

Tinnitus: A Cost Study

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Objectives: The aim of this study was to examine the costs of tinnitus in The Netherlands from a health care and a societal perspective. Furthermore, the impact of disease characteristics and demographic characteristics on these costs were examined.

Methods: A bottom-up cost of illness study was performed, using the baseline data on a cost questionnaire of a randomized controlled trial investigating the (cost) effectiveness of an integral multidisciplinary treatment for tinnitus versus care as usual. Mean yearly costs were multiplied by the prevalence figure of tinnitus for the adult general population to estimate the total cost of illness of tinnitus to society. Because cost data usually are not normally distributed, a non-parametric bootstrap resampling procedure with 1000 simulations was performed to determine statistical uncertainty of the cost estimates per category. Several questionnaires measuring disease and demographic characteristics were administered. The impact of disease characteristics and demographics on costs was investigated using a multivariate regression analysis.

Results: Total mean societal cost of illness was €6.8 billion (95% confidence interval: €3.9 billion–€10.8 billion). The larger part of total cost of illness was not related to health care. Total mean health care costs were €1.9 billion (95% confidence interval: €1.4 billion–€2.5 billion). Significant predictors of both health care costs and societal costs were tinnitus severity, age, shorter duration of tinnitus, and more severe depression.

Conclusion: The economical burden of tinnitus to society is substantial, and severity of tinnitus is an important predictor of the costs made by patients.

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INTRODUCTION

Tinnitus is the perception of a sound for which there is no acoustic source. It is a common chronic health problem, the prevalence of which has been estimated to be 10 to 20% in the general population (Davis & El Refaie 2000; Andersson 2002). In most cases, the symptoms have no identifiable or detectable organic cause and cannot be explained by conventional medical or psychiatric diagnoses. The absence of a known effective treatment often leads to referrals to a variety of caregivers in an unstructured and nonstandardized way (Hoare et al. 2010). Patients seek help in various areas of health care, but most of the therapies do not lead to recovery. As a result, tinnitus

treatment has been described as fragmented and costly to both the patients and the society at large (Lockwood et al. 2002; Reich 2002; Henry et al. 2005). However, empirical evidence supporting this claim is lacking.

To our knowledge, this is the first cost of illness (COI) study for tinnitus. There are two approaches to a COI study, top-down or bottom-up. In a top-down approach the total costs per health care sector in a country are used as a starting point, and fractions of these costs are attributed to a specific disease. However, the use of national health care expenditures may either under- or overestimate total direct costs. Also, the exclusion of cost categories that are not included in national health care expenditures (i.e., travel expenses) also biases the estimates of COI because different disease categories may absorb different non-health care costs. Finally, in a top-down COI study all costs are attributed to the primary diagnosis and tinnitus is often not recognized as such. A bottom-up approach in which health care consumption or cost data of a sample of patients are gathered and extrapolated to the total population is more appropriate in patients with tinnitus.

Although no COI studies have been performed in a tinnitus population, there are several bottom-up studies on costs or health care utilization in patients with other medically unexplained somatic symptoms, like fibromyalgia (Wolfe et al. 1997; Walen et al. 2001; Cronan et al., 2002; Robinson et al. 2003; Boonen et al. 2005; Berger et al. 2007), chronic low-back pain (Boonen et al. 2005; Gore et al. 2012), and irritable bowel syndrome (Maxion-Bergemann et al. 2006; Nyrop et al. 2007; Johansson et al. 2010). Boonen et al. (2005) found that health care costs and productivity losses are higher in patients with chronic low-back pain or fibromyalgia, than in patients with a specific inflammatory rheumatic disorder. Studies investigating health care utilization in irritable bowel syndrome revealed that age, comorbidity, and severity of symptoms were related to higher health care costs (Maxion-Bergemann et al. 2006; Nyrop et al. 2007; Johansson et al. 2010). In patients with fibromyalgia, illness costs have also shown to be associated with psychological comorbidity, especially depression (Wolfe et al. 1997; Robinson et al. 2003; Berger et al. 2007).

In the present study the costs of tinnitus in The Netherlands were examined from a health care and a societal perspective. In the latter perspective, health care costs, out-of-pocket costs, and productivity losses are taken into account. In addition, we investigated the impact of both disease and demographic characteristics on the total health care and societal costs.

MATERIALS AND METHODS

Study Design

This study is part of a randomized controlled clinical trial investigating the effectiveness and cost-effectiveness of an integral multidisciplinary treatment for tinnitus versus care as

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usual (Cima et al. 2009, 2012). The study population consisted of patients referred to a audiological secondary-care facility (Adelante Audiology and Communication, Hoensbroek, The Netherlands) because of their tinnitus complaints. All health care professionals in the surrounding region, who were in contact with tinnitus patients were informed of the study. This was done to ensure that the study was easily accessible to all patients. The present study includes only the baseline measurement to ensure that there is no treatment effect on the costs.

Measures

Societal costs associated with tinnitus were measured using a self-administered cost questionnaire with a recall period of 3 months. We distinguished between three categories of societal costs: health care costs, patient and family costs, and indirect costs. Health care costs included contacts with the general practitioner practice, medical specialists in the hospital, care provided by other health care professionals, and medication. The unit costs of all health care costs were adopted from the Dutch guideline for cost research (Hakkaart-van Roijen et al. 2010) unless stated otherwise (Table 1). Whenever necessary, unit costs were converted to the reference year 2009 by means of index numbers. Patient and family costs included, for example, travel expenses, costs of over-the-counter medication, costs of sports or meditation activities for relieving the tinnitus, the use of ear candles, and “other costs” associated with tinnitus. The cost questionnaire also included the PROductivity and DISease Questionnaire (PRODISQ) items (Koopmanschap 2005) to measure loss of productivity (indirect costs). The costs of loss of productivity of paid work were quantified using the human capital approach, which takes into account absence from work as a result of illness, disability, or premature death (Drummond et al. 2005). The cost of an hour of productivity loss was based on the mean hourly salary costs for men and women from the Dutch guideline for cost research (Hakkaart - van Roijen et al. 2010).

Tinnitus severity or distress caused by tinnitus was assessed using the Tinnitus Questionnaire (TQ) (McCombe et al. 2001). The TQ consists of 52 items rated on a 3-point scale and assesses the psychological distress associated with tinnitus. Psychometric properties of the TQ have proven excellent in different languages (Baguley et al. 2000; McCombe et al. 2001). On the basis of the scores from the TQ, patients were classified into three different severity classes. A TQ score below 30 points was defined as mild tinnitus complaint, a TQ score from 30 to 46 was defined as moderate tinnitus complaint, and a TQ score of more than 47 was defined as severe tinnitus complaint.

Anxiety and depressive symptoms were measured with the Hospital Anxiety and Depression Scale (HADS) (Spinhoven et al. 1997), which consists of 14 items that have to be rated from 0 = “usually” to 4 = “not at all.” Patients with higher scores have more complaints.

Health-related quality of life was measured with the Health Utilities Index Mark III (Horsman et al. 2003). This is a 17-item questionnaire to assess generic health-related quality of life on eight dimensions: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain or complaints. A multiplicative utility scoring function can be used to determine a single utility score based on these dimensions. Possible utility scores range from -0.36 to 1.00 (Feeny et al. 2002), with -0.36 being the worst imaginable health state and 1.00 the best.

In addition, items on general characteristic (age, sex, education), and duration of tinnitus complaints were added to the questionnaire. Duration of tinnitus complaints was scored in one of four categories: <1 year, 1 to 5 years, 5 to 10 years, and >10 years. Hearing loss was measured using pure-tone audiometry and was defined as the bilateral pure-tone average (BPTA) at 1, 2, and 4 kHz.

Statistical Analysis

The mean costs per 3 months per patient were multiplied by 4, to obtain mean yearly costs per patient (van Asselt et al. 2007). Referral by a general practitioner (GP) was necessary for seeking treatment in the secondary-care setting. In some cases, the baseline measurement took place more than 3 months after the referral to Adelante Audiology and Communication as a result of a waiting list. Therefore, it was assumed that all patients visited the GP at least once in the year preceding inclusion. For patients who did not report a GP contact in the retrospective cost questionnaire, one GP contact was included in the annual costs. Because inclusion of patients was scattered over 3 years, there was no structural seasonal effect in the 3 months covered by the baseline measurement. Mean annual costs per patient were multiplied by the prevalence figure of tinnitus for the adult general population to estimate the total cost of illness of tinnitus to the Dutch society. Approximately 30% of individuals perceive tinnitus at some point in their life and 10 to 15% experience tinnitus severely enough to seek medical attention (Axelsson & Ringdahl 1989; Heller 2003). Earlier studies have shown that 3 to 5% of the population has severe tinnitus (Vestergaard 1997; Davis & El Refaie 2000). Because Adelante Audiology and Communication is a secondary-care setting, the base-case analysis was based on the assumption that our sample is representative of a total prevalence of 10%, with 4% having severe complaints and 6% having mild to moderate complaints. In 2009, the Dutch adult population aged 20 years and older consisted of 12,552,000 residents (Central Bureau of Statistics 2009). By applying the prevalence rates of 4% with severe complaints and 6% with mild to moderate complaints to this population, it can be derived that 5,39,736 adults had severe tinnitus complaints and 7,53,120 adults had mild to moderate complaints. The total annual health care costs resulting from tinnitus were compared with the total health care expenditure in The Netherlands in 2009 (84 billion; Central Bureau of Statistics 2009). Several sensitivity analyses were performed. The first sensitivity analysis shows the impact of varying prevalence rates (5% and 15%, instead of 10%). A second sensitivity analysis illustrates the impact of varying the proportion of patients with severe complaints (3% and 5%, instead of 4%). A third sensitivity analysis shows the impact of not extrapolating the costs of productivity losses to yearly costs.

To study the impact of tinnitus severity on costs, the patients were classified into three different severity classes based on the scores from the TQ, as described in the previous paragraph. Differences in demographics among these groups were tested with an analysis of variance for the continuous variables and a χ^2 test for the categorical variables. All data were tested for normality with a Kolmogorov–Smirnov test. Because cost data usually are not normally distributed, a nonparametric bootstrap resampling procedure with 1000 simulations was performed in Excel to determine statistical uncertainty of the cost estimates

TABLE 1. Mean annual costs per patient with mild (n = 96), moderate (n = 128), and severe tinnitus (n = 268)

	Mild		Moderate		Severe		Total		
	Unit Costs	Mean Contacts (BCI)	Mean Costs (BCI)	Mean Contacts (BCI)	Mean Costs (BCI)	Mean Contacts (BCI)	Mean Costs (BCI)	Mean Contacts (BCI)	Mean Costs (BCI)
Health care costs		11.89 (10.0–14.1)	767 (623–908)	20.09 (15.9–24.7)	1329 (1029–1668)	31.38 (27.4–35.4)	2218 (1912–2564)	21.12 (10.4–34.4)	1544 (679–2647)
GP practice		6.20 (5.4–7.2)	183 (156–213)	7.27 (6.1–8.8)	211 (170–263)	9.88 (8.8–11.2)	280 (247–322)	7.78 (5.5–10.8)	225 (162–306)
GP visit	28.00*	4.75	133	5.48	153	6.48	181	5.57	156
GP home visit	43.00*	0.88	37	0.72	31	1.33	57	0.98	42
GP assistant visit	14.00*	0.50	7	0.82	11	1.78	25	1.03	14.44
GP weekend and evening	59.56†	0.09	5	0.25	15	0.29	17	0.21	12
Medical specialists		3.08 (2.3–4.0)	397 (290–510)	4.33 (3.0–5.9)	559 (387–758)	8.06 (6.6–9.8)	1039 (849–1259)	5.16 (2.4–9.3)	771 (338–1367)
ENT specialist visit	129.00*	2.12	274	2.91	376	4.74	612	3.26	420
Dental surgeon visit	129.00*	0.04	6	0	0	0.18	23	0.07	9
Neurologist visit	129.00*	0.17	22	0.25	32	1.08	140	0.50	65
Other medical specialist	129.00*	0.75	96	1.17	151	2.06	265	1.32	171
Other health care professionals		2.36 (1.3–3.8)	182 (116–252)	7.55 (5.2–10.3)	540 (392–707)	11.37 (9.1–14.0)	859 (695–1051)	7.10 (1.5–13.3)	527 (133–989)
Clinical physicist in audiology	145.02‡	0.75	108	0.87	127	1.73	251	1.12	162
Physiotherapist	36.00*	0.89	32	2.62	94	3.17	114	2.23	80
Psychologist	80.00*	0.00	0	0.53	43	1.78	142	0.77	62
Psychiatrist	129.00*	0.00	0	0.28	28	0.45	47	0.24	25
Social worker	65.00*	0.00	0	0.03	2	0.65	42	0.23	15
Occupational therapist	22.00*	0.04	1	0.03	1	0.37	8	0.15	3
Company doctor	129.00*	0.21	26	0.97	126	1.28	165	0.82	106
Homeopath	10.00–82.50§	0.08	4	0.78	43	0.56	29	0.48	25
Acupuncturist	20.00–93.33§	0.38	10	1.30	71	1.28	59	0.99	47
Haptonomist	12.50–40.00§	0.00	0	0.00	0	0.00	0	0.00	0
Magnetizer/faith healer	28.00–50.00§	0.00	0	0.12	5	0.10	1	0.08	2
Prescribed medication									
Medication	Various¶	0.25	5	0.93	19	2.07	39	1.08	21

*Hakkaart et al. 2010.

†Data retrieved from <http://www.nza.nl/regelgeving/tarieven>; average tariff 2009 calculated for Limburg.

‡In the current Dutch health care system, organizations negotiate unit costs of (some of) their products with health care insurance companies. Therefore, some unit costs are business confidential. As a result, it was decided not to reveal the source of unit costs for these care components.

§Cost questionnaire.

¶GIP Databank 2009.

**Data retrieved from <http://www.nvab.nl>

††Oral communication with several hearing aid dispensers.

‡‡Cost calculation.

BCI, bootstrapped confidence interval; GP, general practitioner.

per category (Efron & Tibshirani 1993; Briggs et al. 1997). The differences in costs among the severity classes were studied by calculating confidence intervals from the bootstrapping procedure. If the 95% bootstrapped confidence intervals (BCI) did not overlap, it was concluded that the means were significantly different.

The impact of disease characteristics and demographics on costs in patients with tinnitus was investigated with a multivariate regression analysis. A log transformation was performed on the cost data to resemble normality. Dependent variable was either health care costs or societal costs. Factors that have been tested were tinnitus severity (TQ score), age, sex, duration of tinnitus complaints, educational level, health-related quality of life (Health Utilities Index utility score), depression or anxiety (HADS score), and BPTA at 1, 2, and 4 kHz. A backward-elimination procedure was applied, including covariates with $p \leq 0.1$.

RESULTS

Study Population

Demographic data of the total group and the different severity groups are shown in Table 3. Patients had a mean age of 54 years and 62.5% were male. The mean BPTA at 1, 2, and 4 kHz was 31 dB hearing loss. There were no differences between the groups with regard to age, sex, or mean hearing loss. However, there was a significant difference among the groups with regard to the duration of tinnitus complaints ($\chi^2 = 9.57; p = 0.04$) and the education level ($\chi^2 = 36.17; p = 0.00$). In the group with mild complaints, there were more patients with higher education. In the group with severe complaints there were more patients with lower education. With regard to duration of tinnitus complaints, in the group with mild complaints there were more patients who had tinnitus complaints for less than a year.

Cost of Tinnitus

Table 1 displays the mean annual tinnitus-related health care consumption and health care costs. On average, patients visited a health care professional 21.1 times (95% BCI [10.4–34.4]). Health care professionals who were visited most frequently were the GP, the ENT specialist, and the clinical physicist in audiology. The ENT specialist was visited by 54% of the patients and the clinical physicist in audiology by 24% of the patients. All other health care professionals were visited by less than 1 to 17% of the patients. The total tinnitus-related health care costs per patient were €1544 (95% BCI: €679–€2647). The highest health care costs were associated with care by medical specialists (mean cost per patient €771; 95% BCI: €338–€1367). Mean costs per patient related to GP care were €225 (95% BCI: €162–€306). Visits to other health care professionals amounted to mean costs of €527 per patient (95% BCI: €133–€989). On average, patients spent €21 on medication (95% CI: €1–€46)

Table 2 shows the mean annual out-of-pocket costs, production losses, and societal costs per patient. On average, the out-of-pocket costs were quite small (€69; 95% CI), but ranged from €0 to €6832. Most out-of-pocket costs were made in the category “other costs,” by 11% of the patients. Other costs were, for instance, costs of food supplements and alternative therapies (\leq €270), headphones (\leq €65), ear protection (\leq €170),

TABLE 2. Mean costs per patient with mild (n = 96), moderate (n = 128), and severe tinnitus (n = 268)

	Unit Costs	Mild		Moderate		Severe		Total	
		% Patients Incurring Costs	Mean Costs (BCI)	% Patients Incurring Costs	Mean Costs (BCI)	% Patients Incurring Costs	Mean Costs (BCI)	% Patients Incurring Costs	Mean Costs (BCI)
Patient and family costs*			31 (8–61)		61 (32–94)		115 (55–186)		69 (12–170)
Over-the-counter medication	Various†	5	6	9	5	10	10	6	7
Travel expenses*	Various†	—	3	—	5	—	10	—	6
Sports	Various†	1	1	9	14	6	44	6	20
Meditation	Various†	1	1	6	4	3	8	3	4
Ear candle	Various†	0	0	1	1	1	0	1	0
Other	Various†	8	20	13	33	12	43	11	32
		Mean Days‡ (BCI)	Mean Costs (BCI)	Mean Days‡ (BCI)	Mean Costs (BCI)	Mean Days‡ (BCI)	Mean Costs (BCI)	Mean Days‡ (BCI)	Mean Costs (BCI)
Productivity losses	Mean/hour§	5.08 (1.5–10.0)	1222 (360–2412)	19.87 (11.2–30.2)	4781 (2699–7266)	21.26 (15.3–27.6)	5105 (3679–6620)	15.41 (2.2–27.8)	3702 (520–6688)
Societal costs			2020 (1116–3169)		6170 (3917–8731)		7438 (5896–9190)		5315 (1319–9001)

*Cost questionnaire was used.

†Hakkaert et al. 2010.

‡For this category, only the costs were calculated.

§Based on 8-hr work days.

BCI, bootstrapped confidence interval.

TABLE 3. Summary of baseline characteristics on the total group and different severity groups, based on the scores of the Tinnitus Questionnaire

	Total	Mild	Moderate	Severe	<i>p</i> *
Number of participants	492	96	128	268	
Age in years (SD)	54.2 (11.5)	54.4 (11.9)	53.9 (11.2)	54.3 (11.6)	0.95
Sex (% male)	62.5	64.6	61.4	61.9	0.87
Education (%)					0.00
Low	45.8	27.1	28.1	44.8	
Middle	27.5	38.6	31.5	29.9	
High	26.7	56.0	25.4	18.7	
Duration (%)					0.05
<1 yr	30.3	36.5	23.6	31.3	
1–5 yrs	38.6	27.1	41.7	41.4	
>5 yrs	31.0	36.5	34.6	27.2	
BPTA (1, 2, 4 kHz)	30.8 (17.7)	28.7 (15.6)	29.5 (17.4)	32.3 (18.5)	0.15

* χ^2 tests ($\alpha = 0.05$) for categorical variables, analysis of variance for continuous outcomes.
BPTA, bilateral pure-tone average.

or sound-isolation materials for walls, floors, and ceilings (\leq €1500). Patients were reported to have been absent from their job as a result of the tinnitus for 15.41 days or 123 hours. Mean annual costs associated with these production losses amounted to €3702 per patient (95% CI: €520–€6688). Mean societal costs per patient were €5315 (95% CI: €1319–€9001) per year.

Total mean societal cost of illness of tinnitus in the Dutch population was €6.8 billion (95% CI: €3.9 billion–€10.8 billion). The larger part of total societal cost of illness was not health care related. Total mean health care costs of tinnitus were € 1.9 billion (95% CI: €1.4 billion–€2.5 billion). This amounts to 2.3% of the total Dutch health care expenditure in 2009.

The results of the sensitivity analyses are shown in Figure 1. In the first sensitivity analysis, total health care costs range from €1.7 billion to €2.0 billion, and the total societal costs range from €6.4 billion to €7.2 billion. In the second sensitivity analysis, differences in prevalence especially impact the total societal costs. Depending on different prevalence figures, the health care costs range from €1.0 billion to €2.9 billion whereas the societal costs range from €3.3 billion to €10.0 billion. In the third sensitivity analysis, productivity losses are not extrapolated to yearly costs. This only impacts the societal costs, which are €3.2 billion in this scenario.

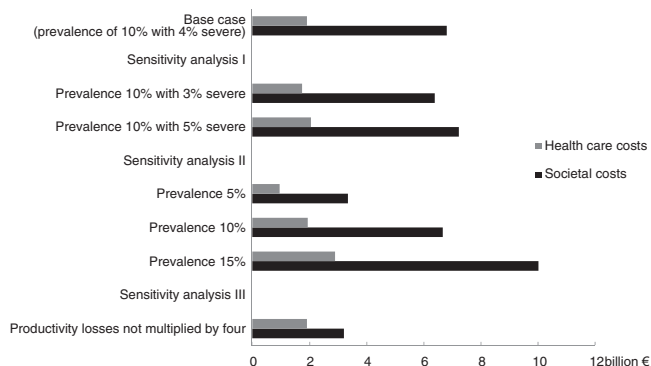


Fig. 1. Sensitivity analysis of total cost of tinnitus.

The Impact of Tinnitus Severity on Costs

Table 1 gives an overview of the tinnitus-related health care costs for each tinnitus-severity group. Although there were slightly more contacts with the GP for the group with severe complaints, no significant differences in the total GP-care costs were observed among the three severity groups. Also, there were more contacts with the GP assistant (95% BCI: 0.50–1.19 for moderate versus 1.33–2.34 for severe) and subsequently, this was more costly in the group of patients with the severe complaints (95% BCI: €7–€17 for moderate versus €19–€33 for severe). With regard to the care by medical specialists, again the group with severe complaints had more contacts compared with the groups with mild and moderate complaints. There were significantly more visits to the ENT specialist and the neurologist in patients with more severe complaints. As a result, the mean costs for the ENT specialist (95% BCI: €278–€484 for moderate versus €524–€710 for severe) and the neurologist (95% BCI: €8–€60 for moderate versus €69–€237 for severe) were higher for patients with severe complaints. Other health care professionals (such as the clinical physicist in audiology, psychologist, physiotherapist, and company doctor) were visited more often in the group with moderate and severe complaints than in the group with mild complaints. This resulted in significantly higher mean costs in the group with moderate complaints (€540) compared with mild complaints (€182), but not in the group with severe complaints (€854) compared with moderate complaints (€539). The higher costs are especially the result of patients with more complaints having more contacts with psychologists, social workers, and clinical physicists in audiology. Table 1 also shows that although patients with severe complaints on average use more medication than those in the mild and moderate group, this is, however, not significantly more costly.

In Table 2, the out-of-pocket costs and the productivity losses are shown for each tinnitus-severity group. There were no differences among the groups with regard to the overall out-of-pocket costs. However, the mean costs of the travel expenses were higher in the group with severe complaints (95% BCI: €3–€6 for moderate versus €8–€11 for severe). Also, the group with moderate and severe complaints had more expenses with regard to the use of sports facilities (95% BCI: €4–€28 and €10–€98, respectively) for relieving the tinnitus than

patients with mild complaints did (95% BCI: €0–€3). Finally, the productivity losses were higher in the group with moderate (€4781; 95% BCI: €2599–€7266) and severe complaints (€5105; BCI: €3679–€6620) compared with the group with mild complaints (€1222; 95% BCI: €360–€2412) because there were more patients on sick leave as a result of tinnitus in these groups.

The Effect of Disease Characteristics and Demographics on Costs

The determinants of costs are shown in Table 4. The most important predictor of health care costs was tinnitus severity. More severe complaints are significantly related to higher health care costs. Other significant predictors of higher health care costs were shorter duration of complaints and a more severe depression score on the HADS. With regard to the societal costs, younger age was the most important predictor. Other significant predictors of higher societal costs were tinnitus severity, shorter duration of complaints, and a more severe depression score on the HADS.

DISCUSSION

To our knowledge, this is the first study to examine the health care utilization and costs for patients with tinnitus, from a societal perspective. Moreover, we included an analysis that studied the effect of demographics and disease characteristics on costs.

With regard to health care utilization, tinnitus sufferers seem to be a heterogeneous group because they seek help in various areas of health care. However, the larger proportion of patients (>50%) seek help from three different caregivers, namely the GP, the ENT specialist, and the clinical physicist in audiology. The mean annual health care costs of tinnitus are €1544 per patient. Literature on other medically unexplained disorders that are comparable with tinnitus in The Netherlands found more or less the same results. The annual costs of fibromyalgia were estimated at €1311 and the cost of chronic low-back pain at €1104 in 2002 (Boonen et al. 2005). The mean annual productivity costs are €3702 for patients with tinnitus. These costs are higher than the productivity losses of comparable

disorders. The productivity costs of fibromyalgia and chronic low back pain were €2573 and €2939, respectively (Boonen et al. 2005).

When applying a prevalence of 10%, with 4% having severe complaints, to the Dutch adult population in 2009, the mean societal cost of illness was €6.8 billion. A comparison of this with the cost of illness of borderline personality disorder in a Dutch population showed that the costs of tinnitus are three times as high. The total societal cost of borderline personality disorder was €2.2 billion in 2000 (van Asselt et al. 2007). The prevalence of borderline personality disorder is 1%, which means that the mean costs per patient are considerably higher than in patients with tinnitus (van Asselt et al. 2007). With a prevalence rate of 4.8%, the societal cost of social phobia in The Netherlands 2003 was €136 million per million inhabitants, which is approximately €1.7 billion for the total population (Acarturk et al. 2009). A top-down study of low-back pain in The Netherlands reported total societal costs of €3.5 billion in 2007 (Lambeek et al.).

Patients with severe complaints had significantly more health care costs than patients with mild and moderate complaints. There were no differences among the groups with regard to out-of-pocket costs. Productivity losses were significantly higher in the moderate and severe groups than in the mild group. Severity of tinnitus was the most important positive predictor of health care costs. Other significant predictors were duration of complaints, depression scores, and age. For societal costs, the most important predictor was age. This is probably the result of the fact that almost three quarter of these costs are explained by the losses in productivity. Eighteen percent of the patients in this study were 65 years of age or older, and therefore, had no productivity losses.

The findings of this study are in line with other studies (Wolfe et al. 1997; Walen et al. 2001; Robinson et al. 2003; Maxion-Bergemann et al. 2006; Berger et al. 2007; Nyrop et al. 2007; Johansson et al. 2010) investigating the relation between health care utilization or costs and disease characteristics. Future research could also take into account the relation between income and health care and societal costs. This was not possible in the present study because a substantial proportion of the patients did not provide information regarding their level of income.

The patient sample here may not be representative of the entire tinnitus population. Therefore, extrapolating mean costs per patient to the total population could have led to a bias. First, we included patients from a secondary-care setting, which could mean that the symptoms these patients experience are more severe than the symptoms of patients who seek help in a primary-care setting. However, measures were taken to ensure that the health care facility was easily accessible to all patients. Moreover, it was a large sample (N = 492) and a substantial number of patients (n = 96) with mild complaints were included in the study. The health care costs range from €1.0 billion to €2.9 billion, and the societal costs range from €3.2 billion to €10.0 billion, depending on the assumption made to extrapolate the costs to the total population. Second, it is possible that costs that were made in the 3 months before the start of treatment are not representative for the whole preceding year. There were some costs, for instance, the costs of sound isolation, that are probably made only once. However, it could be that other patients also made

TABLE 4. Results of multivariate regression analysis after backward elimination of covariates with $p \leq 0.1$

Dependent Variable	Independent Variable	R^2	B	p
Health care costs (n = 409)	Constant	0.27	5.194	0.00
	TQ score		0.317	0.00
	Age		-0.102	0.02
	Duration (1–5 yrs)		-0.215	0.00
	Duration (>5 yrs)		-0.268	0.00
Total costs (N = 424)	HADS depression		0.131	0.01
	Constant	0.24	6.790	0.00
	TQ score		0.197	0.00
	Age		-0.237	0.00
	Duration (1–5 yrs)		-0.118	0.01
	Duration (>5 years yrs)		-0.213	0.00
	HADS depression		0.203	0.00

HADS, Hospital Anxiety and Depression Scale; TQ, Tinnitus Questionnaire.

these costs because of the tinnitus complaints at some point in the preceding year.

Another drawback of the study is the fact that a cost questionnaire with a recall period of 3 months was used. It relies entirely on the patient's memory and also on the patient's judgment of what costs are related to the tinnitus and what costs are not. However, a 3-month recall period is generally thought of as acceptable (Severens et al. 2000; van den Brink et al. 2004), and it was clearly stated to all participants that we were interested in tinnitus-related costs only. Each question contained a remark that the focus was on tinnitus-related costs.

Summarizing the aforementioned findings one can conclude that the economical burden of tinnitus to society is substantial and that severity of tinnitus is an important predictor of the costs that patients make.

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