Gender and Chronic Tinnitus: Differences in Tinnitus-Related Distress Depend on Age and Duration of Tinnitus

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Objective: Conflicting data about the role of gender in tinnitus distress exist in the literature. In addition, little is known about gender differences regarding age and duration of tinnitus. Tinnitus was shown to be related to stress and impairment of coping, sense of coherence, and personal resources. There are known differences in the aforementioned psychological parameters between man and women or among different age groups. The authors hypothesized that this may also be true for patients with chronic tinnitus in addition to gender- and age-related differences in tinnitus annoyance. Therefore, using a large number of patients with chronic tinnitus, the authors analyzed pretherapeutic scores of tinnitus annoyance, perceived stress, proactive coping strategies, sense of coherence, and personal resources in addition to hearing loss and tinnitus pitch and loudness in respect to gender and age of the patients as well as duration of tinnitus.

Design: The study group included 607 female and 573 male patients who reported tinnitus for longer than 3 months. The age of the patients ranged from 17 to 81 years in both gender groups. Pretherapeutic scores of tinnitus annoyance, perceived stress, proactive coping strategies, sense of coherence, and personal resources as well as the degree of hearing loss and tinnitus pitch and loudness were analyzed.

Results: Irrespective of age and tinnitus duration, women were more annoyed by tinnitus and perceived more stress than men did. In addition, women scored lower than men in proactive coping, sense of coherence, and personal resources but had lower levels of hearing loss and tinnitus loudness than men did. The differences were small, but statistically significant. Analysis of three age groups revealed significant differences between older female and male patients. Tinnitus annoyance was stronger in the middle-age groups of women and men (45–59 years of age) than in younger patients and decreased again in older men (≥60 years of age), but not in older women. Women, but not men, had cognitive distress scores that progressed with age. Older women (≥60 years of age) reported more sleep disturbances than older men. Women had more somatic complaints and coped less efficiently than men, except for younger patients (<45 years of age). The scores of perceived stress decreased whereas scores of sense of coherence and self-efficacy increased in older men and women (≥60 years of age). However, women scored worse than men did in this age group. Hearing loss was found to be correlated with tinnitus loudness and age in both gender groups. The duration of tinnitus affected subjective hearing problems, intrusiveness of tinnitus, and proactive coping. This association was in part age-dependent.

Conclusions: The authors found gender differences regarding tinnitus-related distress in patients with chronic tinnitus; however, these differences depended on age and in part on duration of tinnitus. Addressing these differences could result in improved, tailored therapy approaches. For instance, applying physical exercise and relaxation techniques could be of special help for older women to reduce their somatic complaints and sleep disturbances. Similarly, cognitive behavioral therapy could reduce their cognitive distress. Therapy for younger patients should in particular include stress management.

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INTRODUCTION

Tinnitus annoyance and resulting secondary symptoms represent a worldwide health care problem with enormous social and economic demand for therapeutic intervention (Vio & Holme 2005). The issue of gender differences, age, and duration of tinnitus possibly affecting tinnitus-related distress has not yet been resolved. Previous studies provided conflicting results in terms of tinnitus and gender, and little is currently known about gender differences in relation to age and duration of tinnitus.

Only a slight negative correlation between the duration of tinnitus and the number of tinnitus-related problems was found in a previous study; however, tinnitus-related problems seemed to be unrelated to age (Tyler & Baker 1983). In a study with a large sample size, tinnitus annoyance and interference with sleep were found to be higher in female than in male tinnitus sufferers (Stouffer & Tyler 1990). Gender differences regarding tinnitus annoyance and health-related quality of life were also found by other groups (Erlandsson & Holgers 2001; Welch & Dawes 2008). All patients older than 50 years of age were annoyed by tinnitus more than other groups of patients (Hiller & Goebel 2006), but this study also reported higher tinnitus annoyance in men. Sleep difficulties, frequently associated with tinnitus, were found to be greater in elderly tinnitus patients as compared with the control (Hébert & Carrier 2007). Moreover, the perception of tinnitus has been associated with personality characteristics in younger tinnitus sufferers (Welch & Dawes 2008). Prevalence of tinnitus was found to be closely related not only to age and gender, but also to impulse noise exposure and hearing loss (Lindgren et al. 2009). A recent study has demonstrated no influence of gender or age on tinnitus severity (Pinto et al. 2010). In a recent functional imaging study, differences in the activity of prefrontal cortex were found between female and male tinnitus patients (Vanneste et al. 2012). The authors reported higher depression scores in women than in men, but did not find gender differences in tinnitus distress and tinnitus intensity.

Several studies demonstrated that stress, inadequate coping styles, and control beliefs belong to psychological comorbidity in tinnitus patients. Correlation between stress and tinnitus has been demonstrated by a variety of studies (Budd & Pugh 1996; D'Amelio et al. 2004; Härter et al. 2004; Olderog et al. 2004; Seydel et al. 2010). Budd and Pugh (1996) found an association between maladaptive coping and the subjectively reported tinnitus annoyance. The locus of control as an integral part of personality seems to influence the awareness of tinnitus (Tyler et al. 2006; Welch & Dawes 2008). A study by Sirois et al. (2006) suggested improved tinnitus acceptance and habituation in patients with higher self-efficacy and the feeling of control over tinnitus. The results indicate effectiveness of internal and symptom-related control beliefs, thus a necessity of inclusion of these coping styles in the therapy of chronic tinnitus.

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The fact that men and women cope differently with stress is well known (Welch & Dawes 2008; Anshel et al. 2010). Stress intensity for coach-related sources of acute stress is higher in female athletes than in their male counterparts. Moreover, female athletes reportedly use approach-behavioral and avoidance-cognitive coping styles more often than male athletes do (Anshel et al. 2009). Another study demonstrated that upon repeated exposure to stress, women could be more vulnerable than men (Schmaus et al. 2008), a finding that may be applied to chronic tinnitus.

Recently, we described long-term recovery from chronic tinnitus after modified tinnitus retraining therapy, which included a variety of psychological approaches (Seydel et al. 2010). Psychometric data were assessed using the total scores of the Tinnitus Questionnaire (TQ) according to Goebel and Hiller (1998), Perceived Stress Questionnaire (PSQ) (Levenstein et al. 1993;Fliege et al. 2005) and General Depression Scale by Hautzinger and Bailer (1993). The results of our study implied that the therapy outcome depends on gender, patients' age, and duration of tinnitus. Moreover, the study revealed possible differences in the pretherapeutic tinnitus-related distress between female and male patients, which could also be dependent on age and duration of tinnitus.

On the basis of our recent findings and the results of the previous studies, we hypothesized that the degree of tinnitus annoyance could be influenced by gender, age, and duration of tinnitus. Furthermore, we proposed that the known phenomenon of gender and age-related differences affecting stress, coping styles, sense of coherence, and personal resources is most likely true also for tinnitus patients. In addition, we hypothesized that the relationship between tinnitus and psychological comorbidity may be gender-dependent. Last, we propose that the hearing abilities and tinnitus parameters may be associated with psychological parameters.

To prove our hypotheses, we analyzed the data obtained from a large sample of patients with chronic tinnitus in respect to gender, age and the duration of tinnitus. In addition, we analyzed the correlation between tinnitus annoyance and psychological comorbid factors as well as between psychometric scores and hearing loss and tinnitus parameters in female and male patients of tinnitus separately.

Approximately 10% of these data originate from patients who were included in our previous study. The data for this cross-sectional study were collected before the onset of a 7-day multimodal tinnitus therapy.

PARTICIPANTS AND METHODS

The data of 607 female and 573 male patients with chronic tinnitus, who visited the Tinnitus Center at the Charité between March 2005 and February 2009 were included in this study. Altogether, 116 patients were excluded because of severe tinnitus-related distress (TQ score 60–84), which has been associated with severe depression and risk of suicide diagnosed according to ICD-10 (International Classification of Diseases). All patients included in our study did not have comorbidities such as history of Menière's disease, tumors of the middle/inner ear, and severe forms of diabetes or cardiovascular disease. Patients were not subjected to any pharmacological or nonpharmacological tinnitus treatment within 4 weeks before data collection or before the start of 7-day multimodal tinnitus therapy in our outpatient ward. We have included the initial data of 124 patients originating from our previous study, which was focused on studying the outcome of therapy used at our Tinnitus Center (Seydel et al. 2010). The present study was approved by the local ethics committee, and all patients gave written consent to participate in the study and for using their anonymized data for scientific work.

Audiometric measurements were performed to characterize tinnitus and to examine auditory thresholds at tone exposures with frequencies varying from 0.5 to 8 kHz (pure-tone audiogram). Tinnitus examination included the determination of mode, pitch, and loudness of tinnitus. Patients were asked to match the sound that resembled their tinnitus, and their individual tinnitus characteristics were detected by the headset earphone device. Tinnitus loudness was assessed by comparing the intensity of perceived tinnitus with known loudness of a defined acoustic stimulus presented to the contralateral ear. The loudness was interpreted as the threshold in terms of dB hearing level, at which tinnitus was detected.

The patients were between 17 and 81 years of age, with an average of 50 years (SD = 12.5) in both groups. They suffered from bilateral (69%) or unilateral (17% left and 14% right) tinnitus for longer than 3 months. Tinnitus was described either as a pure-tone (61%) or narrowband (25%) noise. In 14% of the cases, tinnitus sound was not definable.

The tinnitus-related distress was evaluated using the following psychometric instruments.

Questionnaires

TQ and its Subscales • The TQ allows a differentiated acquisition of the tinnitus annoyance on different levels. The total score of TQ is interpreted on four severity levels: low (1–30), moderate (31–46), severe (47–59), and a very severe impairment (60–84). A total of 52 items are used to assess specific fields of tinnitus-related distress by means of subscales labeled: emotional distress, cognitive distress, intrusiveness, hearing problems, sleep disturbances, and somatic complaints. The TQ has been sufficiently evaluated and is at present regarded to be the best available method in Germany to determine the tinnitus severity level. The split-half reliability is 0.94 and Cronbach's $\alpha = 0.94$ (Goebel & Hiller 1998).

PSQ and its Subscales • The perceived stress was registered by the PSQ. It comprises 20 items (short version), allowing the subdivision into four subscales: worries, tension, joy, and demands. The subscale "joy" was recoded in the total score. Multiplication of the item scores of each subscale and of the total score by a factor of 100 results in a scale range from 0 to 100. The split-half reliability is in the range of 0.80 to 0.88 and Cronbach's $\alpha = 0.90$ (Fliege et al. 2005).

Proactive Coping Inventory • The Proactive Coping Inventory (PCI) assesses different dimensions of a proactive coping approach and consists of seven subscales (Greenglass et al. 1999; Schwarzer et al. 2000). We used the subscale 1 "proactive coping" (German version), which comprises 17 items and assesses skills in coping with distress, as well as those improving well-being and satisfaction with life (Cronbach's $\alpha = 0.86$) (Schwarzer et al. 1999).

Leipzig Short Scale for Recording the Sense of Coherence • The Sense of Coherence (SOC-L9) (Schumacher et al. 2000) is the short version of Antonovsky's SOC-L29 (Antonovsky 1993). It is a one-dimensional instrument consisting of nine items, which are summarized in the following three scales: comprehensibility (2 items), manageability (3 items), and significance (4 items). The three scales are considered to be subcomponents of a sense

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TABLE 1. Tinnitus characteristics and hearing loss (0.5–8 kHz) measured in the left and right affected ears of female and male patients

		Patients		Mann–Whitney *U* Test		
Parameter	Side	Female[a]	Male[a]	*U*	n1/n2	*p*
Pitch, kHz	Right	5.7 ± 2.7	5.7 ± 2.5	78,454	383/417	0.668
	Left	5.4 ± 2.7	5.7 ± 2.6	87,125	419/436	0.243
Loudness, dB	Right	35.7 ± 21.4	42.3 ± 22.1	57,037	363/381	0.000
	Left	37.3 ± 21.8	44.3 ± 22.2	65,574	401/405	0.000
Hearing loss, dB	Right	23.4 ± 16.6	26.7 ± 16.8	97,471	492/487	0.000
	Left	26.4 ± 17.4**	29.0 ± 16.5*	107,654	516/499	0.002

[a]*Values are reported as mean ± standard deviation.*
*p < *0.05 vs. hearing loss measured on the right side.*
**p < *0.05 vs. hearing loss measured on the right side.*

of coherence. A high sense of coherence is associated with a low level of physical strain and lower somatoform symptoms (Langius & Bjorvell 1993; Strümpfer 1997; Schneider et al. 2004). The SOC-L9 is a valid and reliable measuring instrument (Cronbach's $\alpha = 0.87$) and closely correlates to the total scale SOC-L29 ($r = 0.94$) (Schumacher et al. 2000).

German Questionnaire for Evaluating the Self-Efficacy, Optimism, and Pessimism • Personal resources were measured using the abovementioned instrument (Scholler et al. 1999). Self-efficacy, optimism, and pessimism are independent scales of the questionnaire, which comprises nine items. Five of them are used to assess the self-efficacy and two items each provide information about the optimism and the pessimism. Validation of this questionnaire was performed with five clinical samples obtained from 726 patients (Cronbach's $\alpha = 0.71$–0.76) (Scholler et al. 1999).

Statistical Analysis

Tinnitus characteristics and hearing loss were compared between female and male patients using the Mann–Whitney U test. The relationship between hearing loss, tinnitus characteristics, psychometric parameters, age and duration of tinnitus was analyzed using the Pearson's correlation tests. Two-way and three-way analysis of variance (ANOVA) were used to analyze the influence of gender, age, and duration of tinnitus on the psychometric scores. Bonferroni's post hoc test was applied to compare individual scores. Subscales of TQ and PSQ were analyzed using multivariate ANOVA (MANOVA) to test gender, age, and duration of tinnitus. All statistical tests and graphics were made using Statistica 7.1 (StatSoft).

RESULTS

First, to identify gender differences irrespectively of age and duration of tinnitus, we compared the parameter values between the female and male patients. Correlation analysis was used to analyze the relationship between the parameter values and age or duration of tinnitus. The analyses were run separately in female and male patients; however, we found no or weak linear relationship between psychometric scores and age or duration of tinnitus. Subsequently, psychometric scores of female and male patients were subdivided into three groups, with reference to age and duration of tinnitus, as done in our previous study (Seydel et al. 2010) and analyzed using ANOVA/MANOVA. To identify gender differences within individual groups, especially in the group aged 60 years and above, the post hoc tests were performed. Finally, we analyzed the relationship between tinnitus annoyance and psychological comorbidity and between the psychometric parameters scores and hearing loss or tinnitus loudness separately in female and male patients.

Tinnitus Characteristics, Hearing Loss, and Psychometric Scores in Female and Male Patients

The mean tinnitus pitch estimated on the right or left side did not differ between female and male patients (Table 1). However, tinnitus loudness and mean hearing loss (pure-tone audiogram; 0.5–8 kHz, measured on both sides) were significantly higher in male than in female patients. Moreover, hearing loss was found to be significantly higher on the left side as compared with the right side, both in female and male patients.

In addition, comparison of the hearing loss at each individual frequency revealed significantly higher values (approximately 6 dB) in male than in female patients at 4, 6, and 8 kHz on both sides (Fig. 1).

Normal hearing was found in 44% of the female and 35% of the male patients. A mild degree of hearing loss (>20–40 dB) was measured in 40% of the female and 45% of the male patients. A moderate hearing loss (>40–60 dB) was found in 12% and 15% of the female and male patients, and a severe hearing loss of more than 60 dB was found in 5% of each gender group. High-frequency hearing loss was found in 69% of the female and 79.5%

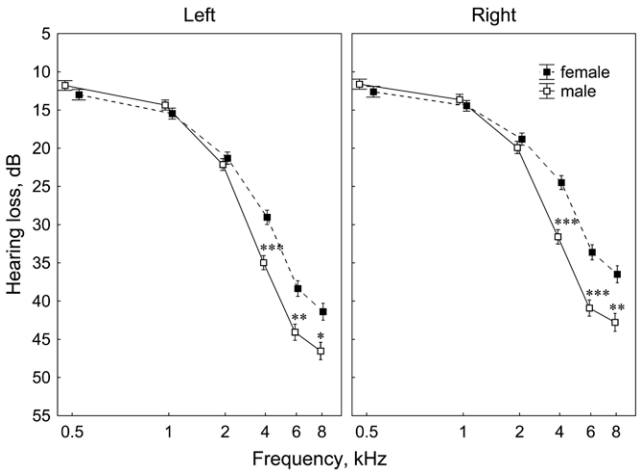

Fig. 1. Hearing loss of the female and male patients with from chronic tinnitus. Pure-tone audiograms were measured on the left (516 female and 499 male) and right (492 female, 487 male) affected ears. Shown are the means ± standard errors of the mean. */**/***$p < 0.001/0.0001/0.00001$ vs. female patients (Mann–Whitney U test).

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TABLE 2. Psychometric parameters of female and male patients

	Patients		*t* Test		
Scale	Female[a]	Male[a]	*t*	df	*p*
Tinnitus Questionnaire	37.4 ± 16.2	34.9 ± 16.6	2.64	1178	0.008
Emotional distress	10.2 ± 5.3	9.7 ± 5.5	1.56	1178	0.118
Cognitive distress	6.5 ± 4.0	6.2 ± 3.9	1.06	1178	0.288
Psychological distress	16.6 ± 8.9	15.9 ± 9.0	1.41	1178	0.157
Sleep disturbances	3.5 ± 2.5	3.0 ± 2.6	2.91	1178	0.004
Somatic complaints	2.2 ± 1.8	1.7 ± 1.8	4.67	1178	0.000
Hearing problems	5.2 ± 3.6	4.7 ± 3.6	2.31	1178	0.021
Intrusiveness	9.9 ± 3.5	9.5 ± 3.7	1.81	1178	0.071
Perceived Stress Questionnaire	45.9 ± 17.5	41.7 ± 18.6	3.85	1107	0.000
Worries	41.7 ± 22.1	36.3 ± 22.9	3.97	1107	0.000
Tension	57.2 ± 20.8	50.4 ± 22.7	5.22	1107	0.000
Demands	48.7 ± 24.2	43.9 ± 24.0	3.32	1107	0.001
Joy	51.0 ± 22.5	52.6 ± 22.2	1.21	1107	0.224
Proactive Coping Inventory	57.7 ± 14.1	61.6 ± 13.8	4.28	942	0.000
Sense of Coherence	65.2 ± 17.7	68.6 ± 18.1	2.95	967	0.003
Self-Efficacy	2.75 ± 0.5	2.9 ± 0.5	4.75	1045	0.000
Optimism	2.7 ± 0.8	2.8 ± 0.7	2.76	1045	0.006
Pessimism	2.1 ± 0.7	2.1 ± 1.2	0.08	1045	0.939

[a]*Values are reported as mean ± standard deviation.*

of the male tinnitus patients. Low-frequency hearing loss was found in 4% and 1.5%, and a pantonal hearing loss was found in 27% and 19% of the female and male patients, respectively.

Female patients had higher tinnitus annoyance than the male patients, as measured by the TQ and its subscales "hearing problems," "sleep disturbances," and "somatic complaints." Further, female patients perceived more stress than men, as measured by the PSQ and its subscales "worries," "tension," and "demands" (Table 2). Women scored lower than men in proactive coping, sense of coherence, self-efficacy, optimism, and pessimism. The differences were small, but statistically significant.

Correlations Between Parameter Values and Age or Duration of Tinnitus in Female and Male Patients

Hearing loss correlated with age in female ($r = 0.50$, $t_{514} = 12.9$ on the left, and $r = 0.47$, $t_{490} = 11.7$ on the right side; $p < 0.0001$) and male patients ($r = 0.61$, $t_{497} = 17.0$ on the left, and $r = 0.57$, $t_{485} = 15.1$ on the right side; $p < 0.0001$); however, the correlation was stronger in men than in women ($p < 0.05$) (Fig. 2).

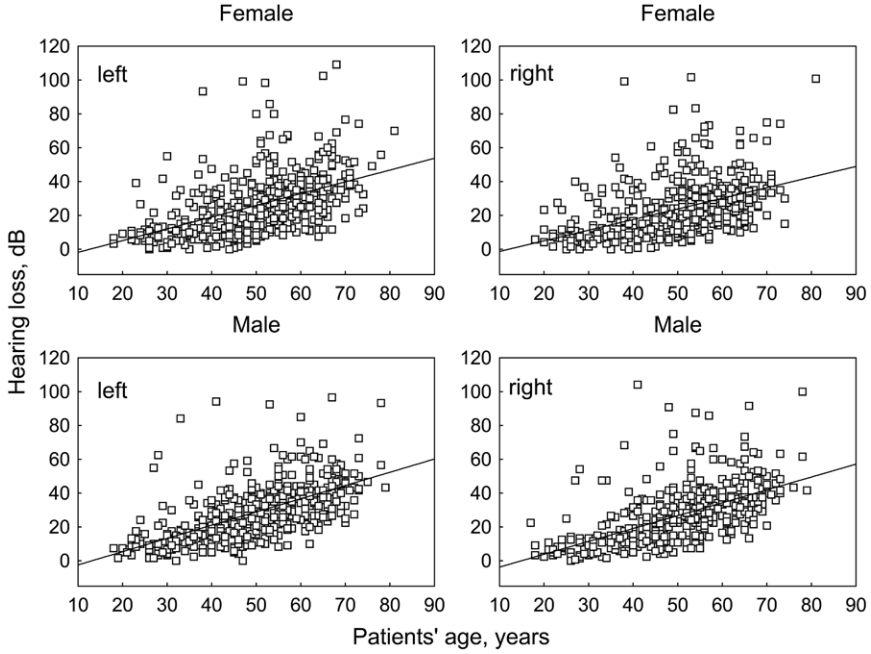

Fig. 2. Hearing loss as a function of age analyzed in female and male patients with chronic tinnitus. Shown are the data of the left and right affected ears including the regression lines and the correlation coefficients (Pearson).

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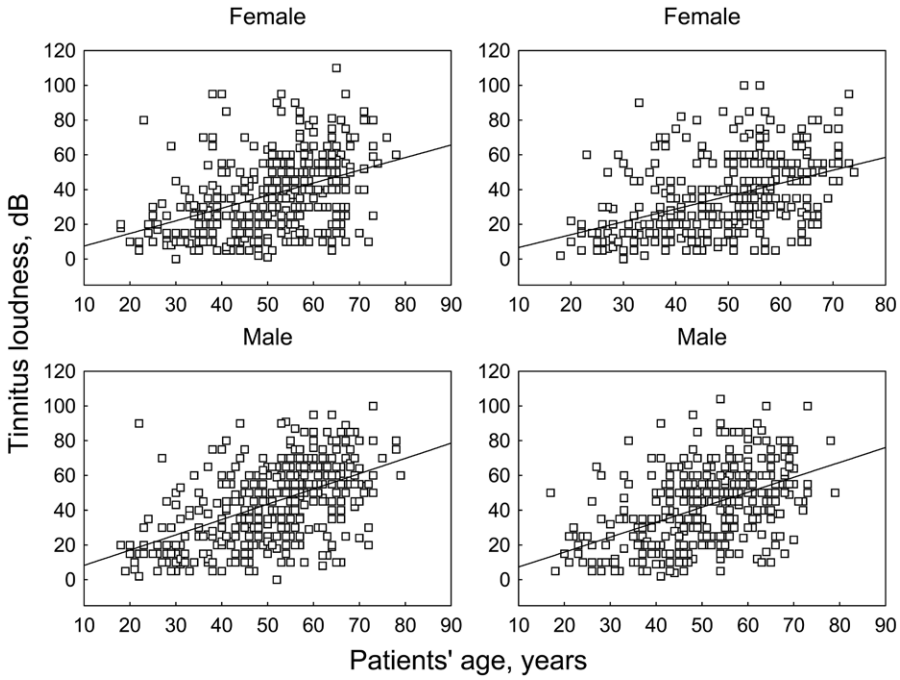

Fig. 3. Tinnitus loudness as a function of age analyzed in female and male patients with chronic tinnitus. Shown are the data of the left and right affected ears including the regression lines and the correlation coefficients (Pearson).

There was also a positive correlation between tinnitus loudness and age, both in female ($r = 0.41$, $t_{399} = 8.8$ on the left, and $r = 0.42$, $t_{361} = 8.9$ on the right side; $p < 0.0001$) and male patients ($r = 0.51$, $t_{403} = 12.0$ on the left, and $r = 0.50$, $t_{379} = 10.8$ on the right side; $p < 0.0001$) (Fig. 3).

We found weak correlations between tinnitus duration and the degree of hearing loss ($r = 0.24$–0.29; $p < 0.0001$) and also between tinnitus duration and tinnitus loudness ($r = 0.20$–0.251; $p < 0.001$) in female and male patients.

The mean hearing loss correlated with tinnitus loudness in both female ($r = 0.73$, $t_{398} = 21.0$ on the left, and $r = 0.77$, $t_{361} = 22.5$ on the right side; $p < 0.0001$) and male patients ($r = 0.71$, $t_{403} = 20.5$ on the left, and $r = 0.75$, $t_{379} = 22.3$ on the right side; $p < 0.0001$) (Fig. 4). The test was additionally run for each

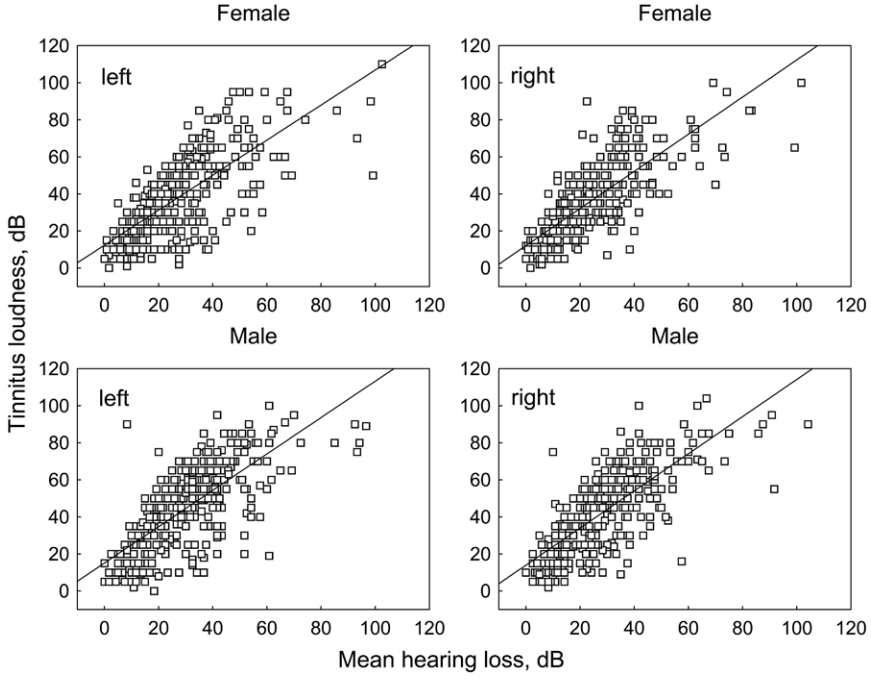

Fig. 4. Tinnitus loudness as a function of hearing loss analyzed in female and male patients with chronic tinnitus. Shown are the data of the left and right affected ears including the regression lines and the correlation coefficients (Pearson).

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TABLE 3. Number of female and male patients in the groups divided by age and duration of tinnitus

			Patients	
Variable	Group	Years	Female	Male
Age	Young	<45	180	182
	Middle	45–59	282	246
	Old	≥60	145	145
Duration	Short	<2	209	179
	Middle	2–9	265	234
	Long	≥10	135	158

frequency of the audiogram. The closest correlation was found at 4, 6, and 8 kHz ($r = 0.70–0.79$).

There was no correlation between the tinnitus pitch and hearing loss, but a weak correlation between tinnitus pitch and tinnitus loudness ($r = 0.21–0.31$) was detected in female and male patients.

No remarkable correlation was found between the psychometric scores and the patients' age or the duration of tinnitus in either gender, suggesting that there is no linear relationship between these factors. A weak negative correlation was found between the perceived stress (PSQ) and the patients' age in women ($r = -0.27$, $t_{566} = -6.6$) and men ($r = -0.28$, $t_{539} = -6.8$; $p < 0.0001$ each). The sense of coherence (SOC-L9) weakly correlated with age in men ($r = 0.23$, $t_{458} = 5.1$; $p < 0.0001$).

Gender Differences in Psychometric Scores With Respect to Age and Duration Groups

The scores of all questionnaires collected from female and male patients were subdivided into three groups, with reference to age and duration of tinnitus (Table 3) and statistically analyzed using ANOVA. To determine which of these factors (gender, age, and duration) would have the strongest effect on the psychometric scores, we used three-way ANOVA in a first step.

The factors gender and age were statistically significant for all questionnaires tested except for pessimism (Table 4). The factor tinnitus duration was only significant for proactive coping (PCI). In addition, there were no significant interaction effects.

The TQ and PSQ subscales were analyzed using MANOVA to take into account correlations between subscales. For the four PSQ subscales, the multivariate test (Wilk's λ) resulted in significant gender ($F_{4, 1065} = 11.04$) and age ($F_{8, 2130} = 25.47$) effects ($p < 0.0001$ each). Again, tinnitus duration was not statistically significant ($F_{8, 2130} = 0.16$). For the six TQ subscales, the factors gender ($F_{6, 1133} = 4.73$), age ($F_{12, 2266} = 5.12$), and duration ($F_{12, 2266} = 3.67$) were significant ($p < 0.0001$ each). However, the factor tinnitus duration was not significant when "hearing problems" and "intrusiveness" were not included as dependent variables ($F_{8, 2270} = 0.84$, $p = 0.56$), whereas gender ($F_{4, 1135} = 6.84$, $p < 0.0001$) and age ($F_{8, 2270} = 3.19$, $p < 0.01$) remained significant. The univariate results of "hearing problems" and "intrusiveness" were as follows: gender, $F_{1, 1138} = 5.56$ and 4.76 ($p < 0.05$ each); age, $F_{2, 1138} = 13.70$ and 15.22 ($p < 0.0001$ each); duration, $F_{2, 1138} = 11.58$ and 5.54 ($p < 0.0001$ and $p < 0.01$).

Thus, age and gender are important factors for most of the psychometric outcomes.

Hearing Problems • In general, the scores increased with duration of tinnitus, but when testing the age groups separately, the significance was found only in the middle- ($F_{2, 514} = 8.08$, $p < 0.001$) and old-age groups ($F_{2, 277} = 4.20$, $p < 0.05$), independent of gender (Fig. 5). Gender differences were found in the young-age group ($F_{1, 347} = 4.84$, $p < 0.05$), with female patients having higher scores than male patients.

Intrusiveness • The scores of this TQ subscale also increased with the duration of tinnitus, but this increase was statistically significant only for the male patients ($F_{2, 550} = 4.88$, $p < 0.01$). Intrusiveness increased with age in female ($F_{2, 588} = 7.77$) and in male ($F_{2, 550} = 7.71$, $p < 0.001$ each) patients.

Proactive Coping • The scores of proactive coping (PCI) decreased slightly with the duration of tinnitus in the younger group ($F_{2, 282} = 3.35$, $p < 0.05$). The scores reported by female patients were statistically lower than those of male patients in the middle-age ($F_{1, 413} = 8.97$) and old-age groups ($F_{1, 212} = 8.13$, $p < 0.01$ each). In the middle-age group, the proactive coping scores were slightly lower than in the younger or older groups, independent of the gender of these groups ($p < 0.05$).

The psychometric parameters that were unaffected by the duration of tinnitus were subsequently tested using two-way ANOVA, with gender and age as independent variables. The age and gender differences were highly significant (Table 5). The interaction effect was significant for the sense of coherence scores.

For the TQ subscales (emotional and somatic distress, sleep disturbance and somatic complaints), the multivariate test (Wilk's λ) resulted in significant gender ($F_{4, 1171} = 6.05$, $p < 0.0001$) and age effects ($F_{8, 2342} = 3.60$, $p < 0.001$) and also significant interaction effect ($F_{8, 2342} = 1.95$, $p < 0.05$). Looking at the univariate results, the factor gender was significant for sleep disturbance and somatic complaints ($F_{1, 1174} = 8.36$ and 21.35 ($p < 0.01$ and < 0.0001). The factor age was significant for emotional and cognitive distress ($F_{2, 1174} = 5.30$ and 4.53,

TABLE 4. Results of the three-way analysis of variance with the score of the scale as a dependent variable and gender, age, and duration of tinnitus as grouping factors

	Gender			Age			Duration		
Scale	*F*	df	*p*	*F*	df	*p*	*F*	df	*p*
Tinnitus Questionnaire	8.12	1, 1138	0.004	10.15	2, 1138	0.000	1.57	2, 1138	0.210
Perceived Stress Questionnaire	22.49	1, 1068	0.000	73.14	2, 1068	0.000	0.07	2, 1068	0.929
Proactive Coping Inventory	17.94	1, 907	0.000	8.84	2, 907	0.000	3.04	2, 907	0.048
Sense of Coherence	12.90	1, 932	0.000	21.60	2, 932	0.000	1.49	2, 932	0.225
Self-Efficacy	21.53	1, 1008	0.000	15.55	2, 1008	0.000	0.38	2, 1008	0.686
Optimism	6.34	1, 1008	0.012	6.57	2, 1008	0.001	1.18	2, 1008	0.307
Pessimism	0.16	1, 1008	0.689	1.25	2, 1008	0.286	0.51	2, 1008	0.502

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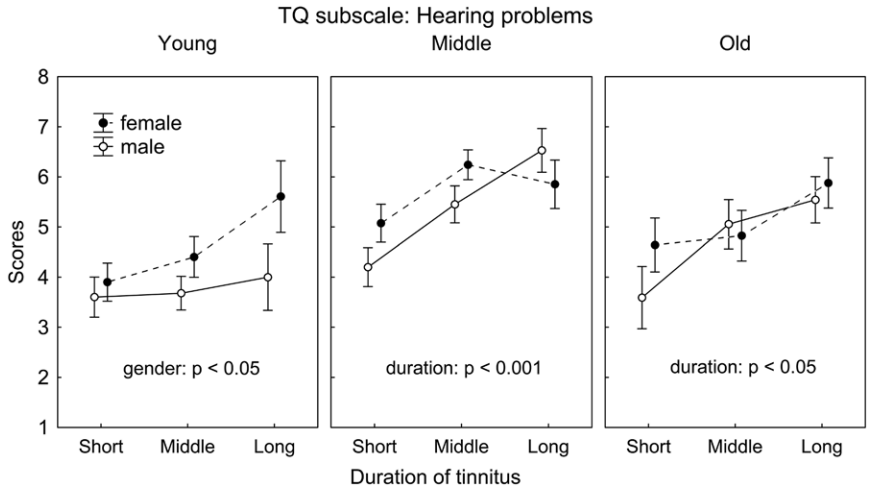

Fig. 5. Influence of gender, age, and duration of tinnitus on auditory perceptual difficulties as measured by the TQ subscale "hearing problems." Shown are the means ± standard errors of the mean. The main effects of two-way analysis of variance with gender and duration as independent factors are inserted into the boxes of each age group. TQ, Tinnitus Questionnaire.

$p < 0.01$ and < 0.05) as well as for sleep disturbance ($F_{2, 1174} = 6.47$, $p < 0.01$). The interaction effect (Gender × Age) was significant for cognitive distress and sleep disturbance ($F_{2, 1174} = 4.28$ and 4.39, $p < 0.05$ each).

For the four PSQ subscales, the multivariate test resulted in significant gender ($F_{4, 1100} = 11.42$) and age ($F_{8, 2200} = 28.53$) effects ($p < 0.0001$ each). The interaction effect was not significant. The factor gender was significant for the following three subscales (univariate results): worries and tension ($F_{1, 1103} = 19.12$ and $= 30.44$, $p < 0.0001$ each) as well as demands ($F_{1, 1103} = 14.61$, $p < 0.001$). The factor age was significant for all four subscales: worries ($F_{2, 1103} = 44.75$), tension ($F_{2, 1103} = 53.02$), joy ($F_{2, 1103} = 26.97$), and demands ($F_{2, 1103} = 112.41$ [$p < 0.0001$ each]).

To determine gender differences within the three age groups, the post hoc tests were performed and revealed the following:

TQ and its Subscales • We found clear differences in the age dependency between female and male patients. In female patients, tinnitus annoyance measured by the TQ total scores was significantly higher in the middle-age and old-age groups than in the younger group (Fig. 6). In male patients, the scores were higher only in the middle-age group, but not in the old-age group. Of the TQ subscales (Fig. 7), the "emotional distress" tended to increase in female patients. The subscales "cognitive distress" and "sleep disturbances" increased significantly with age in female, but not in male patients. This was emphasized by the significant interaction effects mentioned earlier. The subscale "somatic complaints" was not dependent on age; however, the scores were generally higher in female than in male patients. The gender differences were statistically significant in the middle-age and old-age groups.

PSQ and its Subscales • In older patients (≥60 years of age), the scores of the PSQ and its subscales "worries," "tension," and "demands" were significantly lower than in the two younger groups, both in women and men (Fig. 8). In general, female patients had higher scores than male patients, but the post hoc test demonstrated statistically significant differences in the groups aged 60 years and over (PSQ; worries and tension) and in the middle-age group (tension), indicating that the differences increase with age, despite the nonsignificant interaction effects. The scores of the subscale joy were higher in older than in younger female ($p < 0.001$) and male ($p < 0.0001$) patients.

Sense of Coherence • As already indicated by the significant interaction effect (Table 5), the age dependency differs between both genders. Post hoc analysis demonstrated that the scores for SOC-L9 significantly increase with age in male patients (Fig. 9). In female patients, such an increase was only seen between the middle-age and old-age groups. In the older patients (≥60 years of age), the women had significantly lower scores than men.

Self-Efficacy, Optimism, Pessimism • Older male patients (≥60 years of age) scored significantly higher in self-efficacy and optimism than the young- (<45 years of age) and middle-age (45–59 years) groups (Fig. 10). Older female patients (≥60

TABLE 5. Results of the two-way analysis of variance with the score of the scale as a dependent variable and gender and age as grouping factors

	Gender			Age			Interaction		
Scale	*F*	df	*p*	*F*	df	*p*	*F*	df	*p*
Tinnitus Questionnaire	7.40	1, 1174	0.007	13.12	2, 1174	0.000	2.08	2, 1174	0.126
Perceived Stress Questionnaire	18.92	1, 1103	0.000	81.78	2, 1103	0.000	1.96	2, 1103	0.141
Sense of Coherence	9.10	1, 963	0.002	23.49	2, 963	0.000	3.53	2, 963	0.040
Self-Efficacy	23.37	1, 1041	0.000	16.80	2, 1041	0.000	0.80	2, 1041	0.448
Optimism	8.13	1, 1041	0.004	9.15	2, 1041	0.000	0.81	2, 1041	0.446
Pessimism	0.22	1, 1041	0.641	1.26	2, 1041	0.281	1.47	2, 1041	0.231

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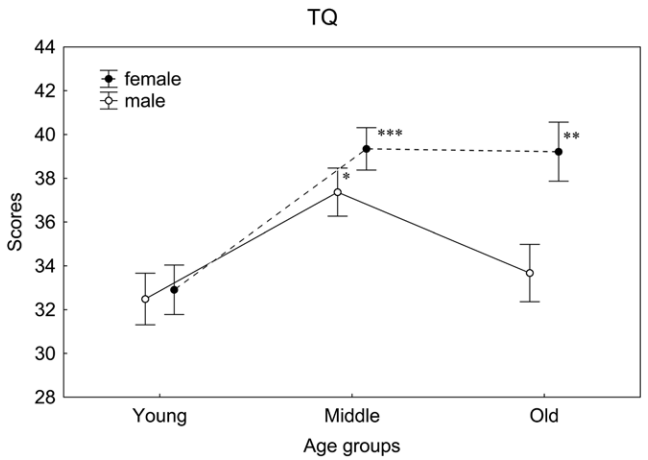

Fig. 6. Influence of gender and age on tinnitus-related distress as measured by the TQ. Shown are the means ± standard errors of the mean. */**/*** $p <$ 0.05/0.01/0.001 vs. young. TQ, Tinnitus Questionnaire.

years of age) also scored higher in self-efficacy than the middle-age group, but the scores were significantly lower than those of older male patients. The pessimism had a tendency to decrease in older male patients.

Correlations Between Tinnitus Annoyance Measured by the TQ and Other Psychometric Scores in Female and Male Patients

In female and male patients, tinnitus annoyance (TQ) scores correlated positively with the perceived stress (PSQ) and negatively with the sense of coherence measured by the SOC-L9; however, the correlation was stronger for men than for women (Table 6). We found weak but statistically significant correlations between tinnitus annoyance and proactive coping, self-efficacy, optimism, or pessimism for both genders.

Correlations Between Psychometric Scores and Hearing Loss or Tinnitus Loudness in Female and Male Patients

Of all psychometric parameters, only the scores obtained from the TQ subscale "hearing problems" correlated with the mean hearing loss both in female ($r = 0.31$, $t_{514} = 7.36$ on the left, and $r = 0.31$, $t_{490} = 7.22$ on the right side) and in male patients ($r = 0.43$, $t_{497} = 10.6$ on the left, and $r = 0.40$, $t_{485} = 9.53$ on the right side; $p < 0.0001$ each). The scores of the TQ subscale hearing problems also correlated with the tinnitus loudness in female ($r = 0.26$, $t_{399} = 5.27$ on the left, and $r = 0.29$, $t_{361} = 5.73$ on the right side) and in male patients ($r = 0.37$, $t_{403} = 8.08$ on the left, and $r = 0.32$, $t_{379} = 6.58$ on the right side; $p < 0.0001$ each).

DISCUSSION

Our present work provided evidence that the degree of tinnitus annoyance could be influenced by gender and age and partly by duration of tinnitus. The known gender- and age-related differences affecting stress, coping styles, sense of coherence, and personal resources is also true for patients with chronic tinnitus. The greatest differences in tinnitus-related distress exist between older female and male tinnitus patients (≥60 years of age). The association between tinnitus annoyance and psychological comorbidity was demonstrated in both genders; however, in men, tinnitus annoyance correlates strongly with perceived stress or sense of coherence as compared with women. There is no correlation between tinnitus-related distress and hearing abilities or tinnitus parameters except for the subscale hearing problems of the TQ.

Our female patients scored higher in psychometric parameters than male patients did, irrespective of age. Similar findings were made earlier by Stouffer and Tyler (1990). The differences we found were small but statistically significant, and indicated that women assess their tinnitus-related distress more intensively than men do, possibly because of differences in coping with stress, habituation processes, and their higher vulnerability

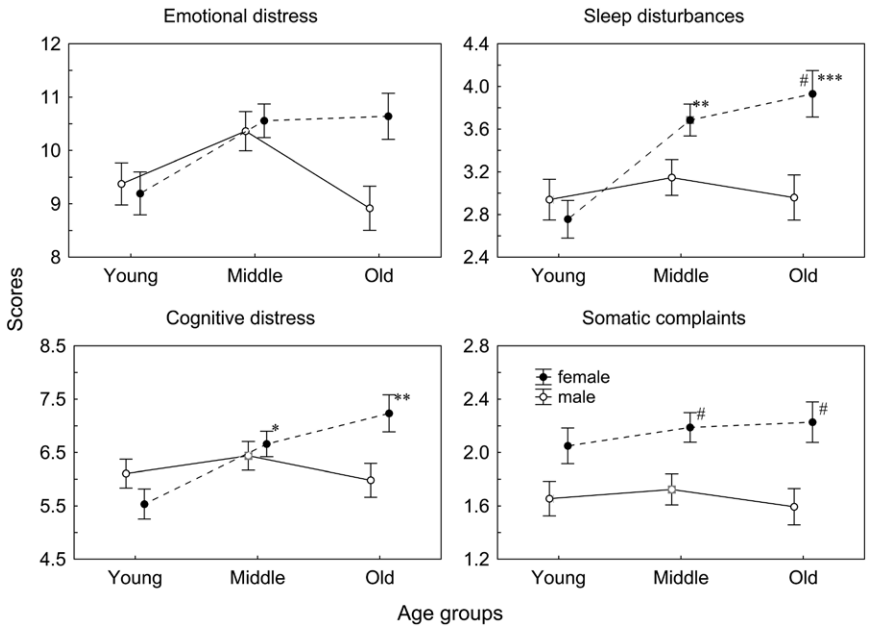

Fig. 7. Influence of gender and age on tinnitus-related distress as measured by the Tinnitus Questionnaire subscales. Shown are the means ± standard errors of the mean. */**/***$p <$ 0.05/0.01/0.001 vs. young; #$p <$0.05 vs. male patients.

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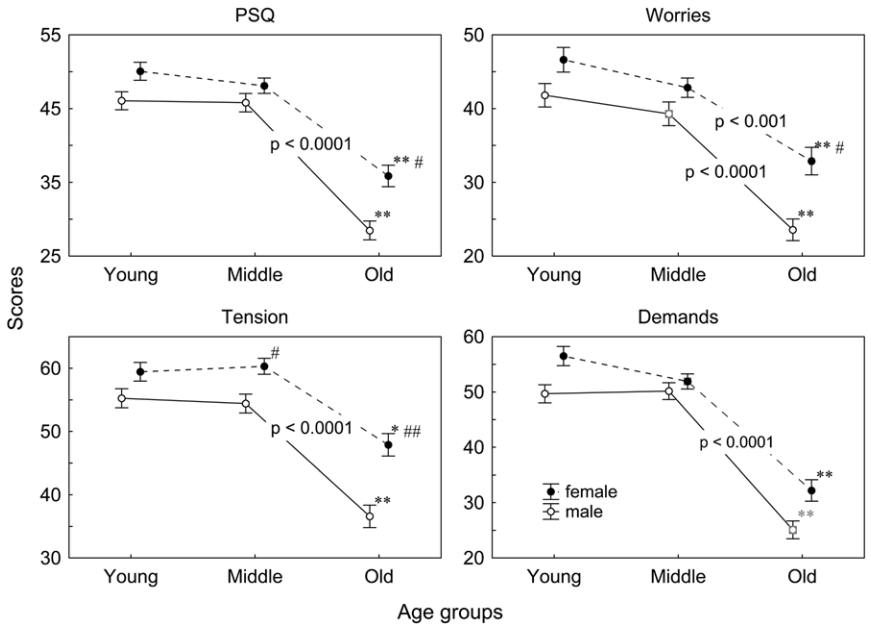

Fig. 8. Influence of gender and age on perceived stress as measured by the PSQ and its subscales. Shown are the means ± standard errors of the mean. */**$p < 0.001/0.0001$ vs. young; #/##$p < 0.05/0.01$ vs. male patients. The p values within the graphs indicate significance between the means of old and middle groups. PSQ, Perceived Stress Questionnaire.

to repeated stress (Schmaus et al. 2008; Welch & Dawes 2008; Anshel et al. 2009, 2010).

Occupational exposure to noise and exposure to high-impulse noise during leisure time were found to be the reason for more prominent hearing loss in men (Palmer et al. 2002; Lindgren et al. 2009). We found tinnitus to be louder in men than in women, supporting a previous report by Hiller and Goebel (2006). The strong correlation we found between hearing loss and tinnitus loudness confirms previous findings by Nicolas-Puel et al. (2002) and corroborates the fact that male patients perceive louder tinnitus than female patients in addition to their higher degree of hearing loss. However, tinnitus-matching procedure is a very subjective form of measurement, possibly leading to restrictive results.

Using the Tinnitus Severity Questionnaire, Erlandsson & Holgers (2001) were not able to find differences in the degree of tinnitus-related distress between male and female tinnitus patients of the same age as that of the sample in our study. It is possible that the small sample size (57 men and 129 women) contributed to this discrepancy. Nevertheless, the authors found that the health-related quality of life such as sleep, emotion, energy, and pain, is affected to higher degree in female tinnitus patients. A further study that examined the personality and perception of tinnitus showed that female patients were more likely to find their tinnitus annoying. However, the group tested was preferentially young and the authors admit that their findings may differ in older patients (Welch & Dawes 2008). Using the same tinnitus questionnaire (TQ) as we did, Vanneste et al. (2012) did not find gender differences in tinnitus annoyance. Despite the similar mean age of the patients, the small sample size of female and male patients (n = 18 each) or the high mean tinnitus annoyance of the patients (total score of the TQ > 50) may be responsible for this finding.

In contrast to our present finding, the degree of tinnitus annoyance was found to be higher in men than in women in earlier studies (Hiller & Goebel 2006). This could be explained by the fact that the authors compared the percentages of female and male patients with mild and most severe distress by calculating the odds ratio whereas we had excluded patients with very severe tinnitus-related distress.

Using MANOVA, we provided evidence that gender and age are the most important predictors not only for tinnitus annoyance, but also for the comorbid factors: perceived stress, coping style, sense of coherence, and personal resources in patients with chronic tinnitus. These psychometric parameters change with age in a nonlinear manner, and these changes differ between men and women.

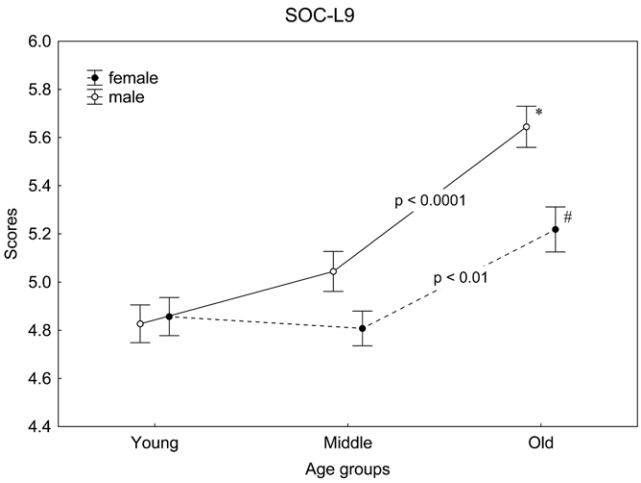

Fig. 9. Influence of gender and age on sense of coherence as measured by the SOC-L9. Shown are the means ± standard errors of the mean. *$p < 0.0001$ vs. young; #$p < 0.05$ vs. male patients. The p values within the graphs indicate significance between the means of old and middle groups. SOC-L9, Sense of Coherence.

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TABLE 6. Correlations between tinnitus annoyance measured by the Tinnitus Questionnaire and the scores of the different questionnaires

	Correlation Coefficients					
	Female Patients			Male Patients		
Questionnaire	*r*	*t*	df	*R*	*t*	df
Perceived Stress Questionnaire	0.35	8.82	567	0.51	13.81	540
Proactive Coping Inventory	–0.22	5.01	494	–0.23	5.00	448
Sense of Coherence	–0.43	10.80	508	–0.52	12.88	459
Self-Efficacy	–0.30	7.23	539	–0.35	8.45	506
Optimism	–0.31	7.57	539	–0.35	8.31	506
Pessimism	0.33	8.23	539	0.24	5.68	506

For all correlation coefficients, $p < 0.0001$.

In a study with the Brazilian version of the Tinnitus Handicap Inventory, Pinto et al. (2010) proposed that gender and age do not influence tinnitus annoyance. Their conclusion was based on the absence of significant correlations between these parameters and tinnitus severity; however, no multivariate analysis was used. Moreover, the number of patients tested was small and consisted of 27 men and 41 women. Another reason for the discrepancy between our results and those of Pinto et al. (2010) might be that the three-label category scale used in the study by Pinto et al. might be very insensitive (Tyler et al. 2007). Concerning the tinnitus annoyance measured by the TQ, we found that in both genders, the TQ scores increased up to an age of approximately 59 years, possibly because of concurrent stress in professional life and family life. In older male patients (≥60 years of age), the TQ scores decreased, whereas in female patients, TQ scores remained high. This is even more obvious for sleep disturbances and cognitive distress. Age-related changes of tinnitus in the context of other medical problems are described in the literature, for example in a review by Henry et al. (2005), but there are no differences between older male and female patients. Sleep complaints were found to play a potential role in elderly tinnitus patients, but the gender differences were not yet analyzed (Hébert & Carrier 2007).

In a population-based survey, the perceived stress measured by the PSQ was shown to decrease in older people (Kocalevent et al. 2007). As shown in the present study on tinnitus patients, reduction of perceived stress was more pronounced in men than in women and particularly affected the PSQ subscales worries and tension. In general, men and women were found to respond in a different way to different types of stress (Stroud et al. 2002; Lundberg 2005). Previous studies on gender differences in the perception of stress and coping styles suggested that women tend to use emotion-focused coping more than men, who generally express a problem-focused coping style (Matud 2004). Moreover, retirement was shown to have different effects on men and women (Szinovacz et al. 1992; Coursolle et al. 2010). The emotional well-being among retired men tends to be better than among retired women, who were described to suffer more likely from depressive symptoms (Coursolle et al. 2010). Retirement should have a stress-relieving effect, because the

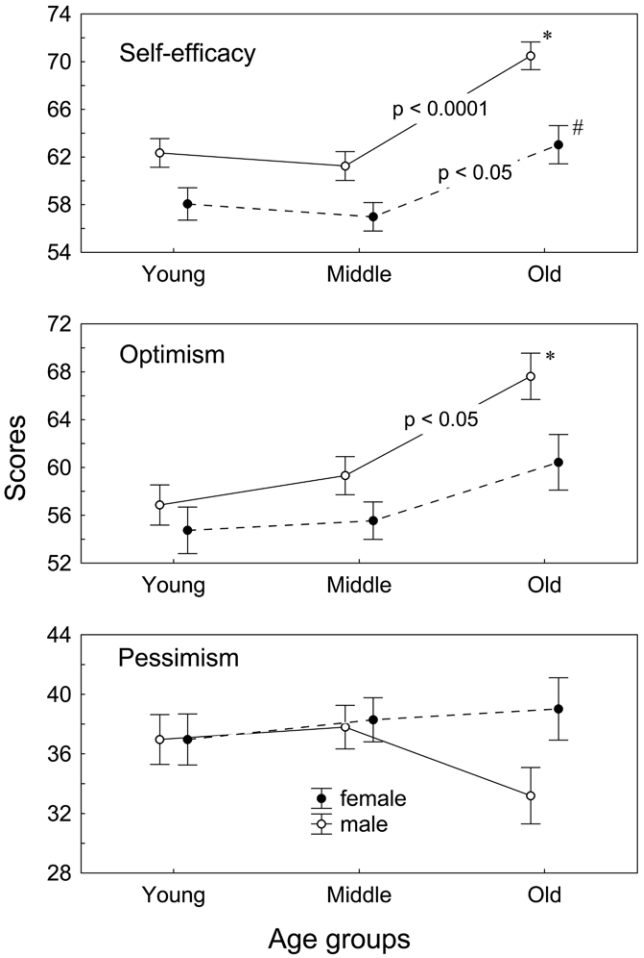

Fig. 10. Influence of gender and age on self-efficacy, optimism, and pessimism. Shown are the means ± standard errors of the mean. *$p < 0.01$ vs. young; #$p < 0.05$ vs. male patients. The p values within the graphs indicate significance between the means of old and middle groups.

active struggle to balance work and family demands is over. However, stressful family conflicts may still continue after retirement and work-based sources of emotional support factors are shortened. That may be felt more strongly by women than by men (Coursolle et al. 2010). In addition, the fact that the retirement income of women is often lower than that of men, could further contribute to female emotional distress. Moreover, male retirement may have a negative effect on the female partner, if men fail to support the housekeeping routine (Szinovacz et al. 1992). This could explain our findings regarding the tinnitus annoyance and perceived stress in older female and male patients (≥60 years of age).

However, the patients between 45 and 59 years of age scored highest in the TQ subscales "intrusiveness of tinnitus" and "hearing problems," and lowest in proactive coping, independent of gender. This result may reflect higher levels of occupational and personal stress in this particular age group. To what extent social conditions may influence these results should be investigated in a future study. In a study of age-dependent differences in coping with chronic illness, the authors found that coping styles change with age and that the coping strategy "seeking information" was lower in older- than in the middle-age adults,

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but also low in older adults who perceived their illness as highly serious (Felton & Revenson 1987). However, younger patients were not included in that study.

In addition to lower perceived stress in older tinnitus patients (≥60 years of age), we observed improved sense of coherence and self-efficacy in this age group. Again, better scores were found in men. Optimism was higher only in older male patients. Nilsson et al. (2010) showed that men have a stronger sense of coherence than women, and that the sense of coherence increases with age in both genders. Our previous study examining the sense of coherence in patients with psychosomatic diseases also revealed higher sense of coherence values in older than in younger patients, but gender was not analyzed in that study (Zirke et al. 2007). It is interesting that a small decrease in a sense of coherence with age was found in a representative sample of the German population (n = 2005) using the SOC-L9 (Schumacher et al. 2000). When compared with patients in that study, our tinnitus patients who were younger than 60 years of age had lower sense of coherence scores, and only the scores of the older patients (≥60 years of age) reached the normal level. The self-efficacy and mobility were found to be strong predictors of general health in older men who were 65 years of age and more as opposed to older women, whose strongest independent predictors of psychological morbidity were health status and subjective quality of life (Bowling 2007).

Duration of tinnitus may also play a role in chronic tinnitus, as shown in our study by an increase in hearing problems and intrusiveness of tinnitus measured by the TQ as well as decrease in proactive coping, although the effect of duration was not as high as that of gender and age. The weak correlations found between tinnitus duration and hearing loss or tinnitus loudness confirm that these two parameters slightly increase with the tinnitus duration. However, Tyler and Baker (1983) found that the number of tinnitus-related problems slightly decreases with duration of tinnitus, but the sample size was rather small in this study. Scott et al. (1990) found that subjects who had tinnitus for a longer time perceived the loudness as more intense. The correlation found in our study between duration of tinnitus and tinnitus loudness was weak, but it corroborates the aforementioned finding.

Regarding the gender differences found in our study, gender norms in the society, especially the increasing employment rate for women should also be considered. Empirical results did not confirm the hypothesis about higher employment rate of women skewing the general attitude toward equal gender roles (Haller & Hoellinger 1994). Traditional gender roles still exist in German families, despite the changes that have happened in the last generation (Maihofer et al. 2001). Employed mothers often complain about the lack of time for their children, but there are also more and more men who report difficulties in combining professional and family life (Maihofer et al. 2001). However, gender differences found in the present study were more pronounced in the group that was 60 years and above, which could be possibly because of the aforementioned different effects of retirement on men and women.

The correlations found between tinnitus annoyance and perceived stress or sense of coherence and between tinnitus annoyance and proactive coping or self-efficacy, optimism, or pessimism indicate that in addition to tinnitus annoyance, these parameters can influence the well-being of tinnitus patients. Again, this correlation was in part stronger in men than in women and might be explained by a different association of these factors with female and male health condition, especially in older age (Bowling 2007).

In a recent study, we found the degree of hearing loss to be higher in patients with more severe tinnitus annoyance than in patients with lower tinnitus annoyance and to be associated with the intrusiveness scale in addition to the hearing problems scale of the TQ in tinnitus patients with noise-induced hearing loss (Mazurek et al. 2010). In the present study, we found tinnitus loudness and hearing loss to be correlated with the hearing problems scale of the TQ, but not with other psychometric parameters tested, thus confirming that tinnitus-related distress, rather than the hearing loss, is more upsetting for the patients (Erlandsson & Holgers 2001; Hébert & Carrier 2007; Pinto et al. 2010) or suggesting that tinnitus loudness and annoyance should be examined separately, as shown in previous studies (Hiller & Goebel 2007; Ward & Baumann 2009). In addition, the majority of our female and male patients had normal hearing or mild degree of hearing loss (≤40 dB), pointing to tinnitus annoyance as a psychosomatic affliction and emotional distress. Nevertheless, our study supported the view of others who postulated that tinnitus studies should be matched for gender and age to avoid skewed results (Lanting et al. 2009).

Here, we analyzed the data of a large but comparatively homogeneous sample of tinnitus patients. To what extent the severe form of tinnitus annoyance and other comorbid health conditions may influence the gender differences in tinnitus annoyance should be examined in future studies. In addition, the inclusion of socioeconomic factors may lead to more specified information.

In conclusion, our study provided evidence supporting the hypothesis about age-dependent differences in tinnitus-related distress between female and male patients with chronic tinnitus. Knowledge of these differences may improve the treatment of chronic tinnitus and provide improved, tailored therapy approaches. In particular, female tinnitus patients who were 60 of age and above with severe somatic complaints and sleep disturbances may benefit from physiotherapy-oriented approaches such as exercise and relaxation techniques. Furthermore, cognitive behavioral therapy might help them to strengthen their self-esteem and reduce their cognitive distress. Group therapies may be especially useful to compare different attitudes, develop functional cognitive strategies, and to reduce anxiety (Jakes et al. 1992; Zöger et al. 2008). Therapy approaches for younger patients, who were demonstrated to be stressed more than other groups of patients in our study, should include stress management. To evaluate the severity of illness or the efficiency of a tinnitus therapy, psychometric analyses of stress, sense of coherence, and coping strategies should be implicated in the diagnosis and monitoring.

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The authors declare no conflicts of interests.

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