

CATASTROPHIZING AND FEAR OF TINNITUS PREDICT QUALITY OF LIFE IN PATIENTS WITH CHRONIC TINNITUS

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Abstract

Objectives: It is well established that catastrophic mis-interpretations and fear are involved in the suffering and disability of patients with chronic pain. This study investigated whether similar processes explain suffering and disability in patients with chronic tinnitus. We hypothesized that patients who catastrophically (mis)interpret their tinnitus would be more fearful of tinnitus, more vigilant towards their tinnitus, and report less quality of life. Moreover, tinnitus-related fear was expected to act as a mediator in reduced quality of life.

Design: Sixty-one tinnitus patients from an outpatient ENT department of the university hospital of Antwerp (Belgium) completed a number of questionnaires about their tinnitus. Hierarchical regression analyses were performed to test hypothesized associations and to assess mediation by tinnitus-related fear. **Results:** Analyses revealed significant associations between catastrophizing and fear, and between catastrophizing and increased attention towards the tinnitus. Furthermore, both tinnitus-related catastrophizing and fear predicted decreased quality of life and moreover, tinnitus-related fear fully mediated the association between catastrophizing about the tinnitus and quality of life. **Conclusions:** The findings confirm earlier suggestions that tinnitus-related concerns and fears are associated with impaired quality of life, which is in line with a cognitive behavioural account of chronic tinnitus. Future research avenues and clinical applications are discussed.

Keywords: Catastrophizing; Cognitive-behavioural; Quality of life; Tinnitus; Tinnitus-related fear

25 **Introduction**

26 Tinnitus is the awareness of a sound without an external source. Several theories regarding its
27 pathophysiology exist of which the most advocated is the hypothesis that tinnitus occurs as a
28 result of spontaneous anomalous neural activity, coinciding with changes in the auditory
29 system at any level along the auditory axis. Tinnitus has been described as a phantom auditory
30 perception and the involvement of non-auditory structures are considered of key importance
31 in clinically relevant tinnitus complaints (Cacace, 2003; Jastreboff, 1990; Jastreboff & Hazell,
32 1993).

33 The larger part of individuals experiencing chronic tinnitus eventually habituates or
34 adapts to the tinnitus sound and is able to function fairly well. Only a small part (5–8 %) of
35 this group tinnitus remains distressing and disabling (Ahmad & Seidman, 2004). In
36 individuals with persistent tinnitus complaints, the acoustical characteristics of the tinnitus
37 (e.g. loudness or pitch) is not univocally related to the severity of the tinnitus or treatment
38 outcome (Jastreboff, 1990; Jastreboff & Hazell, 1993). Only a weak relationship can be
39 established between perceived psycho-acoustic characteristics of the tinnitus (e.g. loudness or
40 pitch) and the severity of complaints. In chronic tinnitus, the interpretation of the sound might
41 be more important in defining the severity of complaints than the sound itself (Andersson,
42 2003; Henry & Meikle, 2000; Hiller & Goebel, 2007; Jastreboff & Hazell, 1993).

43 Severe emotional distress, major declines in concentration, problems in directing
44 attention and sleeping difficulties are the most reported daily activity limitations caused by
45 tinnitus. Most significant in predicting the variability in quality of life of tinnitus patients is
46 psychological distress, including negative attitudes and cognitions, impaired concentration,
47 insomnia, depression, and anxiety (Erlandsson & Hallberg, 2000). Accumulating evidence
48 suggests that cognitive misinterpretations, negative emotional reactivity and attentional
49 processes are crucial in dysfunctional habituation leading to severe tinnitus distress

50 (Andersson & McKenna, 2006; Erlandsson & Hallberg, 2000; Kroner-Herwig, Frenzel,
51 Fritsche, Schilkowsky, & Esser, 2003; Zachriat & Kroner-Herwig, 2004). In other chronic
52 disorders, like irritable bowel syndrome (Gonsalkorale, 2004), chronic fatigue syndrome
53 (Deary, Chalder, & Sharpe, 2007), and chronic pain disorder (Gatchel, Peng, Peters, Fuchs, &
54 Turk, 2007), psychological mechanisms, predicting or promoting dysfunctional responses to
55 symptoms, have similarly shown to be significant predictors of suffering (Crombez, Vlaeyen,
56 Heuts, & Lysens, 1999; Rief & Broadbent, 2007).

57 Given the analogies between chronic tinnitus and chronic pain (Folmer, Griest, &
58 Martin, 2001; Tonndorf, 1987), the current study is an attempt to apply a cognitive
59 behavioural model of chronic musculoskeletal pain and disability to the problem of chronic
60 tinnitus. The Fear-Avoidance (FA) model, originally proposed by Lethem et al. (Lethem,
61 Slade, Troup, & Bentley, 1983) and further elaborated by Vlaeyen and Linton (Vlaeyen &
62 Linton, 2000), is based on classical and operant conditioning paradigms. In case of injury,
63 automatic emotional and sympathetic responses are elicited. Through classical conditioning a
64 threatening situation, signaling pain or (re) injury, elicits conditioned fear responses such as
65 increased arousal, hypervigilance, and avoidance and escape behaviors, negatively reinforced
66 through instant diminishing fear. Although these protective behaviours may be adaptive in the
67 acute phase, they maintain fear in the long run and lead to increased functional disability.

68 The FA model builds upon these principles and includes pain catastrophizing and pain-
69 related fear as key factors. Pain catastrophizing can be defined as the process in which pain
70 receives an extremely negative meaning, consisting of magnification of the stimulus,
71 rumination about its possible consequences, and perceived helplessness and loss of control
72 (Sullivan, Kues, & Mayhew, 1996). Pain related fear can be defined as the fearful reactions
73 towards pain and pain-related activities and fear of (re)injury, including fearful beliefs about
74 causes of pain. The FA model predicts that if pain is misinterpreted catastrophically, it will

75 elicit specific pain-related fear associated with safety behaviours. These behaviours may be
76 functional in the short-term as fear is decreased, but paradoxically they worsen the problem in
77 the long run, because of disuse and increased disability.

78 The importance of pain-related fear in the development of pain-related disability has
79 been previously established as being pivotal in the development of pain-related disability,
80 contributing to disability more than biological or physical factors do (Crombez et al., 1999;
81 Gheldof et al., 2006; Goubert, Crombez, & Van Damme, 2004). Especially, the mediating
82 role of pain-related fear has been postulated, and in fact it has been found in earlier studies
83 that pain-related fear mediates the association between catastrophizing about pain and
84 functional disability (Gheldof et al., 2006). The role of mediators in the maintenance of
85 tinnitus distress has been proposed previously as well. Andersson and Westin (2008)
86 theorized that conditioned responses, such as fear, are likely to act as mediators in the
87 maintenance of chronic tinnitus distress.

88 Similar to chronic pain, catastrophic misinterpretations of tinnitus are likely to lead to
89 tinnitus-related fear, which is likely to be associated with escape/avoidance behaviours and
90 heightened awareness of the sound. Catastrophizing and tinnitus-related fear, may lead to
91 increased attention towards the stimulus, at the cost of the necessary attention for daily
92 activities, in turn leading to frequent interruptions of daily tasks, interference with daily
93 functioning, and compromised quality of life. Additionally, tinnitus-related fear may have a
94 mediating effect on the association between catastrophic misinterpretation of the tinnitus and
95 general quality of life.

96 The present aim is to investigate the applicability of the FA model in patients with
97 chronic tinnitus in a cross-sectional study. We hypothesized that patients who catastrophically
98 misinterpret their tinnitus would be more fearful of tinnitus, and that both catastrophic
99 misinterpretations and heightened fear are associated with increased attention towards the

100 tinnitus. We also expected a strong inverse association between tinnitus-related
101 catastrophizing and fear, and quality of life, moreover tinnitus-related fear was expected to
102 mediate the effect of catastrophic misinterpretations on quality of life.

103

104 **Materials and Methods**

105 *Participants*

106 Sixty-one (mean age = 55.4 yrs, SD = 12.1) participants suffering from chronic tinnitus were
107 recruited from an outpatient ENT department (See table 1 for demographic data). From all
108 incoming ENT patients only those were included who reported to be mainly troubled by their
109 tinnitus. Thirteen participants experienced difficulties in balance and dizziness secondary to
110 their tinnitus, 4 subjects reported to be also incapacitated by their hearing loss and 1 reported
111 to be troubled by hyperacusis next to the tinnitus. Duration of tinnitus was on average 2.6
112 years (SD=.9).

113

114 Table 1. *Demographic data: Age, Gender, Duration and Education*

115

116 *Procedure*

117 Research instruments were administered in an outpatient ENT department of the university
118 hospital of Antwerp (Belgium) during a period of 6 months. The battery of instruments was
119 administered after the purpose of the study was explained to participants and informed
120 consent was obtained. The research protocol was approved by the ethical board of the faculty
121 of Psychology and Educational Sciences of the Ghent University in Belgium.

122

123 **Measures**

124 *Distress caused by the tinnitus* or tinnitus severity was assessed by the Tinnitus Questionnaire
125 (TQ). The TQ consists of 52 items rated on a 3-point scale and assesses the psychological
126 distress associated with the tinnitus. Psychometric properties of the TQ have proven excellent
127 in different languages (Baguley, Humphriss, & Hodgson, 2000; McCombe et al., 2001).

128 *General distress* was measured with the Hospital Anxiety and Depression Scale
129 (HADS), which was successfully used in tinnitus research previously (Andersson, 2002). The
130 Dutch version of the HADS contains 14 items and has good reliability and validity
131 (Spinhoven et al., 1997).

132 Tinnitus severity and general distress were assessed for descriptive purposes. The following
133 measures were used to assess Quality of life, Catastrophizing about tinnitus, Tinnitus-related
134 fear, and attention towards the tinnitus.

135 *Quality of life* was assessed by the Short Form – 36 (SF36) (Hays, Sherbourne, &
136 Mazel, 1993) which comprises 36 items to assess various aspects of quality of life, including
137 physical functioning, bodily pain, emotional functioning, mental health, vitality and social
138 functioning. Two general subscales can be calculated: physical and mental health. In the
139 current study the mean of both scores has been used as a single measure for overall health (El
140 Refaie et al., 2004).

141 *Catastrophizing about tinnitus* was measured by the Tinnitus Catastrophizing Scale
142 (TCS). The TCS (see appendix 1) is an adapted version of the Pain Catastrophizing Scale
143 (Sullivan et al., 1996; Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove,
144 2002). The word ‘pain’ was substituted by the word ‘tinnitus’. The TCS has 13 items to be
145 rated on a 5-point scale (0 = not at all, 4 = always).

146 *Tinnitus-related fear* was assessed with the Fear of Tinnitus Questionnaire (FTQ). Of
147 this novel measure, items were included that were believed to capture worries and fears of

148 patients experiencing tinnitus (see appendix 2). Some of the FTQ items were derived from
149 the Tampa scale for Kinesiophobia (Roelofs et al., 2007) and the Pain Anxiety Symptoms
150 Scale (McCracken, Zayfert, & Gross, 1992). The FTQ was pretested with patients. The FTQ
151 has 17 items to be rated on a true or false scale.

152 *Attention towards the tinnitus* was measured by the Tinnitus Vigilance and Awareness
153 Questionnaire (TVAQ). This novel 18-item measure (see appendix 3) is based on the 16-item
154 Pain Vigilance and Awareness Questionnaire (PVAQ) (Roelofs, Peters, McCracken, &
155 Vlaeyen, 2003). Items 2, 3, 4, 6, 7, 8, 9, 10, 13 and 14 are PVAQ items, in which the word
156 ‘pain’ was substituted by the word ‘tinnitus’. The remaining items that were included were
157 believed to capture heightened awareness of tinnitus. Items are to be rated on a 6-point scale
158 (0 = never, 5 = always).

159

160 *Statistical procedures*

161 First, for all tinnitus self-report measures and the quality of life measure, Cronbach’s Alpha
162 was calculated in order to test internal consistency. Second, Pearson correlation coefficients
163 were calculated in order to test bivariate associations between measures. Third, a series of
164 multiple hierarchical regression analyses was carried out to test the hypotheses that [1]
165 catastrophizing about tinnitus is associated with fearful responses, [2] both catastrophizing
166 about tinnitus and tinnitus-related fear are associated with increased attention towards
167 tinnitus, and that [3] both predict poorer quality of life. Additionally, [4] to test for mediation
168 of tinnitus-related fear on the association between tinnitus catastrophizing and general quality
169 of life the asymptotic and re-sampling procedure for estimating the indirect effects proposed
170 by Preacher and Hayes (Preacher & Hayes, 2004, 2008) was chosen since this approach has
171 more power over the more frequently used method proposed by Baron and Kenny, which
172 includes the Sobel-test to test for mediation (Baron & Kenny, 1986). Moreover, this

173 procedure provides a quantified estimate of the indirect effect with associated confidence
174 limits. Predicted associations are illustrated in figure 1. In all regressions analyses, as well as
175 in the re-sampling procedure to test for mediation, age, gender, and education level were
176 entered as covariables. For all statistical procedures SPSS version 18.0 for Windows was
177 used.

178

179 Figure 1. *Predicted associations between catastrophizing about tinnitus (TCS), tinnitus-*
180 *related fear (FTQ), Increased attention towards tinnitus (TVAQ) and Quality of life (SF36)*

181

182 **Results**

183 *Descriptive data*

184 Patients reported a mean TQ-score (tinnitus distress) of 50 (SD=16.8) indicating that on
185 average severe distress associated with tinnitus was experienced (TQ- cut off = 46). In line
186 with suggestions from McCombe et al. (McCombe et al., 2001) we further classified patients
187 in terms of their TQ-scores. Scores on the TQ and location of the tinnitus in the current
188 sample are depicted in figure 2.

189 Mean scores on the HADS depression and anxiety subscales were 6.4 (SD=4.5) and 7.6
190 (SD=4.6) respectively. Scores below 8 indicate that pathological anxiety or depression is
191 absent (Spinhoven et al., 1997). On the depression subscale, 43.3% of respondents scored
192 above this clinical cut-off score. On the anxiety subscale this was 48.3% of respondents. No
193 significant differences were found between male and female patients in age, tinnitus severity,
194 or depressive or anxious mood.

195 The internal consistency (Cronbach's α) of all self-report measures were excellent
196 (TCS, α = .93, FTQ, α = .82, TVAQ, α = .81, and SF36, α = .93, TQ= .90, HADS Depression
197 and Anxiety, α = .86 and α = .85 respectively).

198

199 Figure 2. (a) Scores on the Tinnitus Questionnaire (TQ) and (b) Tinnitus location

200

201 **Correlations**

202 Table 2 displays means, standard deviations and Pearson correlations among the TQ, TCS, the
203 FTQ, the TVAQ, the SF36 and age. Correlations between TQ, TCS, FTQ, TVAQ, SF36 on
204 the one hand and age on the other hand were not significant. As was expected, correlations
205 among the tinnitus scales were significantly positive. The significant correlations between the
206 TQ and the TCS, FTQ, and the TVAQ support the convergent validity of these new scales.
207 Significant negative correlations were found between quality of life and distress due to
208 tinnitus, catastrophizing about tinnitus, tinnitus-related fear, and increased attention towards
209 tinnitus, supporting the divergent validity.

210

211 Table 2. Means, Standard Deviations, and Pearson correlation coefficients

212

213 **Regression analyses**

214 *Catastrophizing about tinnitus is associated with Tinnitus-related fear*

215 In order to investigate whether the level of catastrophizing (TCS) contributes to tinnitus
216 related fear (FTQ), a hierarchical regression analysis was performed. The first step in the
217 analysis included the control variables age, gender, and education. This model yielded no
218 significant F-value. Catastrophizing was added in the next step (see table 3) and significantly
219 contributed to total explained variance of tinnitus related fear. The control variables did not
220 reach significance. See table 3 for statistics from regression equations.

221

222 Table 3. *Statistics from regression equations: Tinnitus catastrophizing (TCS) as independent*
223 *variable and Tinnitus-related fear (FTQ) as dependent variable*

224

225 *Catastrophizing about tinnitus and Tinnitus-related fear are associated with increased*
226 *attention towards the tinnitus*

227 To assess whether catastrophic interpretations (TCS) of tinnitus are associated with increased
228 attention towards the tinnitus (TVAQ), a second regression analysis was performed. Again
229 demographic variables were entered first (age, gender, and education). This model did not
230 reach significance. Adding catastrophizing in the next step yielded a significant model (see
231 table 4; model 2 a).

232 Next, catastrophizing about tinnitus was replaced by tinnitus-related fear to assess
233 whether heightened fear is a predictor for increased awareness towards the tinnitus. Results
234 show that in this case fear of the tinnitus added significantly to the model, controlled for age,
235 gender, and education (See table 4; model 2 b).

236 A final analysis was performed to test whether heightened fear is related to increased
237 attention towards the tinnitus, above and beyond catastrophizing about tinnitus. After
238 controlling for age, gender and education, catastrophizing was added to the model first, and
239 tinnitus-related fear was added last; results show that fear of the tinnitus no longer
240 significantly added to the model (see table 4 for statistics from regression equations).

241

242 Table 4. *Statistics from regression equations: Tinnitus catastrophizing (TCS) and Tinnitus-*
243 *related fear (FTQ) as independent variables and increased attention towards tinnitus (TVAQ)*
244 *as dependent variable*

245

246 *Catastrophizing about tinnitus and Tinnitus-related fear are associated with Quality of life*

247 A final hierarchical regression analysis was performed to assess whether the level of
248 catastrophizing (TCS) and tinnitus-related fear (FTQ) would both have a unique contribution
249 in explaining poorer quality of life (SF36). The first step in the model included age, gender,
250 and education, none of which reached significance (see table 5). Adding the level of
251 catastrophizing contributed significantly to the model. Adding heightened fearfulness of the
252 tinnitus in the third step again yielded significant results. See table 5 for statistics from
253 regression equations.

254

255 *Table 5. Statistics from regression equations: Tinnitus catastrophizing (TCS) and Tinnitus-*
256 *related fear (FTQ) as independent variables and quality of life (SF36) as dependent variable*

257

258 *Fear of tinnitus mediates the association between catastrophizing and quality of life*

259 In order to assess mediation, the 'asymptotic and re-sampling' procedure for estimating the
260 bias corrected indirect effects (Preacher & Hayes, 2004, 2008) was chosen. Both test statistics
261 and the confidence interval of the indirect effects indicate a full mediating effect of tinnitus
262 related fear on the association between tinnitus catastrophizing and quality of life (see figure 3
263 for the mediator model and statistics). In table 6 the coefficients and test statistics of the
264 control variables (age, gender and education) and the mediation paths (see figure 3) are listed
265 and in table 7 the confidence intervals of the indirect effect after re-sampling are listed.

266

267 Figure 3. The mediator model with Tinnitus related fear (FTQ) as the mediator in the
268 association between catastrophizing about tinnitus (TCS) and Quality of life (SF36).
269 Standardized Beta's of individual paths, and the standardized Beta of the direct effect.

270

271 Table 6. *Partial effect of control variables on dependent variables and indirect, total and*
272 *direct effects of the mediation model*

273

274 Table 7. *Mediation of the effect of Tinnitus Catastrophizing on Quality of Life through*
275 *Tinnitus Related Fear*

276

277 **Discussion**

278 The current study investigated whether catastrophic misinterpretations of tinnitus and tinnitus-
279 specific fear would be important in explaining chronic tinnitus suffering and quality of life. A
280 novel framework explaining chronic tinnitus complaints was presented; the fear-avoidance
281 model of pain served as a heuristic framework to formulate specific hypotheses. Previous
282 findings in tinnitus research corroborate the possible applicability of the FA model for chronic
283 tinnitus. The importance of classical and operant learning principles in the maintenance and
284 possible treatment avenues in chronic tinnitus complaints have been postulated before
285 (Wilson, 2006). One of the assumptions of the neurophysiological model of tinnitus
286 (Jastreboff, 1990; Jastreboff & Hazell, 1993; Jastreboff & Hazell, 2004), is that conditioned
287 reflexes in processing the tinnitus sound are especially important in the development,
288 habituation processes and recovery of disabling tinnitus. The neurophysiological model also
289 postulates that in the generation and maintenance of chronic bothersome tinnitus, the
290 perception and interpretation of the signal is strongly related to heightened negative emotional
291 states, eliciting increased attention towards the tinnitus, enhancing the perception itself

292 (Jastreboff, 1990). This is in accordance with the currently proposed FA model, which
293 expands on these notions and incorporates a possible cognitive-behavioural account for the
294 onset and maintenance of chronic bothersome tinnitus. Our findings support both models, in
295 that they postulate the importance of the relation between interpretation of the signal and
296 heightened negative emotional responses, with increased attention towards the signal and
297 enhanced perception as a result.

298 Catastrophic misinterpretation was expected to influence the fearful response to the
299 tinnitus sound. Furthermore, catastrophic misinterpretations of tinnitus and tinnitus-related
300 fear were expected to be associated with a higher tendency to attend to the tinnitus. Last, we
301 predicted that both catastrophizing about the tinnitus and a higher level of fear of tinnitus
302 would be associated with lower quality of life and that tinnitus-related fear mediated the
303 association between tinnitus catastrophizing and quality of life.

304 The current findings corroborate the parallels between chronic pain and chronic tinnitus.
305 They suggest that the fear-avoidance model proposed in chronic pain literature extends to
306 patients with chronic tinnitus. Almost all of the associations mentioned earlier were found to
307 be significant. The level of catastrophizing was highly associated with both self-reported
308 tinnitus specific fear and increased attention towards the tinnitus. Higher levels of tinnitus-
309 related fear were associated with increased attention towards the tinnitus as well. However,
310 this association was no longer significant after controlling for catastrophizing first. This might
311 be due to the large conceptual overlap between catastrophizing about tinnitus and fearful
312 reactions towards the tinnitus. Indeed, catastrophizing beliefs may be considered part of the
313 overall fear construct, next to protective behaviours and physiological arousal (Lang, Levin,
314 Miller, & Kozak, 1983). Finally, catastrophic misinterpretations of tinnitus were significantly
315 related to poorer quality of life ratings and heightened fear uniquely added to this model,

316 above and beyond the contribution of catastrophizing about tinnitus. Moreover, tinnitus-
317 related fear fully mediated the association between tinnitus catastrophizing and quality of life.

318 Chronic tinnitus complaints are considered complex and difficult to treat or alleviate. It
319 has not been possible to explain daily interference and disability caused by the tinnitus by the
320 characteristics of the sound itself. Tinnitus sufferers report experiencing difficulties in
321 concentration because of the tinnitus, and terms like “intrusiveness of the sound”
322 distinguishes moderate from severe tinnitus in most subjective reports (Andersson &
323 McKenna, 2006). Many theorists have proposed that psychological factors are the main
324 predictors concerning tinnitus severity (Andersson, 2002; Hallam, McKenna, & Shurlock,
325 2004; Jensen, Turner, Romano, & Karoly, 1991). Moreover, cognitive behavioural therapy
326 has been proven effective in several clinical trials (Andersson, 2002; Dobie, 1999; Kroner-
327 Herwig et al., 2003; Martinez Devesa, Waddell, Perera, & Theodoulou, 2007; Rief, Weise,
328 Kley, & Martin, 2005). Tinnitus complaints might be best explained by adopting a
329 biopsychosocial approach and using a cognitive behavioural framework. The cognitive
330 tinnitus sensitization model proposed by Zenner and Zalaman (Zenner & Zalaman, 2004)
331 introduced an explanation for the significant improvements in tinnitus complaints by
332 cognitive behavioural therapy. Processes of inadequate appraisal, inadequate coping, negative
333 affect, and increased attention towards the tinnitus were distinguished; however, the
334 associations between these processes were not yet specified in a single theoretical framework.
335 The current study is a first step in this direction. Our results are in accordance with previous
336 findings in studies on chronic tinnitus and chronic pain, and seem to support a similar
337 underlying cognitive behavioural model as the one proposed by Vlaeyen & Linton (2000).
338 These findings provide important new insights regarding the role of cognitive
339 misinterpretations and fear in the maintenance of chronic tinnitus. In fact, they suggest that
340 catastrophic misinterpretation of tinnitus is not only highly associated with heightened fear of

341 the tinnitus sound, but also with increased attention towards the threatening sound and lower
342 ratings of quality of life. Moreover, findings suggest that tinnitus-related fear is associated
343 with increased attention towards the tinnitus and with a decrease in quality of life as well.
344 Interestingly, it was found that tinnitus specific fear fully mediated the relation between
345 catastrophizing about tinnitus and quality of life. This finding suggests that tinnitus-related
346 fear accounts for the relation between catastrophic misinterpretations of tinnitus and quality of
347 life ratings.

348 In chronic pain research, the mediating role of fearful reactions has been investigated
349 and established (Gheldof et al., 2006; Goubert et al., 2004). It was found that in the
350 association between pain severity and functional and social disability, fear of painful
351 movement had an important mediating effect. The theoretical concept of mediators in the
352 maintenance of tinnitus distress have been previously proposed (Andersson & Westin, 2008).
353 First it was brought to attention that the tinnitus receives its negative connotation through
354 classical conditioning (Jastreboff & Jastreboff, 2006). It was furthermore theorized that
355 aversive responses towards the tinnitus sound might act as mediators and be the prime cause
356 of maintained tinnitus distress in the long run. The current findings corroborate these
357 assumptions in that aversive responses, like catastrophizing and fear might be the key factors
358 in the maintenance of chronic tinnitus distress with an important mediating role of tinnitus
359 specific fear in this process.

360 This study has a number of limitations. *First*, it is important to note that the current
361 investigation was carried out using measures initially developed for chronic pain research.
362 Correlations between the TQ and the new measures were significant; indicating a high
363 convergent validity. Divergent validity was indicated by the significant negative correlation
364 between the SF36 and the tinnitus measures. Future research is needed to examine the
365 psychometric properties of these instruments in larger samples of patients with tinnitus.

366 *Second*, for reasons described below we used results on the TQ for descriptive purposes
367 only. Guidelines for the grading of tinnitus severity have been described by Mc Combe et al.
368 (McCombe et al., 2001). They concluded that the grading of tinnitus severity is almost
369 synonymous with grading psychological distress. Since tinnitus severity is largely determined
370 by psychological factors, the instruments developed for this purpose, like the TQ, comprise
371 items which are quite similar to those of more specific measures to assess level of
372 catastrophizing, hypervigilance and tinnitus related fear. For this reason it was considered
373 inappropriate in the current investigation to use the TQ as a reference for disability caused by
374 the tinnitus or tinnitus severity, since this would compromise analyses. Severity of tinnitus
375 should be otherwise specified when used for researching cognitive models, possibly within
376 the realm of a biopsychosocial framework. Another option would be to include Visual
377 Analogue Scales (VAS) in the future to establish tinnitus severity or impact on daily life.
378 *Third*, these results concern cross-sectional data. Therefore, causality cannot be inferred from
379 current data. *Fourth*, another risk worth mentioning is that shared method variance might be
380 causing an artificial inflation of correlations in the current analyses (Nicholls, Licht, & Pearl,
381 1982). *Last*, audiological measurements, such as level and lateralisation of hearing loss,
382 tinnitus localisation and pitch match frequency and intensity, maskability, **and uncomfortable**
383 **loudness levels (UCL) to assess for decreased sound tolerance** were not available for analyses.
384 In future studies it would be of interest to see whether these measures could predict
385 interpretation, fear and attentional bias towards the tinnitus. It might also be important to
386 investigate whether these psychological mechanisms affect tinnitus measures like maskability
387 or subjective loudness (intensity) **and sound tolerance**.

388 In sum, the present study indicates important parallels between chronic pain and chronic
389 subjective tinnitus. Important new insights regarding the role of cognitive misinterpretations
390 and fear in the maintenance of chronic tinnitus and the mediating role of these fearful

391 reactions towards the tinnitus have been presented. Important to note is that next to several
392 parallels there are differences as well between chronic tinnitus and chronic pain disorder. For
393 example, ineffective safety behaviours are assumed to play an important role in the
394 maintenance of chronic tinnitus complaints. These safety behaviours are expected to be
395 different from those observed in chronic pain patients, research efforts should be undertaken
396 to further investigate the exact nature, occurrence, and consequences of these safety
397 behaviours in tinnitus patients.

398 Results show that adopting a biopsychosocial approach, in studying development,
399 maintenance, assessment and treatment approaches in chronic tinnitus might offer new venues
400 for research and management of chronic tinnitus (Martinez Devesa et al., 2007). Future efforts
401 should focus on development and validation of appropriate measures, experimental studies in
402 which value of tinnitus sounds are manipulated, and replication of results using larger samples
403 employing a longitudinal design.

404

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412

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536

537

538 **Appendix 1**

539 *Tinnitus Catastrophizing Scale (TCS)*

540 We are interested in your thoughts en feelings when experiencing tinnitus. With this
541 questionnaire we want to investigate what influence tinnitus has on you; on your mood, your
542 behaviour, your attitude. Below you can find 13 statements describing different thoughts and
543 feelings which might be related to your tinnitus. Please try to indicate to what extent these
544 thought or feelings apply to you by using the following rating scale: 0 = *Not at all*; 1 = *to a*
545 *small extent*; 2 = *to some extent*; 3 = *to a large extent*; 4 = *Always*

546 ***If I experience Tinnitus ...***

- 547 ... I worry all the time about whether the tinnitus will end
- 548 ... I feel I can't go on
- 549 ... It's terrible and I think it's never going to get any better
- 550 ... It's awful and I feel it overwhelms me
- 551 ... I feel I can't stand it anymore
- 552 ... I become afraid the tinnitus will get worse
- 553 ... I keep thinking about other times I experienced tinnitus
- 554 ...I anxiously want the tinnitus to go away
- 555 ... I can't seem to keep it out of my mind
- 556 ... I keep thinking about how strong my tinnitus is
- 557 ... I keep thinking about how badly I want the tinnitus to stop
- 558 ... There is nothing I can do to reduce the intensity of the tinnitus
- 559 ... I wonder whether something serious may happen

560

561

Fear of Tinnitus Questionnaire (FTQ)

This questionnaire will help us understand how you think and feel about your tinnitus condition. It enables us to examine how tinnitus affects you, what effect it has on your mood, your behaviour, your attitude. Below you will find 17 statements. Please check the box next to each statement that you think applies to your current situation.

- 1** I am afraid that my tinnitus will deteriorate my hearing
- 2** I am afraid that my tinnitus will become worse
- 3** I fear that my tinnitus is the result of a tumour
- 4** Even though my tinnitus is getting worse, I do not think it points to a serious disease
- 5** I am afraid that my tinnitus will drive me crazy
- 6** The fact that I have tinnitus does not mean that my health is at risk
- 7** I am afraid my tinnitus will leave me deaf
- 8** I am afraid the moment will come that my head cannot withstand tinnitus anymore
- 9** My mental condition will become severely affected by my tinnitus
- 10** I am afraid that tinnitus will stop me from ever having a normal life again
- 11** I am afraid that I will never be able to experience silence again because of tinnitus
- 12** I am afraid that loud noises will aggravate my tinnitus
- 13** I am afraid I will not be able to do anything anymore because of my tinnitus
- 14** It worries me to think I may never be able to learn how to cope with this condition
- 15** It would be terrible if my tinnitus proved a life-long condition
- 16** I am concerned that tinnitus may be a risk to my physical health
- 17** I am afraid that tinnitus may be a preliminary sign of brain haemorrhage or similar

Tinnitus Vigilance and Awareness Questionnaire (TVAQ)

Below you find 18 sentences describing how people react on their tinnitus. . With this questionnaire we want to investigate what influence tinnitus has on you; on your mood, your behaviour, your attitude. Please indicate how often a statement applies to you by circling a number between 0 (never) and 5 (always).

	Never			Always		
1 I am very aware of changes in my tinnitus	0	1	2	3	4	5
2 I am quick to notice changes in the intensity of my tinnitus	0	1	2	3	4	5
3 I am quick to notice the effects of medication on my tinnitus	0	1	2	3	4	5
4 I am quick to notice changes in sound or intensity of my tinnitus	0	1	2	3	4	5
5 The tinnitus keeps me constantly occupied	0	1	2	3	4	5
6 I notice the tinnitus even if I am busy with another activity	0	1	2	3	4	5
7 I find it easy to ignore my tinnitus	0	1	2	3	4	5
8 I know immediately when my tinnitus starts or increases	0	1	2	3	4	5
9 When I do something that increases my tinnitus, the first thing I do is check to see how much my tinnitus was increased	0	1	2	3	4	5
10 I know immediately when my tinnitus decreases	0	1	2	3	4	5
11 I must attend to my tinnitus a lot	0	1	2	3	4	5
12 I carefully monitor how intense my tinnitus is	0	1	2	3	4	5
13 I become preoccupied with my tinnitus	0	1	2	3	4	5

14 I do not dwell on my tinnitus	0	1	2	3	4	5
15 Sometimes I'm able to ignore the tinnitus, even if it is present	0	1	2	3	4	5
16 I am aware of my tinnitus from the moment I get up till the moment I go to sleep	0	1	2	3	4	5
17 The tinnitus distracts me, no matter what I do	0	1	2	3	4	5
18 Often, my tinnitus is so bad that I cannot ignore it	0	1	2	3	4	5

565

TABLES

Table 1. *Demographic data: Age. Gender. Duration and Education*

Age (yrs)	%
> 35	5
35 < 50	33
50 < 65	33
65 <	28
Gender	%
Male	40
Female	60
Duration (yrs)	%
> 1	4
1 < 5	21
5 < 10	15
10 <	60
Education	%
Elementary	13
Junior high	20
High school	16
College education or University degree	51

Table 2. Means, Standard Deviations, and Pearson correlation coefficients

Variabels	Mean	SD	2	3	4	5	6
1. Tinnitus severity (TQ)	15	16.8	.74**	.70**	.57**	-.57**	-.01
2. Tinnitus Catastrophizing (TCS)	25.1	13.7	-	.70**	.62**	-.32*	.05
3. Fear of tinnitus (FTQ)	43.6	8.2	-	-	.42**	-.43**	.13
4. Increase attention towards the tinnitus (TVAQ)	49.6	15.4	-	-	-	-.31*	-.08
5. Quality of life (SF36)	53.3	8.4	-	-	-	-	-.03
6. Age	55.71	11.93	-	-	-	-	-

Note: *P < .05 (2-tailed); **P < .01 (2-tailed)

TQ: Tinnitus questionnaire; TCS: Tinnitus catastrophizing scale; FTQ: Fear of tinnitus questionnaire; TVAQ:

Tinnitus vigilance and awareness questionnaire; SF36: Short form 36

Table 3. Statistics from regression equations: Tinnitus catastrophizing (TCS) as independent variable and Tinnitus-related fear (FTQ) as dependent variable

<i>Model</i>	<i>R² change(F)</i>	<i>Independents</i>	<i>B</i>	<i>Stand B</i>
1	0.04(0.77)	Age	0.08	0.11
		Gender	-1.92	-0.11
		Education	-0.62	-0.08
2	0.48(15.07)	Tinnitus Catastrophizing (TCS)	0.45 **	0.71 **

Note: *P < .05 (2-tailed); **P < .01 (2-tailed)

TCS: Tinnitus catastrophizing scale; FTQ: Fear of tinnitus questionnaire

Table 4. Statistics from regression equations: Tinnitus catastrophizing (TCS) and Tinnitus-related fear (FTQ) as independent variables and increased attention towards tinnitus (TVAQ) as dependent variable

<i>Model</i>	<i>R2 change (F)</i>	<i>Independents</i>	<i>B</i>	<i>Stand B</i>
1	0.062(1.23)	Age	0.01	0.00
		Gender	-0.22	-0.01
		Education	3.37	0.25
2 a	0.37(10.54)	Tinnitus Catastrophizing (TCS)	0.70 **	0.62 **
2 b	0.22 (16.50)	Fear of tinnitus (FTQ)	0.84 **	0.48 **
3	0.02(8.35)	Tinnitus Catastrophizing (TCS)	0.65 **	0.57 **
		Fear of tinnitus (FTQ)	0.12	0.07

Note: *P < .05 (2-tailed); **P < .01 (2-tailed)

TCS: Tinnitus catastrophizing scale; FTQ: Fear of tinnitus questionnaire; TVAQ: Tinnitus vigilance and awareness questionnaire

Table 5. Statistics from regression equations: Tinnitus catastrophizing (TCS) and Tinnitus-related fear (FTQ) as independent variables and quality of life (SF36) as dependent variable

<i>Model</i>	<i>R2 change (F)</i>	<i>Independents</i>	<i>B</i>	<i>Stand B</i>
1	0.05(0.88)	Age	-0.08	-0.10
		Gender	1.89	0.11
		Education	-1.73	-0.22
2	0.08(1.97)	Tinnitus Catastrophizing (TCS)	-0.19 **	-0.29 **
3	0.12(3.46)	Tinnitus Catastrophizing (TCS)	0.04	0.06
		Fear of tinnitus (FTQ)	-0.51 **	-0.50 **

Note: *P < .05 (2-tailed); **P < .01 (2-tailed)

TCS: Tinnitus catastrophizing scale; FTQ: Fear of tinnitus questionnaire; SF36: Short form 36

Table 6. *Partial effect of control variables on dependent variables and indirect, total and direct effects of the mediation model*

Control variables	Effects	Coefficients	Standard error	<i>p</i>
Age		-.04	.09	.66
Gender		1.08	2.20	.62
Education		-2.12	-2.02	.05
	Path a	.45	.06	.00*
	Path b	-.51	.18	.00*
	Path c	-.19	.08	.02*
	Path c'	.04	.11	.72

Note: a path, effect of tinnitus catastrophizing on tinnitus related fear; b path effect of tinnitus related fear on quality of life, controlled for catastrophizing; c path, total affect, of tinnitus catastrophizing on quality of life (*significant effect see also figure 3); c'path, direct affect, of tinnitus catastrophizing on quality of life controlled for the mediator, all path analyses controlled for age, gender and education.

Table 7. *Mediation of the effect of Tinnitus Catastrophizing on Quality of Life through Tinnitus Related Fear*

	Bootstrapping					
	Percentile 95% CI		BC 95% CI		Bca 95% CI	
	Lower	Upper	Lower	Upper	Lower	Upper
FTQ	-.3868	-.0690	-.4165	-.0662	-.4047	-.0710

Note: FTQ, Tinnitus related fear, BC, bias corrected; Bca bias corrected and accelerated;

2000 bootstrap samples, analyses controlled for age, gender and education

FIGURES

Figure 1: Predicted associations between Catastrophizing about tinnitus (TCS), Tinnitus-related fear (FTQ), Increased attention towards tinnitus (TVAQ) and Quality of life (SF36) and the mediating effect of Tinnitus-related fear (FTQ)

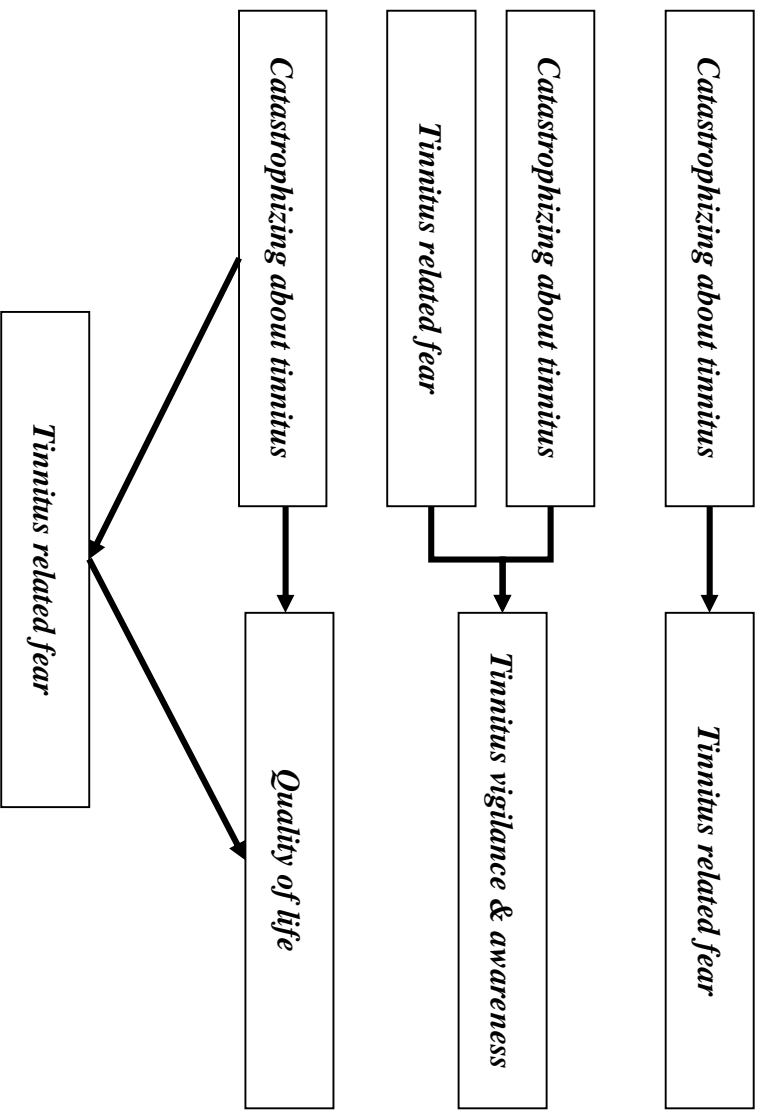


Figure 2. (a) Scores on the Tinnitus Questionnaire (TQ) and (b) Tinnitus location

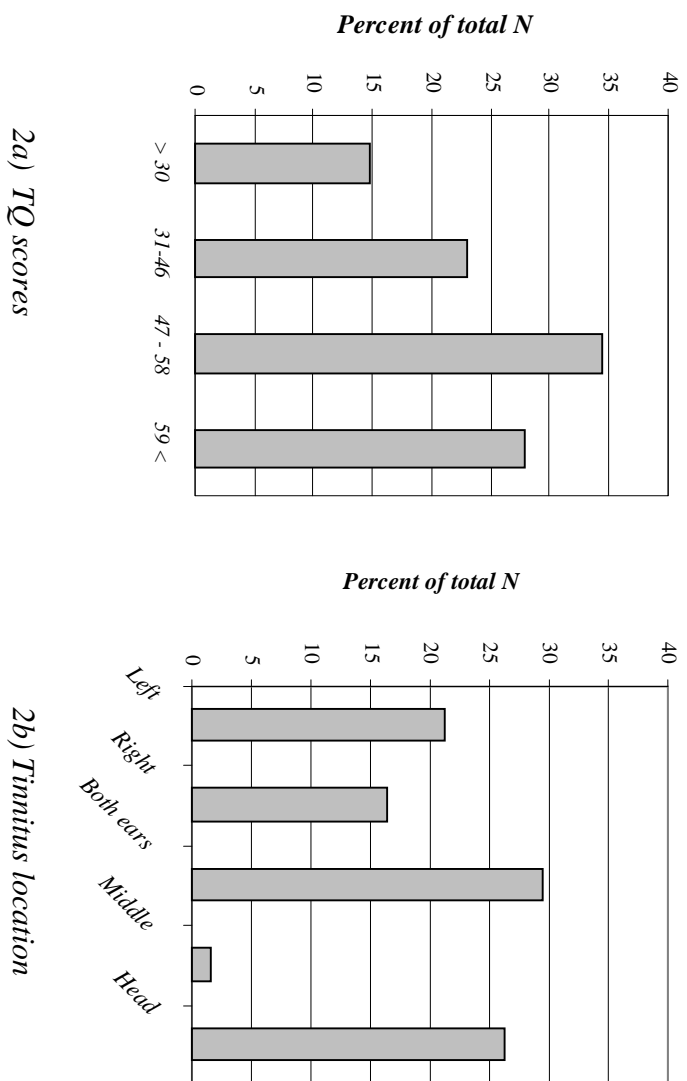
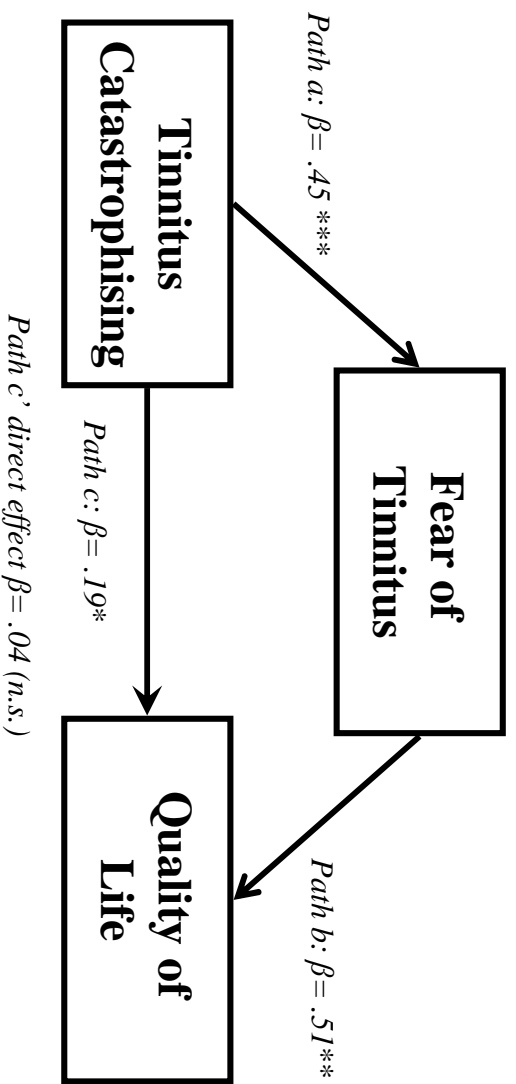


Figure 3. The mediator model with Tinnitus related fear (FTQ) as the mediator in the association between catastrophising about tinnitus (TCS) and Quality of life (SF36). Standardized Beta's of individual paths, and the standardized Beta of the direct effect



Note: *P < .05 (2-tailed); **P < .01 (2-tailed); *** P < .001