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# Journal of Nervous and Mental Disease

## Acquired hearing loss, anger and emotional distress: the mediating role of perceived disability --Manuscript Draft--

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| <b>Abstract:</b>                                     | <p>The aim of study was to test whether Acquired Hearing Loss (AHL)-related perceived disability mediates the association between AHL and psychological outcomes, including anger.</p> <p>Two-hundred ninety-seven consecutive outpatients with AHL assessed by Pure Tone Average (PTA) loss completed: Hearing Handicap Inventory for Adults (HHIA), State-Trait Anger Expression Inventory-2 (STAXI-2), Brief Symptom Inventory (BSI), Diagnostic Criteria for Use in Psychosomatic Research (DCPR) and Social Functioning Questionnaire (SFQ).</p> <p>In the sample, composed of 44.5% males with a mean age of 53.8 and a mean PTA of 30.7, AHL was associated to perceived hearing handicap, also correlating to all psychological measures except DCPR demoralization. Associations were stronger between the HHIA-emotional subscale, STAXI-State Anger and Feeling Angry and BSI-Somatization, Interpersonal Sensitivity, Depression and Psychoticism. Perceived disability predicted the presence of almost all psychosocial outcomes and confirms to be the most significant target of clinical action.</p> |



**UNIMORE**  
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Modena, 23rd August 2018

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Editor-in-chief of the Journal of Nervous and Mental Disease

Dear Prof. Talbott,

Please find enclosed a manuscript entitled "Acquired hearing loss, anger and emotional distress: the mediating role of perceived disability", which we submit for consideration for publication in *the Journal of Nervous and Mental Disease*.

We decided to submit our work to your Journal in view of its implications on the topic of psycho-social distress in the medically ill. The study explores the complex and controversial relationship between measurable alterations of somatic functioning (in this case, the sense of hearing) and its subjective consequences in terms of quality of life, disability and emotional suffering of affected individuals, with a special attention on specific psychological constructs such as anger and demoralization.

We think this paper could be of interest to your Journal's readers.

An earlier version of the manuscript was submitted to *Psychotherapy and Psychosomatics*, which rejected it due to publication pressure rather than manuscript quality. Nevertheless, since then we have carefully reviewed the work with a view to ensuring its clarity and impact. The data reported in the manuscript have not been previously published in any form nor presented as a conference abstract.

No conflict of interest has to be declared by any of the authors.

Thank for considering our manuscript for publication, we look forward to your response in due course.

On behalf of the Authors,

Yours sincerely,

Silvia Ferrari.

1 **Acquired hearing loss, anger and emotional distress: the mediating role of perceived disability**

2

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3 **Short title for use as running head**

4 Hearing loss, emotional distress and perceived disability

5

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10

11 **Conflict of interest**

12 None to declare

13

14

15

1    **Abstract**

2    The aim of study was to test whether Acquired Hearing Loss (AHL)-related perceived disability mediates the  
3    association between AHL and psychological outcomes, including anger.

4    Two-hundred ninety-seven consecutive outpatients with AHL assessed by Pure Tone Average (PTA) loss  
5    completed: Hearing Handicap Inventory for Adults (HHIA), State-Trait Anger Expression Inventory-2 (STAXI-  
6    2), Brief Symptom Inventory (BSI), Diagnostic Criteria for Use in Psychosomatic Research (DCPR) and Social  
7    Functioning Questionnaire (SFQ).

8    In the sample, composed of 44.5% males with a mean age of 53.8 and a mean PTA of 30.7, AHL was  
9    associated to perceived hearing handicap, also correlating to all psychological measures except DCPR  
10   demoralization. Associations were stronger between the HHIA-emotional subscale, STAXI-State Anger and  
11   Feeling Angry and BSI-Somatization, Interpersonal Sensitivity, Depression and Psychoticism. Perceived  
12   disability predicted the presence of almost all psychosocial outcomes and confirms to be the most  
13   significant target of clinical action.

14

15    **Keywords**

16    Acquired hearing loss, anger, disability, emotional distress, adjustment to disability

17

18

19 **Introduction**

20 Acquired Hearing Loss (AHL) is common, with a prevalence ranging from 21 to 90%, increasing by 4-9% per  
21 year of ageing (Chia E et al., 2006; Golding M et al., 2006). The population prevalence of AHL is expected to  
22 increase in the future, due to both the progressive ageing of population of developed nations and the high  
23 noise risk exposure in working (Alberti P, 1998) and leisure (Borchgrevink H, 2003) environments.

24 AHL negatively impacts physical and role functioning, psychological well-being and quality of life, as also  
25 assessed by the WHO-International Classification of Functioning, Disability and Health (ICF) (WHO, 2001).

26 Gopinath et al reported an odds ratio of 6.6 for developing hearing disability and handicap within 5 year of  
27 onset in older adults with AHL (Gopinath B et al., 2012a). Difficulties in the localization of sounds and  
28 recognition of words and sentences, especially in noisy environments, may lead to the development of  
29 maladaptive communication strategies and considerable limitations in daily activities (Gopinath B et al.,  
30 2012b). Affected individuals may experience subjective loss of their social role, loss of self-esteem and  
31 psychological distress, typically expressed in terms of anxiety and depressive symptoms or syndromes  
32 (Barlow J et al., 2007; Hallberg L et al., 2008; Monzani D et al., 2008; Monzani D et al., 2007; Thomas A,  
33 1981). Distorted communication due to AHL may result in social isolation and stigmatization (Tambs K,  
34 2004), with consequent negative effects on quality of life (Hallberg L, et al., 2008; Helvik A et al., 2006;  
35 Mulrow C et al., 1990; Ringdahl A & Grimby A, 2000). Hearing disability affects not only psychosocial  
36 functioning, but also patients' general health, with reports of greater pain, elevated cardio-vascular  
37 morbidity, and increased all-cause mortality (Gopinath B, et al., 2012a; Hogan A et al., 2015).

38 AHL is experienced very differently as a subjective phenomenon (de Graaf R & Bijl R, 2002; Eriksson-  
39 Mangold M & Carlsson S, 1991; Gatehouse S, 1990; Hägnebo C et al., 1998; Hallam R et al., 2006; Hallberg  
40 L, et al., 2008; Helvik A, et al., 2006; Jáuregui-Renaud K et al., 2008; Preminger JE & Meeks S, 2010;  
41 Saunders G & Forsline A, 2006; Saunders G et al., 2004; Thomas A & Herbst K, 1980; Yueh B et al., 2003).  
42 Individuals with mild-to-moderate levels of objectively assessed hearing loss may show disproportionately  
43 higher level of consequent impairment and disability than those with much worse audiological test  
44 performance. Emotional distress is thought to be a key explanatory factor, but a thorough understanding of  
45 both the specific characteristics of this distress and of the nature and timing of its association with AHL and  
46 AHL-related disability remains poorly delimited. On one hand, premorbid psychosocial status may shape  
47 patients' coping styles, with pre-existing anxiety, depression, or personality traits affecting patients' ability  
48 to adjust to the sensory impairment. On the other, emotional distress may arise as the result of AHL, with  
49 AHL increasing the individuals' perceptions of their disability rather than directly (Meyer JM & Kashubeck-  
50 West S, 2013). Thus, audiometrically-derived measures of AHL may be not the only important predictor of  
51 coping with AHL: psychosocial factors, such as preoccupation with ageing or low perceived social support,  
52 have been recognized as being of comparable relevance (Gomez R & Madey S, 2001). Psychosocial factors  
53 including stigma play a role in determining the outcome of AHL (Southall K et al., 2010), as they often do for  
54 other clinical conditions, with the construct of "abnormal illness behaviour" conceived to describe this  
55 relevant psychological dynamic (MECHANIC D, 1962).

56 Among the different psychological dimensions of distress related to AHL, anger – defined as a feeling of  
57 antagonism, hostility, displeasure or rage – has been poorly explored, despite its relevance to outcomes of



58 various medical conditions being previously demonstrated (Bongard S & al'Absi M, 2005; Conrad R et al.,  
59 2008; Köhler T & Boelicke T, 2000; Ouimette P et al., 2004). Irritability, frustration, diffidence and family  
60 conflict, possibly related to perceived increased dependence on others due to impaired communication,  
61 may greatly affect AHL subjects. In their pioneering work, Eriksson-Mangold and Carlsson (Eriksson-  
62 Mangold M & Carlsson S, 1991) reported a link between hostility, interpersonal sensitivity and AHL-  
63 associated self-perceived disability. More recently, sensory impairment has been associated with impulsive  
64 aggressive behaviours, as it appears to increase the risk for distorted perception of trigger stimuli as being  
65 provocative or threatening (Siever L, 2008). Irritability is a well-established response to psychologically  
66 relevant triggers such as those where the individual feels threatened in some way or is frustrated in a  
67 purposive course of action. Both situations are frequent in daily life experience of hearing impaired adults,  
68 who are often compelled to ask family, friends and colleagues to repeat what they failed to hear. Indeed,  
69 Garstecki and Eler reported greater anger and stress among older women with comparable AHL, who also  
70 expressed greater problem awareness and less denial, compared to men with AHL (Garstecki D & Eler S,  
71 1999). Moreover, suggestions that the link between anger and AHL might be reciprocal have also been  
72 reported (Monzani D, et al., 2008), with anger conceptualized as the result of pre-morbid personality traits  
73 that increase psychological vulnerability to sensory impairment.

74 The aim of the present study was to assess the association between AHL, perceived disability and  
75 psychosocial dimensions, particularly focusing on state and trait anger, in a population of consecutive  
76 outpatients. Specifically, the role of perceived AHL-related disability as potential mediator between AHL

77 and anger was evaluated. We also sought to determine whether perceived disability moderated the  
78 associations between objective levels of hearing loss and psychological outcomes.

79

## 80 **Participants, materials and methods**

### 81 *Participants*

82 Two-hundred ninety-seven consecutive adult outpatients referred for assessment of AHL by ENT specialists  
83 and general practitioners to a tertiary centre of audiology at the University Hospital of Modena, Italy were  
84 enrolled in the study in a three-year period. Exclusion criteria were the presence of major neurological  
85 disorders, fluctuating hearing loss, poor fluency in the Italian language, and current use of hearing aids  
86 and/or cochlear implants. Neither aetiology nor severity of hearing loss were exclusion criteria. The  
87 Modena Ethics Committee approved the study protocol and each participant gave written informed  
88 consent to take part in the research.

89

### 90 *Measures*

91 Patients underwent audiological assessment to diagnose and quantify hearing loss and were administered  
92 the psychometric inventories.

93 Otologic examination included otoscopy, pure tone audiometry, tympanometry and acoustic reflex  
94 threshold test. Pure tone audiometry was carried out by the mean of an Interacoustic AD 229 E audiometer  
95 equipped with standard TDH-39 headphones. Patients were seated inside a double-walled, sound  
96 attenuating booth that meets the standard ANSI S.1-1999. Air conduction thresholds were recorded using

97 the routine 10 dB descending and 5 dB ascending method (modified Hughson-Westlake method), starting  
98 at 1000 Hz at 40 dB HL in the left ear and were obtained from 0.25 to 8 kHz bilaterally (Jerger J et al.,  
99 1958)). No segregation of cases was carried out on the basis of hearing loss type (sensorineural, conductive  
100 and mixed). Hearing loss was defined by a speech-frequency Pure Tone Average (PTA) of air conduction  
101 thresholds at 0.5, 1, 2, and 4 kHz in the better ear above 25 dB.

102 To accommodate potential threshold and non-linear associations in the statistical analyses, hearing  
103 impairment was also categorized to define mild (26 to 40), moderate (41 to 55), moderately severe (56 to  
104 70), severe (71-90), and profound (>91) loss.

105 The following psychometric instruments were then administered:

106 The Hearing Handicap Inventory for Adults (HHIA), developed by Newman and colleagues (Newman C et al.,  
107 1990), is a 25-item self-assessment questionnaire addressing the emotional and social/situational aspects  
108 of perceived hearing handicap; it is made of two subscales to be scored separately (HHIAE being the  
109 emotional subscale and HHIAS the socio/situational subscale), with a score range between 0 and 100 and a  
110 higher score corresponding to a higher perception of hearing handicap. The validated Italian language  
111 version (Monzani D, et al., 2007) was used.

112 The State-Trait Anger Expression Inventory–2 (STAXI-2) (Spielberger CD, 1999) is a 57-item inventory that  
113 measures both the intensity of anger as a transient emotional state (State Anger) and the more enduring  
114 propensity to experience angry feelings as a personality trait (Trait Anger). The instrument consists of six  
115 scales, five subscales and an Anger Expression Index. The six scales are State Anger, Trait Anger, Anger  
116 Expression-Out, Anger Expression-In, Anger Control-Out and Anger Control-In; the five subscales are Feeling

117 Angry, Feel Like Expressing Anger Verbally, Feel Like Expressing Anger Physically (subscales to State Anger)  
118 and Angry Temperament and Angry Reaction (subscales for Trait Anger). The Italian validated version of the  
119 scale was used (Spielberger CD, 1992).

120 The Brief Symptom Inventory (BSI) (Derogatis L & Melisaratos N, 1983; Derogatis LR, 1975) is used to  
121 identify self-reported clinically relevant psychological symptoms. It consists of 53 5-point Likert scale items,  
122 covering nine psychological domains: Somatization (SOM), Obsessive-Compulsive (O-C), Interpersonal  
123 Sensitivity (I-S), Depression (DEP), Anxiety (ANX), Hostility (HOS), Phobic anxiety (PHOB), Paranoid ideation  
124 (PAR) and Psychoticism (PSY).

125 Screening for two of the twelve Diagnostic Criteria for use in Psychosomatic Research (DCPR) (Fava G et al.,  
126 1995), Irritability and Demoralisation, was included in the assessment, using the Italian version of the DCPR-  
127 derived clinical interview (Rafanelli C et al., 2005).

128 The Social Functioning Questionnaire (SFQ) is an eight-item self-rating scale (score range 0-24) covering the  
129 most important domains of social life, such as work, home activities, finance, social, family and sexual  
130 relationships and spare time activities (Tyrer P et al., 2005).

131

### 132 *Analysis*

133 Descriptive statistics, correlations, analyses of variance and moderation analyses were undertaken using  
134 SPSS Version 24. Mediation modelling was implemented in Mplus 7.4. Moderation testing involved  
135 incremental addition of the moderation variable (one of the HHIA scales) and then its interaction with the  
136 primary predictor. Significant moderation was indicated by a test of the change in  $R^2$  arising. Mediation

137 effects were investigated by fitting the path model shown in Figure 1. Confidence intervals for the  
138 mediation path ( $a \times b$ ) were estimated using bootstrapping methods with 5000 re-samplings.

139

## 140 **Results**

141 The sample was composed by 133 males (44.8%) and 164 females (total  $N = 297$ ). Mean age was 53.8 years  
142 old ( $SD = 13.6$ ), mean years of education were 9.6 ( $SD = 4.2$ ); 23.9 % ( $n = 71$ ) of the patients were single  
143 while 76.1% ( $n = 226$ ) were in a marital relationship. The majority of the sample ( $n = 128$ , 43.1%) held a  
144 non-professional job, 37.4% ( $n = 111$ ) were retired. There were no statistically significant differences  
145 between males and females regarding age, education and occupation. Mean PTA of the sample was 30.7 db  
146 ( $SD = 18.1$ , range: 6.2 – 117.5). Table 1 details the overall description of the sample.

147

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INSERT TABLE 1 ABOUT HERE

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149 Table 2 shows associations between AHL – measured as PTA and by severity grouping – and perceived  
150 disability and psychometric measures.

151

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INSERT TABLE 2 ABOUT HERE

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152

153 AHL was found to be strongly associated to perceived hearing handicap, for both total HHIA score and  
154 scores of the two HHIA subscales, emotional and socio-situational.

155 A statistically significant association, though less pronounced, was also found with STAXI – 2 State Anger,  
156 Feeling Angry, Anger Control-Out and Total Anger, and BSI Phobic Anxiety. A trend toward statistical  
157 significance was found for the association between AHL and Feel Like Expressing Anger Verbally, Anger  
158 Control-In and Somatization. When examined in terms of the hearing impairment severity groups, only the  
159 association to Phobic Anxiety remained robustly significant.

160 All HHIA-perceived hearing handicap measures correlated to all psychological measures with the exception  
161 of the association of DPCR demoralization with the socio/situational subscale, which narrowly escaped  
162 significance ( $p = 0.077$ ). These findings are displayed in Table 3.

163

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INSERT TABLE 3 ABOUT HERE

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164

165 Correlations were generally higher for the HHIA-emotional subscale. Correlations were particularly strong  
166 for the STAXI – 2 State Anger and Feeling Angry scores and for BSI-Somatization, Interpersonal Sensitivity,  
167 Depression and Psychoticism. For Feeling Angry and Psychoticism, correlations were high both for the HHIA  
168 total score and the two subscales. HHIA also had a good association with the SFQ score.

169 Having confirmed the association between AHL, hearing-related self-perceived disability and psychosocial  
170 distress, we tested a mediation model which posed perceived disability as a mediator between AHL and  
171 psychosocial distress, suggesting that AHL may cause disability that leads, in turn, to psychosocial distress.

172 Testing this model, both HHIA scales were found to be significant mediators of AHL for most of the  
173 psychosocial variables associated with AHL. For many of these variables, the HHIA scales completely

174 mediated this association, leaving the previously significant direct path from PTA to psychological distress  
175 non significant. Table 4 and Figure 1 illustrate this model.

176

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INSERT TABLE 4 AND FIGURE 1 ABOUT HERE

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177

178 A moderation analysis for the two HHIA subscales was also performed, with results displayed in table 5.

179

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INSERT TABLE 5 ABOUT HERE

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180

181 The analysis was stepwise, including firstly PTA, then the HHIA subscale, and then the interaction. Adding  
182 the HHIA subscales to models including PTA improved prediction for many of the outcomes, specifically:  
183 Somatization, Phobic anxiety, State anger, Control out, Total anger for HHIA-S and Somatization, Phobic  
184 anxiety, State anger, Feeling angry and Trait anger for HHIA-E, however no significant improvement in  
185 prediction occurred when the interaction between PTA and HHIA subscales was added to the model for any  
186 outcome. This implies that there was no moderating effect due to subjective disability on AHL.

187

188 **Discussion**

189 The aim of the study was to investigate the association between AHL, AHL-related self-perceived disability  
190 and psychosocial distress, particularly anger.

191 The study confirms the existence of a strong correlation between AHL severity and perceived disability,  
192 both in the socio-situational and emotional domains. This builds on previous findings from our research  
193 group (Monzani D, et al., 2008; Monzani D, et al., 2007) and with comparable studies (Cieśła K et al., 2016;  
194 Meyer JM & Kashubeck-West S, 2013; Timmer BH et al., 2015). A direct association was also found between  
195 PTA-measured AHL and phobic anxiety. The direct association of the objective amount of hearing loss with  
196 other psychological outcomes, which, although statistically significant, was generally not substantial. In  
197 particular, the impact of objective AHL on state-trait anger was minimal: PTA correlated significantly only  
198 with the STAXI total score and only with PTA represented as a scaled outcome. The association was lost  
199 when hearing loss was categorized as groups of increasing severity.

200 Conversely, and consistent with previous findings, perceived disability – especially the HHIA emotional  
201 subscale – was substantially associated with all but one of the psychological outcomes. The association was  
202 particularly strong for BSI-psychoticism, BSI-somatization and SFQ-social functioning. Hearing impairment is  
203 known to be a risk factor for psychosis (Linszen MM et al., 2016), with social isolation and reduced  
204 confidence among the possible explanatory mechanisms. However, it should be borne in mind that two  
205 items on the BSI (#14 “Feeling lonely even when you are with people” and #44 “Never feeling close to  
206 another person”), in particular, may yield biased responses when applied to the hearing impaired, as AHL  
207 itself frequently profoundly impairs social functioning. In explaining the high levels of psychoticism found in  
208 the sample, interpersonal sensitivity, as described by Eriksson-Mangold and Carlsson (Eriksson-Mangold M  
209 & Carlsson S, 1991), may also be implicated; this BSI subscale was also found to correlate significantly with  
210 HHIA in our sample, again raising similar concerns about what specific meaning this construct has in



211 patients with AHL. Hearing impairment has been previously documented as a risk factor for somatic  
212 expression of emotional distress (Nachtegaal J et al., 2009), possibly since it may invoke some of the  
213 cognitive mechanisms described to be related to somatization, e.g. somatosensory amplification and  
214 excessive self-monitoring, or also due to exceeding anxiety, as it also emerges from the data here  
215 discussed. Health anxiety is known to play a role in many clinical conditions, including ENT disorders (Kirby  
216 SE & Yardley L, 2009). Finally, the strong association of HHIA with social functioning as measured by the SFQ  
217 is not surprising, considering the partial overlap in the measuring target of both tools. STAXI anger was  
218 found to be associated to perceived disability, as hypothesized, though more weakly than expected,  
219 suggesting that the emotional spectrum accompanying AHL may be more composite and complex. For  
220 example, anger is commonly associated to changes in the mood, and frequently included as a symptom in  
221 the clinical expression of major depression (Perlis R et al., 2009; Winkler D et al., 2005). No correlation was  
222 found for DCPR irritability or demoralization, whereas the association was rather strong, particularly for the  
223 HHIA emotional subscale, with BSI-depression. This supports previous suggestions that demoralization and  
224 depression may share some of their psychopathological features but should be conceived as distinguished  
225 clinical constructs (Fava G, et al., 1995; Ferrari S et al., 2008; Galeazzi GM et al., 2004; Rafanelli C, et al.,  
226 2005). The association between AHL, AHL-related impairment and depression is also well-established in  
227 international literature (Keidser G et al., 2015), and results from the present study provide adjunctive  
228 support.

229 Our data also confirm the common observation of the high fraction of individuals with low objective levels  
230 of hearing loss who nevertheless complain of high disability. More interestingly, as reflected in the modest

231 correlations reported, the number of participants reporting low levels of disability but high levels of  
232 psychosocial distress was also high. Many authors have addressed the limited relevance of relying solely on  
233 objective measurements of hearing loss and the need to include results of subjective assessments in clinical  
234 decision processes. It is frequently observed that the latter may be very heterogeneous and varying, and  
235 therefore present substantial management difficulties for physicians (Timmer BH, et al., 2015). The present  
236 work provides clinicians with specific targets for assessment—simple to implement in clinical routines—  
237 that may offer an easier quantification and monitoring as determinants of perceived disability.

238 The mediation model developed to clarify a plausible causal pathway of the three variables (AHL, disability  
239 and emotional distress) confirmed that HHIA scores (total, and of both the subscales) may be considered as  
240 a plausible mediating factor between PTA-hearing loss and various measures of psychosocial distress. The  
241 model suggests that perceived disability can be seen as almost invariably mediating the association  
242 between AHL and psychological distress. Greater perceived disability has been found to be a strong  
243 predictor of successful rehabilitation outcomes, confirming it should be a priority target for assessment in  
244 clinical practice (Laplante-Lévesque A et al., 2012). Keisder et al (Keidser G, et al., 2015) also argued that  
245 worsened perception of quality of life due to communication difficulties and social isolation is the link  
246 between hearing deficit and mental functioning/suffering. Using a self-referring internet recruited sample,  
247 Meyer et al. (Meyer JM & Kashubeck-West S, 2013) applied structural equation modelling to study the  
248 mediation of coping styles between perceived severity of hearing loss and perceived adaptation to  
249 disability as predictors and psychological wellbeing as outcome. They found that greater perceived severity  
250 of disability (measured by the HHIA as in our study) was related to more Emotion Focused Coping, which in

251 turn predicted decreases in psychological wellbeing. Their results integrate well with those of our study,  
252 which shows how the perceived severity of disability mediates the effect of AHL on specific psychosocial  
253 expressions of distress, such as anxiety or anger or psychoticism. These, in turn, may negatively affect the  
254 adoption of more helpful, problem-focused coping.

255 Despite its strength in recruiting a substantial, clinically representative consecutive sample, a number of  
256 limitations of the present research should be acknowledged. The cross-sectional design means that the  
257 mediation models demonstrate the *plausibility* of possible causal pathways: results have to be considered  
258 with due caution and assessed again by alternative mechanisms. For instance, the role of perceived  
259 disability and psychological distress might be reverse of the path explored in this paper, with psychological  
260 distress acting as a mediator between objective hearing loss and subjective perception of impairment. We  
261 believe this is a less plausible and parsimonious mechanism, but cross-sectional data alone cannot refute it:  
262 both models may provide useful information and may capture complementary sides of a complex process.  
263 To fully understand causal mechanisms relating objective AHL to psychological status, further, prospective  
264 longitudinal research is needed. Finally, it should also be borne in mind that many of the associations  
265 observed were modest and that the mean age of the sample was rather high, with the possibility that  
266 personality-related items were affected by the ageing process rather than by hearing loss as such.

267

## 268 **Conclusions**

269 This paper confirms that perceived disability related to AHL, as measured by the HHIA, appears to have a  
270 distinct role in addition to that of AHL itself with respect to psychosocial distress, but the concomitance of

271 perceived disability has its own specific addictive effect. Awareness and management of factors related to  
272 psychosocial distress is of particular relevance to everyday clinical practice, making the difference between  
273 successful and ineffective rehabilitation programs and hearing aid use, advice and monitoring. The routine  
274 assessment of psychological disability in patients with AHL is highly recommended. This would facilitate the  
275 personalization of treatment programs, potentially enhancing their relevance and success.

276

## 277 **References**

278 Alberti P (1998) Noise-induced hearing loss - a global problem. In PD Luxon L (Ed) *Advances in noise*  
279 *research* (Vol. II, pp. 7-15). London: Whurr Publishers Ltd.

280 Barlow J, Turner A, Hammond C & Gailey L. (2007) Living with late deafness: insight from between worlds.  
281 *Int J Audiol* 46:442-448.

282 Bongard S & al'Absi M. (2005) Domain-specific anger expression and blood pressure in an occupational  
283 setting. *J Psychosom Res* 58:43-49.

284 Borchgrevink H. (2003) Does health promotion work in relation to noise? *Noise Health* 5:25-30.

285 Chia E, Mitchell P, Rochtchina E, Foran S, Golding M & Wang J. (2006) Association between vision and  
286 hearing impairments and their combined effects on quality of life. *Arch Ophthalmol* 124:1465-1470.

287 Cieśła K, Lewandowska M & Skarżyński H. (2016) Health-related quality of life and mental distress in  
288 patients with partial deafness: preliminary findings. *Eur Arch Otorhinolaryngol* 273:767-776.

289 Conrad R, Geiser F, Haidl G, Hutmacher M, Liedtke R & Wermter F. (2008) Relationship between anger and  
290 pruritus perception in patients with chronic idiopathic urticaria and psoriasis. *J Eur Acad Dermatol*  
291 *Venereol* 22:1062-1069.

292 de Graaf R & Bijl R. (2002) Determinants of mental distress in adults with a severe auditory impairment:  
293 differences between prelingual and postlingual deafness. *Psychosom Med* 64:61-70.

294 Derogatis L & Melisaratos N. (1983) The Brief Symptom Inventory: an introductory report. *Psychol Med*  
295 13:595-605.

296 Derogatis LR (1975) Brief Symptom Inventory. Baltimore: Clinical Psychometric Research.

297 Eriksson-Mangold M & Carlsson S. (1991) Psychological and somatic distress in relation to perceived  
298 hearing disability, hearing handicap, and hearing measurements. *J Psychosom Res* 35:729-740.

299 Fava G, Freyberger H, Bech P, Christodoulou G, Sensky T, Theorell T & Wise T. (1995) Diagnostic criteria for  
300 use in psychosomatic research. *Psychother Psychosom* 63:1-8.

301 Ferrari S, Galeazzi G, Mackinnon A & Rigatelli M. (2008) Frequent attenders in primary care: impact of  
302 medical, psychiatric and psychosomatic diagnoses. *Psychother Psychosom* 77:306-314.

303 Galeazzi GM, Ferrari S, MacKinnon A & Rigatelli M. (2004) Interrater reliability, prevalence, and relation to,  
304 ICD-10 diagnoses of the diagnostic criteria for psychosomatic research in consultation-liaison  
305 psychiatry patients. *Psychosomatics* 45:386-393.

306 Garstecki D & Erler S. (1999) Older adult performance on the Communication Profile for the Hearing  
307 Impaired: gender difference. *J Speech Lang Hear Res* 42:785-796.

308 Gatehouse S. (1990) The role of non-auditory factors in measured and self-reported disability. *Acta*  
309 *Otolaryngol Suppl* 476:249-256.

310 Golding M, Taylor A, Cupples L & Mitchell P. (2006) Odds of demonstrating auditory processing abnormality  
311 in the average older adult: the Blue Mountains Hearing Study. *Ear Hear* 27:129-138.

312 Gomez R & Madey S. (2001) Coping-with-hearing-loss model for older adults. *J Gerontol B Psychol Sci Soc*  
313 *Sci* 56:P223-225.

314 Gopinath B, Schneider J, Hickson L, McMahon CM, Burlutsky G, Leeder SR & Mitchell P. (2012a) Hearing  
315 handicap, rather than measured hearing impairment, predicts poorer quality of life over 10 years in  
316 older adults. *Maturitas* 72:146-151.

317 Gopinath B, Schneider J, McMahon CM, Teber E, Leeder SR & Mitchell P. (2012b) Severity of age-related  
318 hearing loss is associated with impaired activities of daily living. *Age Ageing* 41:195-200.

319 Hagnebo C, Andersson G & Melin L. (1998) Correlates of vertigo attacks in Ménière's disease. *Psychother*  
320 *Psychosom* 67:311-316.

321 Hallam R, Ashton P, Sherbourne K & Gailey L. (2006) Acquired profound hearing loss: mental health and  
322 other characteristics of a large sample. *Int J Audiol* 45:715-723.

323 Hallberg L, Hallberg U & Kramer S. (2008) Self-reported hearing difficulties, communication strategies and  
324 psychological general well-being (quality of life) in patients with acquired hearing impairment.  
325 *Disabil Rehabil* 30:203-212.

326 Helvik A, Jacobsen G & Hallberg L. (2006) Psychological well-being of adults with acquired hearing  
327 impairment. *Disabil Rehabil* 28:535-545.

328 Hogan A, Phillips RL, Brumby SA, Williams W & Mercer-Grant C. (2015) Higher social distress and lower  
329 psycho-social wellbeing: examining the coping capacity and health of people with hearing  
330 impairment. *Disabil Rehabil* 37:2070-2075.

331 Jáuregui-Renaud K, Ramos-Toledo V, Aguilar-Bolaños M, Montaña-Velázquez B & Pliego-Maldonado A.  
332 (2008) Symptoms of detachment from the self or from the environment in patients with an  
333 acquired deficiency of the special senses. *J Vestib Res* 18:129-137.

334 Jerger J, Carhart R & Lassman J. (1958) Clinical observations on excessive threshold adaptation. *AMA Arch*  
335 *Otolaryngol* 68:617-623.

336 Keidser G, Seeto M, Rudner M, Hygge S & Rönnberg J. (2015) On the relationship between functional  
337 hearing and depression. *Int J Audiol* 54:653-664.

338 Kirby SE & Yardley L. (2009) The contribution of symptoms of posttraumatic stress disorder, health anxiety  
339 and intolerance of uncertainty to distress in Ménière's disease. *J Nerv Ment Dis* 197:324-329.

340 Köhler T & Boelicke T. (2000) [Do patients with rheumatoid arthritis suppress anger and aggression?].  
341 *Psychother Psychosom Med Psychol* 50:157-160.

342 Laplante-Lévesque A, Hickson L & Worrall L. (2012) What makes adults with hearing impairment take up  
343 hearing AIDS or communication programs and achieve successful outcomes? *Ear Hear* 33:79-93.

344 Linszen MM, Brouwer RM, Heringa SM & Sommer IE. (2016) Increased risk of psychosis in patients with  
345 hearing impairment: Review and meta-analyses. *Neurosci Biobehav Rev* 62:1-20.

346 MECHANIC D. (1962) The concept of illness behavior. *J Chronic Dis* 15:189-194.

347 Meyer JM & Kashubeck-West S. (2013) Well-being of individuals with late-deafness. *Rehabil Psychol* 58:124-  
348 136.

349 Monzani D, Galeazzi G, Genovese E, Marrara A & Martini A. (2008) Psychological profile and social  
350 behaviour of working adults with mild or moderate hearing loss. *Acta Otorhinolaryngol Ital* 28:61-  
351 66.

352 Monzani D, Genovese E, Palma S, Rovatti V, Borgonzoni M & Martini A. (2007) Measuring the psychosocial  
353 consequences of hearing loss in a working adult population: focus on validity and reliability of the  
354 Italian translation of the hearing handicap inventory. *Acta Otorhinolaryngol Ital* 27:186-191.

355 Mulrow C, Aguilar C, Endicott J, Tuley M, Velez R, Charlip W, . . . DeNino L. (1990) Quality-of-life changes  
356 and hearing impairment. A randomized trial. *Ann Intern Med* 113:188-194.

357 Nachtegaal J, Smit JH, Smits C, Bezemer PD, van Beek JH, Festen JM & Kramer SE. (2009) The association  
358 between hearing status and psychosocial health before the age of 70 years: results from an  
359 internet-based national survey on hearing. *Ear Hear* 30:302-312.

360 Newman C, Weinstein B, Jacobson G & Hug G. (1990) The Hearing Handicap Inventory for Adults:  
361 psychometric adequacy and audiometric correlates. *Ear Hear* 11:430-433.

362 Ouimette P, Cronkite R, Prins A & Moos RH. (2004) Posttraumatic stress disorder, anger and hostility, and  
363 physical health status. *J Nerv Ment Dis* 192:563-566.

364 Perlis R, Fava M, Trivedi M, Alpert J, Luther J, Wisniewski S & Rush A. (2009) Irritability is associated with  
365 anxiety and greater severity, but not bipolar spectrum features, in major depressive disorder. *Acta*  
366 *Psychiatr Scand* 119:282-289.



367 Preminger JE & Meeks S. (2010) The influence of mood on the perception of hearing-loss related quality of  
368 life in people with hearing loss and their significant others. *Int J Audiol* 49:263-271.

369 Rafanelli C, Roncuzzi R, Milaneschi Y, Tomba E, Colistro M, Pancaldi L & Di Pasquale G. (2005) Stressful life  
370 events, depression and demoralization as risk factors for acute coronary heart disease. *Psychother*  
371 *Psychosom* 74:179-184.

372 Ringdahl A & Grimby A. (2000) Severe-profound hearing impairment and health-related quality of life  
373 among post-lingual deafened Swedish adults. *Scand Audiol* 29:266-275.

374 Saunders G & Forsline A. (2006) The Performance-Perceptual Test (PPT) and its relationship to aided  
375 reported handicap and hearing aid satisfaction. *Ear Hear* 27:229-242.

376 Saunders G, Forsline A & Fausti S. (2004) The performance-perceptual test and its relationship to unaided  
377 reported handicap. *Ear Hear* 25:117-126.

378 Siever L. (2008) Neurobiology of aggression and violence. *Am J Psychiatry* 165:429-442.

379 Southall K, Gagné JP & Jennings MB. (2010) Stigma: a negative and a positive influence on help-seeking for  
380 adults with acquired hearing loss. *Int J Audiol* 49:804-814.

381 Spielberger CD (1992) *STAXI, State-Trait Anger Expression Inventory: Manuale, edizione Italiana* (AL  
382 Comunian, Trans.). Firenze: O.S., Organizzazioni Speciali.

383 Spielberger CD (1999) *State-Trait Anger Expression Inventory - 2*. Odessa, FL: Psychological Assessment  
384 Resources Inc.

385 Tambs K. (2004) Moderate effects of hearing loss on mental health and subjective well-being: results from  
386 the Nord-Trøndelag Hearing Loss Study. *Psychosom Med* 66:776-782.

387 Thomas A. (1981) Acquired deafness and mental health. *Br J Med Psychol* 54:219-229.

388 Thomas A & Herbst K. (1980) Social and psychological implications of acquired deafness for adults of  
389 employment age. *Br J Audiol* 14:76-85.

390 Timmer BH, Hickson L & Launer S. (2015) Adults with mild hearing impairment: Are we meeting the  
391 challenge? *Int J Audiol* 54:786-795.

392 Tyrer P, Nur U, Crawford M, Karlsen S, McLean C, Rao B & Johnson T. (2005) The Social Functioning  
393 Questionnaire: a rapid and robust measure of perceived functioning. *Int J Soc Psychiatry* 51:265-  
394 275.

395 WHO (2001) *International Classification of Functioning, Disability and Health (ICF)*. Geneva: World Health  
396 Organisation.

397 Winkler D, Pjrek E & Kasper S. (2005) Anger attacks in depression--evidence for a male depressive  
398 syndrome. *Psychother Psychosom* 74:303-307.

399 Yueh B, Shapiro N, MacLean C & Shekelle P. (2003) Screening and management of adult hearing loss in  
400 primary care: scientific review. *JAMA* 289:1976-1985.

401

402

403 **Legend for figure 1**

404

405 Figure 1 – Mediation model and pathways with HHIA as mediator between AHL and psychosocial distress.

406 Abbreviations: PTA= Pure Tone Average; HHIA= Hearing Handicap Inventory for Adults

407

408

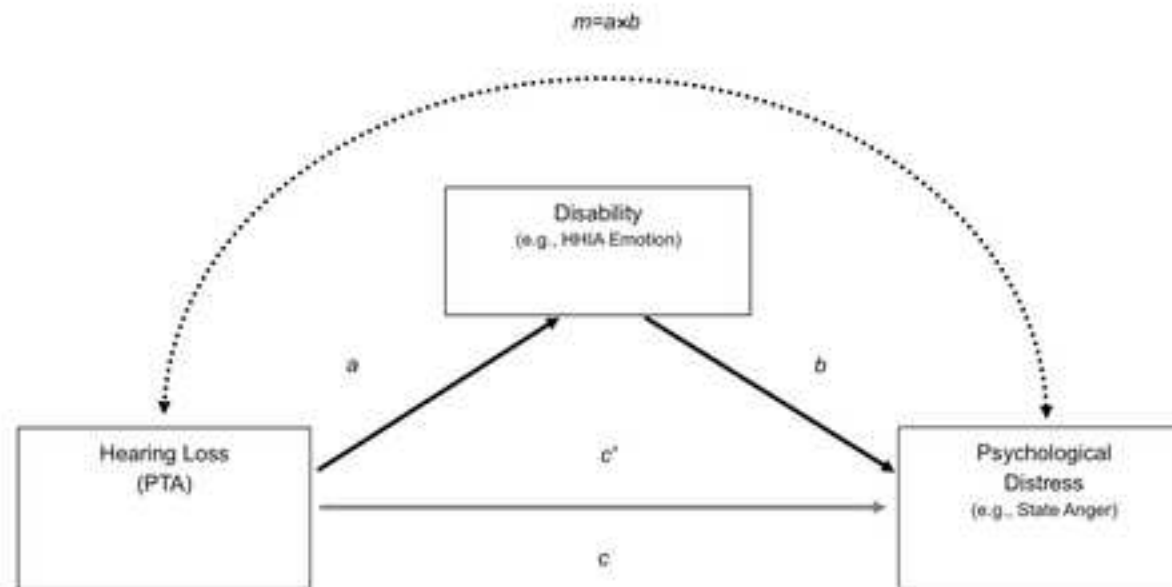


Figure 1 – Mediation model and pathways with HHIA as mediator between AHL and psychosocial distress.

Abbreviations: PTA= Pure Tone Average; HHIA= Hearing Handicap Inventory for Adults

Table 1 – AHL, perceived hearing handicap and psychological measures (N = 297).

| Measure   | Mean | SD   | Min  | Max   |
|---|------|------|------|-------|
| <b>PTA (hearing loss in decibel)</b>  | 30.7 | 18.1 | 6.3  | 117.5 |
| <b>HHIA</b>   |      |      |      |       |
| HHIA emotional subscale   | 8.5  | 10.9 | 0    | 50.0  |
| HHIA socio/situational subscale   | 8.5  | 11.1 | 0    | 52.0  |
| HHIA total score  | 17.0 | 21.3 | 0    | 94.0  |
| <b>STAXI-2</b>  |      |      |      |       |
| State anger   | 45.6 | 5.6  | 42.0 | 92.0  |
| Trait anger   | 42.9 | 7.7  | 28.0 | 68.0  |
| Feeling angry   | 46.2 | 6.1  | 42.0 | 82.0  |
| Feel like expressing anger verbally   | 45.2 | 5.0  | 40.0 | 80.0  |
| Feel like expressing anger physically   | 45.8 | 4.7  | 40.0 | 94.0  |
| Angry temperament   | 44.2 | 6.5  | 34.0 | 64.0  |
| Angry reaction  | 43.3 | 8.3  | 30.0 | 74.0  |
| Anger expression out  | 45.9 | 8.7  | 30.0 | 86.0  |
| Anger expression in   | 47.5 | 10.2 | 30.0 | 80.0  |
| Anger control out   | 51.5 | 11.5 | 20.0 | 72.0  |
| Anger control in  | 51.3 | 11.1 | 24.0 | 72.0  |
| Total anger   | 46.0 | 9.5  | 20.0 | 76.0  |
| <b>BSI</b>  |      |      |      |       |
| SOM somatization  | 0.6  | 0.6  | 0    | 3.4   |
| OC obsessive-compulsive   | 0.7  | 0.7  | 0    | 3.2   |
| I-S interpersonal sensitivity   | 0.5  | 0.6  | 0    | 3.2   |
| DEP depression  | 0.5  | 0.6  | 0    | 3.0   |
| ANX anxiety   | 0.6  | 0.5  | 0    | 3.5   |
| HOS hostility   | 0.3  | 0.4  | 0    | 2.4   |
| PHOB phobic anxiety   | 0.3  | 0.5  | 0    | 2.8   |
| PAR paranoid ideation   | 0.5  | 0.6  | 0    | 3.8   |
| PSY psychoticism  | 0.3  | 0.5  | 0    | 3.2   |
| <b>DPCR</b>   |      |      |      |       |
| DCPR irritability   | 0.5  | 0.5  | 0    | 1     |
| DCPR demoralization   | 0.3  | 0.5  | 0    | 3     |
| <b>SFQ total score</b>  | 6.1  | 3.1  | 0    | 19.0  |
| Abbreviations: PTA= Pure Tone Average; HHIA= Hearing Handicap Inventory for Adults; STAXI-2= State-Trait Anger Expression Inventory-2; BSI= Brief Symptom Inventory; SFQ=Social Functioning Questionnaire |      |      |      |       |
| N ranges from 263 to 297 due to missing responses.  |      |      |      |       |

Table 2 – Associations between AHL (expressed by hearing loss severity group and PTA) and perceived hearing handicap and psychological measures (N = 297).

|   | Hearing loss severity group |         | PTA   |         |
|---|-----------------------------|---------|-------|---------|
|   | F <sup>†</sup>              | Sig.    | r     | Sig.    |
| <b>HHIA</b>   |                             |         |       |         |
| HHIAE emotional subscale  | 27.91                       | <.001** | 0.53  | <.001** |
| HHIAS socio/situational subscale  | 41.24                       | <.001** | 0.59  | <.001** |
| HHIA total score  | 37.39                       | <.001** | 0.58  | <.001** |
| <b>STAXI-2</b>  |                             |         |       |         |
| State anger   | 0.96                        | .431    | 0.13  | .026*   |
| Trait anger   | 0.75                        | 0.558   | 0.05  | .357    |
| Feeling angry   | 1.06                        | .375    | 0.12  | .038*   |
| Feel like expressing anger verbally   | 0.91                        | .462    | 0.11  | .071    |
| Feel like expressing anger physically   | 0.83                        | .507    | 0.09  | .109    |
| Angry temperament   | 1.16                        | .328    | 0.08  | .203    |
| Angry Reaction  | 0.57                        | .685    | 0.03  | .590    |
| Anger expression out  | 2.07                        | .085    | 0.07  | .265    |
| Anger expression in   | 0.65                        | .629    | -0.01 | .816    |
| Anger control out   | 1.44                        | .220    | -0.13 | .023*   |
| Anger control in  | 2.05                        | .087    | -0.11 | .056    |
| Total anger   | 2.21                        | .064    | 0.15  | .017*   |
| <b>BSI</b>  |                             |         |       |         |
| SOM somatization  | 2.25                        | .064    | 0.11  | .053    |
| OC obsessive-compulsive   | 0.76                        | .546    | 0.02  | .766    |
| I-S interpersonal sensitivity   | 0.20                        | .938    | -0.02 | .680    |
| DEP depression  | 1.19                        | .317    | 0.07  | .243    |
| ANX anxiety   | 1.83                        | .124    | 0.06  | .331    |
| HOS hostility   | 0.64                        | .636    | 0.02  | .679    |
| PHOB phobic anxiety   | 4.98                        | .001*   | 0.16  | .006*   |
| PAR paranoid ideation   | 0.64                        | .636    | -0.09 | .119    |
| PSY psychoticism  | 1.02                        | .396    | 0.10  | .094    |
| <b>DCPR</b>   |                             |         |       |         |
| DCPR irritability   | 0.99                        | .415    | 0.01  | .860    |
| DCPR demoralization   | 1.85                        | .119    | 0.07  | .250    |
| <b>SFQ total score</b>  | 2.48                        | .045*   | 0.06  | .311    |
| *p<.05 **p<.001   |                             |         |       |         |
| Abbreviations: PTA= Pure Tone Average; HHIA= Hearing Handicap Inventory for Adults; STAXI-2= State-Trait Anger Expression Inventory-2; BSI= Brief Symptom Inventory; DCPR= Diagnostic Criteria for Psychosomatic Research; SFQ=Social Functioning Questionnaire |                             |         |       |         |
| † df for F test is 1, 258–292. Variation in denominator df due to missing responses.  |                             |         |       |         |

Table 3 – Intercorrelations between subjectively perceived hearing handicap, AHL, and psychological measures (N = 297).

| Correlations   | HHIA  |       |       |
|--|-------|-------|-------|
|  | HHIAE | HHIAS | Total |
| <b>HHIA</b>  |       |       |       |
| HHIAE (emotional subscale)   | —     | .87   | .97   |
| HHIAS (socio/situational subscale)   | .87   | —     | .97   |
| HHIA TOTAL   | .97   | .97   | —     |
| <b>PTA</b>   | .53   | .59   | .58   |
| <b>STAXI –2</b>  |       |       |       |
| State anger  | .31   | .29   | .31   |
| Trait anger  | .28   | .21   | .25   |
| Feeling angry  | .36   | .34   | .36   |
| Feel like expressing anger verbally  | .28   | .26   | .28   |
| Feel like expressing anger physically  | .21   | .22   | .22   |
| Angry temperament  | .23   | .20   | .22   |
| Angry reaction   | .24   | .17   | .21   |
| Anger expression out   | .13   | .12   | .13   |
| Anger expression in  | .16   | .12   | .15   |
| Anger control out  | -.15  | -.18  | -.17  |
| Anger control in   | -.13  | -.15  | -.15  |
| Total anger  | .24   | .25   | .25   |
| <b>BSI</b>   |       |       |       |
| SOM somatization   | .32   | .29   | .31   |
| O-C obsessive-compulsive   | .30   | .28   | .30   |
| I-S interpersonal sensitivity  | .31   | .27   | .30   |
| DEP depression   | .35   | .30   | .33   |
| ANX anxiety  | .29   | .25   | .28   |
| HOS hostility  | .26   | .24   | .26   |
| PHOB phobic anxiety  | .30   | .28   | .30   |
| PAR paranoid ideation  | .27   | .20   | .24   |
| PSY psychoticism   | .38   | .36   | .38   |
| <b>DCPR</b>  |       |       |       |
| DPCR Irritability  | .20   | .13   | .17   |
| DPCR demoralization  | .16   | .10   | .14   |
| SFQ total score  | .30   | .30   | .31   |
| All correlations above .10 are significant $p < 0.05$ ; correlations $> 0.2$ , $p < 0.001$ |       |       |       |
| Abbreviations: PTA= Pure Tone Average; HHIA= Hearing Handicap Inventory for Adults;        |       |       |       |
| STAXI-2= State-Trait Anger Expression Inventory–2; BSI= Brief Symptom Inventory;           |       |       |       |
| DCPR= Diagnostic Criteria for Psychosomatic Research; SFQ=Social Functioning               |       |       |       |
| Questionnaire  |       |       |       |
| Pairwise N ranges from 263 to 296 due to missing responses.                                |       |       |       |





Table 4 – Models of perceived disability (HHIA subscales) as a mediator of the effect of AHL on psychosocial distress<sup>§</sup>.

|                                 | No mediation |       | HHIAS mediation model <sup>§§</sup> |       |        |        |        |        |          |          | HHIAE mediation model <sup>§§§</sup> |       |        |        |        |        |          |          |
|---------------------------------|--------------|-------|-------------------------------------|-------|--------|--------|--------|--------|----------|----------|--------------------------------------|-------|--------|--------|--------|--------|----------|----------|
|                                 | c            | Sig   | c'                                  | Sig.  | b      | Sig.   | m      | Sig.   | lower CI | upper CI | c'                                   | Sig.  | b      | Sig.   | m      | Sig.   | lower CI | upper CI |
| <b>Somatization</b>             | 0.114        | 0.053 | -0.095                              | 0.173 | 0.348  | <0.001 | 0.206  | <0.001 | 0.112    | 0.313    | -0.078                               | 0.263 | 0.357  | <0.001 | 0.189  | <0.001 | 0.103    | 0.292    |
| <b>Phobic anxiety</b>           | 0.160        | 0.006 | -.009                               | 0.910 | 0.280  | 0.002  | 0.166  | 0.004  | 0.057    | 0.277    | -0.002                               | 0.984 | 0.297  | 0.001  | 0.158  | 0.002  | 0.066    | 0.263    |
| <b>State anger</b>              | 0.130        | 0.026 | -0.065                              | 0.429 | 0.328  | 0.004  | 0.195  | 0.005  | 0.064    | 0.336    | -0.045                               | 0.539 | 0.329  | 0.001  | 0.174  | 0.001  | 0.069    | 0.284    |
| <b>Trait anger</b>              | 0.055        | 0.357 | -0.073                              | 0.415 | 0.300  | 0.002  | 0.178  | 0.003  | 0.062    | 0.295    | -0.063                               | 0.446 | 0.316  | 0.001  | 0.168  | 0.001  | 0.069    | 0.272    |
| <b>Feeling angry</b>            | 0.121        | 0.038 | -0.110                              | 0.146 | 0.280  | 0.001  | 0.166  | 0.002  | 0.061    | 0.275    | -0.124                               | 0.084 | 0.345  | <0.001 | 0.183  | <0.001 | 0.092    | 0.284    |
| <b>Feeling express verbally</b> | 0.105        | 0.071 | -0.106                              | 0.246 | 0.383  | 0.001  | 0.226  | 0.004  | 0.066    | 0.374    | -0.051                               | 0.536 | 0.324  | 0.007  | 0.169  | 0.015  | 0.015    | 0.295    |
| <b>Control out</b>              | -0.135       | 0.023 | -0.043                              | 0.527 | -0.153 | 0.045  | -0.091 | 0.050  | -0.184   | -0.004   | -0.074                               | 0.237 | -0.113 | 0.127  | -0.060 | 0.138  | -0.144   | 0.014    |
| <b>Control in</b>               | -0.115       | 0.056 | -0.037                              | 0.596 | -0.126 | 0.072  | -0.075 | 0.078  | -0.160   | 0.006    | -0.058                               | 0.374 | -0.099 | 0.141  | -0.053 | 0.151  | -0.079   | 0.011    |
| <b>Total anger</b>              | 0.147        | 0.017 | -0.009                              | 0.895 | 0.251  | <0.001 | 0.149  | <0.001 | 0.069    | 0.236    | 0.018                                | 0.770 | 0.227  | 0.001  | 0.120  | 0.001  | 0.052    | 0.201    |

<sup>§</sup> All coefficients are standardized beta weights

<sup>§§</sup> Path PTA→HHIAS a =.591 (p<.001) for all models

<sup>§§§</sup> Path PTA→HHIAE a =.531 (p<.001) for all models

Abbreviations: HHIAS= Hearing Handicap Inventory for Adults Socio/situational subscale; HHIAE= Hearing Handicap Inventory for Adults Emotional subscale

Table 5 – Stepwise models predicting psychological outcomes from PTA, HHIA subscales and their interaction (N = 297).

| HHIAS  | PTA            |         | PTA + HHIAS                 |         | PTA + HHIAS + PTA<br>x HHIAS |         | PTA + HHIAE                 |         | PTA + HHIAE + PTA<br>x HHIAE |         |
|--|----------------|---------|-----------------------------|---------|------------------------------|---------|-----------------------------|---------|------------------------------|---------|
|  | R <sup>2</sup> | (sig)   | Change<br>in R <sup>2</sup> | (sig)   | Change<br>in R <sup>2</sup>  | (sig)   | Change<br>in R <sup>2</sup> | (sig)   | Change<br>in R <sup>2</sup>  | (sig)   |
| <b>Somatization</b>                          | 0.013          | (0.053) | 0.079                       | (0.000) | 0.000                        | (0.975) | 0.091                       | (0.000) | 0.000                        | (0.767) |
| <b>Phobic anxiety</b>                        | 0.026          | (0.006) | 0.050                       | (0.000) | 0.014                        | (0.038) | 0.062                       | (0.000) | 0.007                        | (0.147) |
| <b>State anger</b>                           | 0.017          | (0.026) | 0.070                       | (0.000) | 0.001                        | (0.498) | 0.078                       | (0.000) | 0.001                        | (0.517) |
| <b>Trait anger</b>                           | 0.003          | (0.357) | 0.051                       | (0.000) | 0.004                        | (0.302) | 0.084                       | (0.000) | 0.005                        | (0.225) |
| <b>Feeling angry</b>                         | 0.015          | (0.038) | 0.111                       | (0.000) | 0.000                        | (0.772) | 0.121                       | (0.000) | 0.000                        | (0.955) |
| <b>Feeling expressing anger<br/>verbally</b> | 0.011          | (0.069) | 0.058                       | (0.000) | 0.006                        | (0.164) | 0.072                       | (0.000) | 0.004                        | (0.215) |
| <b>Control out</b>                           | 0.018          | (0.023) | 0.015                       | (0.041) | 0.033                        | (0.709) | 0.009                       | (0.119) | 0.001                        | (0.702) |
| <b>Control in</b>                            | 0.013          | (0.056) | 0.011                       | (0.085) | 0.000                        | (0.786) | 0.007                       | (0.162) | 0.005                        | (0.260) |
| <b>Total anger</b>                           | 0.022          | (0.017) | 0.040                       | (0.001) | 0.000                        | (0.994) | 0.034                       | (0.002) | 0.001                        | (0.559) |

Abbreviations: PTA= Pure Tone Average; HHIAS= Hearing Handicap Inventory for Adults Socio/situational subscale; HHIAE= Hearing Handicap Inventory for Adults Emotional subscale