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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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Abstract:	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.
	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).
	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.



Modena, 23rd August 2018

John A. Talbott, M.D. Professor of Psychiatry Department of Psychiatry University of Maryland School of Medicine 110 S. Paca St, 4th Floor Baltimore, MD, 21201, USA

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,

Silve Ferrer

Silvia Ferrari.

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11	Conflict of interest
12	None to declare
13	

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).
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- 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

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 onset in older adults with AHL (Gopinath B et al., 2012a). Difficulties in the localization of sounds and 27 28 recognition of words and sentences, especially in noisy environments, may lead to the development of maladaptive communication strategies and considerable limitations in daily activities (Gopinath B et al., 29 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 functioning, but also patients' general health, with reports of greater pain, elevated cardio-vascular 36 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 performance. Emotional distress is thought to be a key explanatory factor, but a thorough understanding of 44 45 both the specific characteristics of this distress and of the nature and timing of its association with AHL and AHL-related disability remains poorly delimited. On one hand, premorbid psychosocial status may shape 46 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 relevant psychological dynamic (MECHANIC D, 1962). 55

Among the different psychological dimensions of distress related to AHL, anger – defined as a feeling of
 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 Erler 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 & Erler 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 disorders, fluctuating hearing loss, poor fluency in the Italian language, and current use of hearing aids 85 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:

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

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

primary predictor. Significant moderation was indicated by a test of the change in R² arising. Mediation

effects were investigated by fitting the path model shown in Figure 1. Confidence intervals for the
mediation path (a×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) where 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

INSERT TABLE 1 ABOUT HERE

148

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

151

INSERT TABLE 2 ABOUT HERE

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 significance was found for the association between AHL and Feel Like Expressing Anger Verbally, Anger 157 158 Control-In and Somatization. When examined in terms of the hearing impairment severity groups, only the 159 association to Phobic Anxiety remained robustly significant. All HHIA-perceived hearing handicap measures correlated to all psychological measures with the exception 160 161 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

INSERT TABLE 3 ABOUT HERE

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. Testing this model, both HHIA scales were found to be significant mediators of AHL for most of the 172 173 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

INSERT TABLE 4 AND FIGURE 1 ABOUT HERE

177

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

179

INSERT TABLE 5 ABOUT HERE

180

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

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 (Cieśla 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 the clinical expression of major depression (Perlis R et al., 2009; Winkler D et al., 2005). No correlation was 221 222 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.

Our data also confirm the common observation of the high fraction of individuals with low objective levels
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 model suggests that perceived disability can be seen as almost invariably mediating the association 241 242 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 mediation of coping styles between perceived severity of hearing loss and perceived adaptation to 248 249 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 turn predicted decreases in psychological wellbeing. Their results integrate well with those of our study,
which shows how the perceived severity of disability mediates the effect of AHL on specific psychosocial
expressions of distress, such as anxiety or anger or psychoticism. These, in turn, may negatively affect the
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 longitudinal research is needed. Finally, it should also be borne in mind that many of the associations 264 265 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

This paper confirms that perceived disability related to AHL, as measured by the HHIA, appears to have a
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	
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401

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





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

Measure	Mean	SD	Min	Max
PTA (hearing loss in decibel)	30.7	18.1	6.3	117.5
ННА				
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
STAXI-2				
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
BSI				
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
DPCR				
DCPR irritability	0.5	0.5	0	1
DCPR demoralization	0.3	0.5	0	3
SFQ total score	6.1	3.1	0	19.0
Abbreviations: PTA= Pure Tone Average; HHIA= He State-Trait Anger Expression Inventory–2; BSI= Brie Questionnaire	aring Hand f Symptom	icap Inventor I Inventory; S	y for Adults; FQ=Social Fu	STAXI-2=

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

N ranges from 263 to 297 due to missing responses.

	Hearing loss s	Hearing loss severity group			
	F ⁺	Sig.	r	Sig.	
HHIA					
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*	
STAXI-2					
State angei	0.96	.431	0.13	.026*	
Trait angei	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 ir	0.65	.629	-0.01	.816	
Anger control out	1.44	.220	-0.13	.023*	
Anger control ir	2.05	.087	-0.11	.056	
Total angei	2.21	.064	0.15	.017*	
BSI					
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 ideatior	0.64	.636	-0.09	.119	
PSY psychoticism	1.02	.396	0.10	.094	
DCPR					
DCPR irritability	0.99	.415	0.01	.860	
DCPR demoralization	1.85	.119	0.07	.250	
SFQ total score	2.48	.045*	0.06	.311	

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

+ df for F test is 1, 258–292. Variation in denominator df due to missing responses.

297).					
Correlations	ННА				
	HHIAE	HHIAS	Total		
HHIA					
HHIAE (emotional subscale)	—	.87	.97		
HHIAS (socio/situational subscale)	.87	—	.97		
HHIA TOTAL	.97	.97	_		
РТА	.53	.59	.58		
STAXI –2					
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		
BSI					
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		
DCPR					
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; correlat	ions > 0.2,	p<0.001			
Abbreviations: PTA= Pure Tone Average; HHIA= Hearing	Handicap Ir	nventory for	Adults;		
STAXI-2= State-Trait Anger Expression Inventory-2; BSI=	Brief Symp	tom Invento	ory;		
DCPR= Diagnostic Criteria for Psychosomatic Research; S	FQ=Social I	unctioning			
Questionnaire					
Pairwise N ranges from 263 to 296 due to missing respor	nses.				

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

	No me	diation			НН	IAS media	tion mod	el§§	HHIAE mediation model §§§						el §§§			
	с	Sig	c'	Sig.	b	Sig.	m	Sig.	lower Cl	upper Cl	c'	Sig.	b	Sig.	m	Sig.	lower Cl	upper Cl
Somatization	0.114	0.053	-0.095	0.173	0.348	<0.001	0.206	<0.001	0.112	0313	-0.078	0.263	0.357	<0.001	0.189	<0.001	0.103	0.292
Phobic anxiety	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
State anger	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
Trait anger	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
Feeling angry	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
Feeling express verbally	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
Control out	-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
Control in	-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
Total anger	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
§ All coefficien	ts are st	andardi	zed beta	a weight	S	•	•	•	•	•	-	•	•	•	•	•		•

Table 4 – Models of perceived disability (HHIA subscales) as a mediator of the effect of AHL on psychosocial distress[§].

§§ Path PTA \rightarrow HHIAS a =.591 (p<.001) for all models

 $^{\$\$\$}$ Path PTA \rightarrow 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

	РТА		PTA +	HHIAS	PTA + HH	IAS + PTA	PTA +	HHIAE	PTA + HHIAE + PTA		
					x Hł	HIAS			x HHIAE		
HHIAS	R ²	(sig)	Change	(sig)	Change	(sig)	Change	(sig)	Change	(sig)	
			in R ²		in R ²		in R ²		in R ²		
Somatization	0.013	(0.053)	0.079	(0.000)	0.000	(0.975)	0.091	(0.000)	0.000	(0.767)	
Phobic anxiety	0.026	(0.006)	0.050	(0.000)	0.014	(0.038)	0.062	(0.000)	0.007	(0.147)	
State anger	0.017	(0.026)	0.070	(0.000)	0.001	(0.498)	0.078	(0.000)	0.001	(0.517)	
Trait anger	0.003	(0.357)	0.051	(0.000)	0.004	(0.302)	0.084	(0.000)	0.005	(0.225)	
Feeling angry	0.015	(0.038)	0.111	(0.000)	0.000	(0.772)	0.121	(0.000)	0.000	(0.955)	
Feeling expressing anger	0.011	(0.069)	0.058	(0.000)	0.006	(0.164)	0.072	(0.000)	0.004	(0.215)	
verbally											
Control out	0.018	(0.023)	0.015	(0.041)	0.033	(0.709)	0.009	(0.119)	0.001	(0.702)	
Control in	0.013	(0.056)	0.011	(0.085)	0.000	(0.786)	0.007	(0.162)	0.005	(0.260)	
Total anger	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										ng	

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