.0	54.3
Social Functioning*†	88.7	87.5	85.5	79.3
Role-Emotional*	91.6	91.1	88.9	82.9
Mental Health Index*	81.3	80.2	77.2	72.8
PCS*†	45.8	44.0	43.2	39.9
MCS*	55.3	55.2	53.9	52.3

*Mean scores demonstrated a significant linear trend (F-test for trend, $p < .05$); †Mean score for those with severe tinnitus was significantly different from the mean scores for each of the other three severity categories (*t*-test for least squares means, $p < .05$).

Table 4. Adjusted Mean SF-36 Scores by Severity of Tinnitus (Epidemiology of Hearing Loss Study, 1998–2000)

SF-36 Domains	Tinnitus Severity			
	No Tinnitus (n = 2074)	Mild (n = 411)	Moderate (n = 213)	Severe (n = 45)
Physical Functioning	57.8	55.5	57.6	53.4
Role-Physical*†	49.9	47.6	48.5	33.1
Bodily Pain*†	63.8	61.3	60.8	49.8
General Health Perceptions	54.2	53.6	53.1	52.8
Vitality*	48.0	46.4	45.7	43.6
Social Functioning	74.1	74.0	73.6	67.8
Role-Emotional	81.8	82.1	81.2	75.6
Mental Health Index*	71.3	70.6	69.1	65.4
PCS*	38.3	37.3	37.8	34.7
MCS	51.0	51.1	50.2	48.9

Note: Mean scores are adjusted for age, sex, current antidepressant use, hearing loss, number of sleep problems, smoking status, and history of arthritis, cancer, cardiovascular disease, ear infections, emphysema, head injury, or sinus infections.

*Mean scores demonstrated a significant linear trend (F-test for trend, $p < .05$); †Mean score for those with severe tinnitus was significantly different from the mean scores for each of the other three severity categories (t-test for least squares means, $p < .05$).

domains and both summary scales (Table 3). After adjusting for several additional factors, mean scores from four domains as well as the Physical Component Summary scale decreased significantly with increasing tinnitus severity (Table 4). These results suggest a negative impact of tinnitus on quality of life in this large cohort of older adults.

The correlation of 0.51 between tinnitus severity and tinnitus annoyance was reasonably high considering individual variation in the extent to which people attend to and tolerate their tinnitus. While most people reporting moderate or severe tinnitus found it to be annoying, others reported not being annoyed by tinnitus (Table 2). As has

become evident in the study of pain (Turk and Okifuji, 2002), it is likely there is large variation in human coping responses to tinnitus sensation. In fact, Dobie (2004) concludes that “tinnitus sensation and tinnitus suffering are different and largely independent phenomena.”

Tinnitus severity was most strongly associated with the Role-Physical domain. Participants indicating severe tinnitus had a mean Role-Physical score 16.8 points lower than participants without tinnitus (Table 4). The mean Role-Physical score of 33.1 for those in the present study with severe tinnitus is similar to the mean score of 34.4 obtained from normative participants with congestive heart failure (Ware et al, 1993).

Table 5. Adjusted Mean SF-36 Scores by Tinnitus Status at the Baseline and 5-Year Follow-up Examinations

SF-36 Domains	Tinnitus Status		
	No tinnitus at baseline or 5-year follow-up (n = 1894)	Tinnitus first reported at 5-year follow-up (n = 277)	Tinnitus at both baseline and 5-year follow-up (n = 394)
Physical Functioning	58.3†	54.2*†	58.2*
Role-Physical	50.3†	45.1†	48.7
Bodily Pain	63.8††	60.6†	59.8†
General Health Perceptions	54.0	52.3	53.8
Vitality	47.8†	44.9†	46.4
Social Functioning	74.2	72.7	73.6
Role-Emotional	82.0	79.9	82.0
Mental Health Index	70.9†	68.7†	70.0
PCS	38.4†	36.8†	37.8
MCS	50.8	50.2	50.6

Note: Mean scores are adjusted for age, sex, current antidepressant use, hearing loss, number of sleep problems, smoking status, and history of arthritis, cancer, cardiovascular disease, ear infections, emphysema, head injury, or sinus infections. Data for participants who reported tinnitus at the baseline examination but no tinnitus at the 5-year follow-up examination are not shown.

*††The differences in means for scores with corresponding superscripts were statistically significant (t-test, $p < .05$).

The Role-Physical domain consists of four questions pertaining to problems (e.g., reduced duration, less accomplishment, limited kind, or difficulty) with work or other regular daily activities as a result of physical health. Consequently, the large declines in Role-Physical mean scores with increasing tinnitus severity suggest an association between tinnitus and physical productivity.

The Bodily Pain domain demonstrated the second largest differences in mean scores across the spectrum of tinnitus severity. Participants indicating severe tinnitus had a mean Bodily Pain score 14.0 points lower than participants without tinnitus (Table 4). A mean score of 49.8 for those in the present study with severe tinnitus is less than the mean score of 54.8 obtained from normative participants with both chronic obstructive pulmonary disease and hypertension (Ware et al, 1993). The Bodily Pain domain includes two questions about quantity and effect of bodily pain in the past four weeks.

There are at least two potential explanations for the association between tinnitus severity and mean scores on the Bodily Pain domain. Folmer et al (2001) pointed out that the perception of chronic tinnitus has many physiological characteristics in common with the perception of chronic pain. So much so that Briner (1995) suggested the term "phantom auditory pain" to describe more severe continuous tinnitus. This may help to explain why tinnitus, though not painful itself, may be associated with increased perceptions of bodily pain. It is also possible that participants experiencing more pain were more likely to be using non-steroidal anti-inflammatory medications (NSAIDs) to control pain and that these medications may have exacerbated tinnitus symptoms. However, the regular use of aspirin, an NSAID known to be potentially ototoxic, was not associated with tinnitus symptoms or Bodily Pain scores in this cohort.

Mean SF-36 scores for all domains tended to decrease (worsen) with increasing tinnitus severity. However, the Role-Physical and the Bodily Pain domains demonstrated stronger associations with tinnitus severity than did other domains. The reasons why tinnitus severity was more strongly associated with physically related domains than with mentally/emotionally related domains is not clear, although psychosomatic complaints have been shown to be more common among

tinnitus sufferers (Scott et al, 1990; Folmer et al, 2001). In addition, there may be residual uncontrolled confounding because our measures of other physical conditions did not include markers of severity.

Adjusted mean SF-36 scores tended to be lower for those who first reported tinnitus at the five-year follow-up (incident tinnitus) compared to those who reported tinnitus at both the baseline and five-year follow-up examinations (prevalent tinnitus), although most differences in means did not reach statistical significance. This suggests that, other things being equal, individuals with more recent onset of tinnitus may experience more negative reactions to the noise than individuals who have experienced tinnitus for a longer period of time. This pattern is consistent with the habituation theory discussed by Hallam (1987) that suggests that, while several factors can interfere with the process, habituation to tinnitus noises over time is the normal response.

The prevalence of current antidepressant use increased with severity of tinnitus. However, while antidepressant users scored lower, on average, than nonusers on several of the SF-36 domains, the association between tinnitus severity and mean SF-36 scores was similar for both users and nonusers of antidepressants (results not shown). Sullivan et al (1992) suggested that depression may promote the transformation of tinnitus, a generally tolerable sensation, into an intolerable and disabling one. On the other hand, Erlandsson and Hallberg (2000) point out that tinnitus of sudden onset can be a traumatic experience that leads to depression, leading in turn to a perceived negative impact on quality of life. Other researchers have suggested that a vicious circle can form between tinnitus severity, insomnia, anxiety, and depression, with one or more of these symptoms exacerbating the others (Folmer et al, 2001).

There are some potential limitations of this study. While known confounders were controlled for, tinnitus may represent a heterogeneous disorder that can be caused by or exacerbated by many factors; therefore, the possibility exists that unknown factors that affect both tinnitus and quality of life may have been inadequately controlled for in these analyses, in spite of our multivariate approach. Also, while the SF-36 is a well-recognized standardized measure of health-

related quality of life, there is no widely accepted objective measure of tinnitus severity. Participants subjectively rated their tinnitus as mild, moderate, or severe and, since participants cannot share one another's experiences and compare perceived sensations directly, there is likely to be some individual variation in scaling. This problem is well documented in the study of pain perception and response (Dionne et al, 2005). In addition, this study reflects a cross-sectional view of the relation between tinnitus severity and quality of life, and these self-reported assessments may vary over time, as evidenced by the differences in SF-36 scores between participants with incident versus prevalent tinnitus. Nevertheless, participants with more severe tinnitus reported lower quality of life as measured by the SF-36 than did other participants.

In conclusion, this is the first population-based study to examine the effects of tinnitus on quality of life in a large cohort of older adults in the United States. The perception of tinnitus was fairly common: almost 25% of the population reported at least mild tinnitus, and 9.4% reported moderate to severe tinnitus. The results of this study demonstrate that quality of life is diminished in participants with tinnitus, and the effect increases with increasing severity. With improvements in longevity, the number of older adults affected by tinnitus is expected to increase, suggesting that additional efforts to identify effective prevention, diagnosis, and treatment are warranted to increase the quality of life experienced by older adults.

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