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# Reliability and validity of a Danish adaptation of the Tinnitus Handicap Inventory

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The objective of this study was to determine the reliability and validity of a Danish translation of the Tinnitus Handicap Inventory (THI), a self-report measure of perceived tinnitus handicap. The Danish version of the THI was administered to 50 patients reporting tinnitus as their primary complaint or secondary to hearing loss. Construct validity was assessed using tinnitus symptom rating scales, the Beck Depression Inventory (BDI), the State-Trait Anxiety Inventory (STAI), the Tinnitus Coping Style Questionnaire (TCSQ), the Eysenck Personality Questionnaire (EPQ), and perceived tinnitus loudness and pitch. The Danish translation of the THI and its subscales showed good internal consistency reliabilities ( $\alpha = 0.93$  to  $\alpha = 0.74$ ) comparable to those of the original version. High to moderate correlations were observed between THI and psychological distress, tinnitus symptom ratings, neuroticism and maladaptive tinnitus coping. A confirmatory factor analysis failed to validate the three subscales of THI, and high intercorrelations found between the subscales question whether they represent three distinct factors. The results suggest that the Danish THI-Total scale may be a reliable and valid measure of general tinnitus related distress that can be used in a clinical setting to quantify the impact of tinnitus on daily living.

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## Introduction

There has been increasing interest among healthcare providers in quantifying the adverse consequences of disease states. A number of self-report measures, e.g. Quality-of-Life questionnaires, have been developed to assess the impact of disease on the general well-being of patients (Dimsdale & Baum, 1995). However, different diseases are associated with specific physiological and psychological symptoms, and disorder-specific measures are needed (Finlay, 1997). Several attempts have been made to measure the impact of tinnitus on quality of life, including the Tinnitus Reaction Questionnaire (Wilson et al., 1991), Hallam's Tinnitus Questionnaire (Hallam et al., 1988), and the Tinnitus Handicap Questionnaire (Kuk et al., 1990). Open-ended approaches such as the Tinnitus Problem Questionnaire (Sanchez & Stephens, 1997) have also been used, and such an approach

has been shown to be more sensitive to changes following rehabilitation than a self-rated questionnaire (Jakes et al., 1985). Open-ended approaches, however, may generally be more difficult to administer, and the analysis and interpretation of the results may be more demanding than those collected using self-rated questionnaires. The Tinnitus Handicap Inventory (THI) (Newman et al., 1996) was developed to serve as a possible functional outcome measure in pre-post treatment paradigms, with the reduction in self-perceived handicap as the desired outcome. Until now, no tinnitus-specific questionnaire has been available in the Danish language. The primary purpose of the present study was therefore to investigate whether a Danish translation of the THI (THI-DK) is a reliable and valid measure of tinnitus-related problems in Danish tinnitus sufferers. Secondly, the study could serve as a general cross-cultural validation of the construct in question.

## Materials and methods

### *Translation procedure*

The THI (Newman et al., 1996) consists of a total of 25 items and 3 subscales: a functional subscale (THI-Functional) (12 items), an emotional subscale (THI-Emotional) (8 items), and a catastrophic response subscale (THI-Catastrophic) (5 items). The original version of the THI (THI-US) was translated into Danish (THI-DK) using a translation-back translation method (Bradley, 1994). After the initial translation into Danish, a fluent English-speaking person who was ignorant of the original version back-translated this version into English. The wording of individual items was then adjusted based on a comparison of the original and the back-translated version. Possible responses to each item are “no”, “sometimes”, or “yes”. A “no” response is awarded 0 points, a “sometimes” response, 2 points, and a “yes” response, 4 points. Total scores are calculated for the THI-Total scale as well as the three subscales.

### *Subjects*

The final version of the THI-DK was administered to 50 tinnitus patients (37 males, 12 females, aged 22 to 79 years) recruited consecutively at the Departments of Otorhinolaryngology and Audiology Aarhus University Hospitals after receiving oto-neurological and audiological evaluations. All patients suffered from severe continuous uni- or bilateral tinnitus with a mean duration of 5.2 years (range 6 months to 26 years, median 3.1 years).

### *Assessment of tinnitus severity*

Tinnitus severity was assessed by asking the patients to complete three visual analogue scales (VAS) measuring: (1) the perceived loudness of their tinnitus (Tinnitus Loudness), (2) the perceived annoyance associated with their tinnitus (Tinnitus Annoyance), and (3) the perceived degree of attention consumed by their tinnitus (Tinnitus Attention). The VAS scales consisted of 100-mm lines with endpoints anchored with as *total absence* and *maximum* of (1) tinnitus loudness, (2) annoyance, and (3) attention, respectively. Additional tinnitus severity measures included: (4) the duration of their tinnitus, (5) perceived degree of sleep interruption, (6) hyperacusis, (7) vertigo, and (8) otalgia. Psychoacoustic measurements included: (9) tin-

nitus loudness match, and (10) tinnitus pitch match.

### *Additional measures*

The patients were also asked to complete a Danish translation of (11) the Tinnitus Coping Style Questionnaire (TCSQ) (Budd & Pugh, 1995), which assesses the coping style of tinnitus sufferers. The TCSQ consists of three subscales: (1) Maladaptive coping, (2) Effective coping, and (3) Passive coping. Internal reliability coefficients of the subscales (1.  $r=0.89$ ; 2.  $r=0.81$ , and 3.  $r=0.50$ ) were comparable to those of the original English version (0.92; 0.83; 0.67). Additional measures included: (12) The State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1977), which measures both anxiety as a general trait and the here-and-now level of perceived anxiety, (13) Beck's Depression Inventory (BDI) (Beck et al., 1961), (14) the Social Support Questionnaire (SSQ) (Sarason et al., 1988), which measures the degree of perceived social support from spouse, family, friends, and others, and (15) the Eysenck Personality Questionnaire (EPQ) (Eysenck & Eysenck, 1963), which consists of four subscales: (1) Extroversion/introversion, (2) Neuroticism, (3) Psychoticism, and (4) a Lie subscale, which measures the tendency of a person to respond in a “socially desirable” way.

## Results

Table I summarizes the endorsement rates for each of the 25 items for the Danish translation (THI-DK) and the original version (THI-US). As seen, the endorsement rates for a “Yes” response ranged from 4% to 53%, for a “Sometimes” response, 25–63%, and for a “No” response, 10–67%. The score ranges of the THI-US version were 8–63%, 11–49%, and 19–64%, respectively. Gender differences in perceived tinnitus handicap were examined using *t*-tests for independent samples. As was the case for the original version, no significant effects of gender, age or hearing loss were observed ( $p < 0.05$ ).

### *Internal consistency reliability*

Item-total correlations and the internal consistency reliability coefficients (Cronbach's alpha) were calculated for the THI-Total scale and the three subscales separately. Item-total correla-

Table I. Endorsement rates and item-total correlations\* of the Danish translation (THI-DK) and the original version of the Tinnitus Handicap Inventory (THI-US)\*\*

Item	Endorsement rates (%)			Item-Total correlation
	Yes	Sometimes	No	
The purpose of the scale is to identify the problems your tinnitus may be causing you. Check "Yes", "Sometimes", or "no" for each question. Do not skip a question.				
1F Because of your tinnitus, is it difficult for you to concentrate?	27 (24)	55 (49)	18 (27)	0.68 (0.70)
2F Does the loudness of your tinnitus make it difficult to hear people?	16 (35)	39 (35)	45 (30)	0.39 (0.22)
3E Does your tinnitus make you angry?	10 (20)	43 (38)	47 (42)	0.52 (0.54)
4F Does your tinnitus make you feel confused?	14 (18)	33 (25)	51 (57)	0.59 (0.64)
5C Because of your tinnitus, do you feel desperate?	12 (17)	41 (25)	47 (58)	0.68 (0.54)
6E Do you complain a great deal about your tinnitus?	6 (17)	25 (26)	69 (57)	0.43 (0.63)
7F Because of your tinnitus, do you have trouble falling asleep at night?	29 (24)	27 (38)	45 (38)	0.24 (0.48)
8C Do you feel as though you cannot escape your tinnitus?	51 (60)	39 (20)	10 (20)	0.53 (0.55)
9F Does your tinnitus interfere with your ability to enjoy social activities (dinner, movies)?	33 (8)	33 (29)	33 (63)	0.67 (0.61)
10E Because of your tinnitus, do you feel frustrated?	20 (29)	53 (37)	27 (34)	0.71 (0.77)
11C Because of your tinnitus, do you feel that you have a terrible disease?	14 (14)	25 (23)	61 (63)	0.53 (0.48)
12F Does your tinnitus make it difficult for you to enjoy life?	16 (12)	43 (26)	39 (62)	0.78 (0.69)
13F Does your tinnitus interfere with your job or household responsibilities?	31 (10)	37 (32)	31 (58)	0.76 (0.56)
14F Because of your tinnitus, do you find that you are often irritable?	20 (22)	43 (32)	37 (46)	0.70 (0.69)
15F Because of your tinnitus, is it difficult for you to read?	20 (20)	27 (29)	49 (51)	0.52 (0.48)
16E Does your tinnitus make you upset?	16 (25)	63 (38)	20 (37)	0.79 (0.76)
17E Do you feel that your tinnitus has placed stress on your relationship?	12 (26)	33 (20)	55 (54)	0.70 (0.53)
18F Do you feel it difficult to focus your attention away from your tinnitus and on other things?	16 (15)	45 (42)	37 (43)	0.67 (0.69)
19C Do you feel that you have no control over your tinnitus?	45 (63)	31 (18)	25 (19)	0.29 (0.48)
20F Because of your tinnitus, do you feel tired?	43 (18)	25 (23)	33 (59)	0.70 (0.58)
21E Because of your tinnitus, do you feel depressed?	12 (18)	45 (26)	39 (56)	0.70 (0.63)
22E Does your tinnitus make you feel anxious?	4 (25)	27 (28)	65 (49)	0.66 (0.54)
23C Do you feel that you can no longer cope with your tinnitus?	4 (11)	37 (40)	59 (49)	0.58 (0.59)
24F Does your tinnitus get worse when you are under stress?	53 (43)	25 (25)	22 (32)	0.16 (0.49)
25E Does your tinnitus make you feel insecure?	14 (16)	27 (20)	59 (64)	0.65 (0.47)

\* F represents items included in the Functional subscale, E, items included in the Emotional subscale, and C, items included in the Catastrophic response subscale. \*\* Endorsement rates and item-total correlations of the original (THI-US) version are listed in parentheses.

tions for the THI-DK-Total and the THI-US-Total scales are given in Table I. Cronbach's alpha coefficients and the range of item-total correlations for the THI-DK and THI-US are given in Table II. The reliability coefficients of the THI-DK were comparable to or higher than those found for the original version, ranging from 0.93 to 0.74. As can be seen in Table II, the ranges of item-total correlations for the THI-

Total and subscales of the THI-DK were also comparable to those of the THI-US. As seen in Table III, the mean scores of the Danish version were generally higher than those of the original version for the THI-Total scale and THI-Functional subscale. The score ranges of the Danish translation, however, were comparable to those of the THI-US. As seen in Table IV, the correlations among the total- and subscales of

Table II. Reliability coefficients (Cronbach's alpha) of the Danish translation of the THI (THI-DK) and the original version (THI-US)

	THI-DK (alpha)	THI-US (alpha)	THI-DK (Item-total)	THI-US (Item-total)
THI-total (25 items)	0.93	0.93	0.16–0.79	0.22–0.77
Functional (12 items)	0.87	0.86	0.22–0.72	0.27–0.76
Emotional (8 items)	0.88	0.87	0.52–0.83	0.56–0.82
Catastrophic (5 items)	0.74	0.68	0.42–0.54	0.42–0.48

Table III. Mean scores ( $\pm$ SD) and range of scores of the total THI scale and subscales of the Danish translation (THI-DK) and the original version (THI-US)

	THI-Total	Functional	Emotional	Catastrophic
THI-DK (mean) ( $n = 49$ )	40.0 $\pm$ 22.3	19.8 $\pm$ 13.3	9.6 $\pm$ 8.0	8.5 $\pm$ 5.0
THI-US (mean) ( $n = 66$ )	24.4 $\pm$ 20.5	11.0 $\pm$ 9.7	8.2 $\pm$ 8.4	6.1 $\pm$ 4.5
THI-DK (range) ( $n = 49$ )	4–82	0–44	0–26	0–18
THI-US (range) ( $n = 66$ )	0–92	0–44	0–32	0–18

Table IV. Pearson product-moment correlations among THI total and subscales of the Danish (THI-DK) and the original (THI-US) version

	THI-Total	Functional	Emotional	Catastrophic
THI-Total DK (US)	1.00 (1.00)	–	–	–
Functional DK (US)	0.95 (0.92)	1.00 (1.00)	–	–
Emotional DK (US)	0.94 (0.93)	0.82 (0.75)	1.00 (1.00)	–
Catastrophic DK (US)	0.82 (0.89)	0.67 (0.65)	0.74 (0.78)	1.00 (1.00)

the THI-DK were comparable to the correlations found among the scores of the subscales of the original (THI-US) version.

### Construct validity

Table V summarizes the correlations among scores on the THI-DK and tinnitus severity, tinnitus coping, psychological distress, and personality questionnaire measures. As can be seen, significant correlations were observed between the THI-Total and subscales and tinnitus severity measures of Tinnitus loudness, annoyance, and attention. Moderate correlations were also found between THI-Total scores and tinnitus symptoms of hyperacusis and otalgia. Low, non-significant correlations were found for tinnitus pitch. High to moderate correlations were found between THI-Total scores and the tinnitus coping style measures of Maladaptive and Passive Coping. No correlations were found between THI scores and Effective Coping. Significant correlations were also seen between THI total and subscale scores and the psychological distress measures of depression (BDI), anxiety (STAI), and neuroticism (EPQ-neuroticism). Though inverse correlations were seen

between THI and social support scores (SSQ), extraversion (EPQ-Extraversion), and age, none of these reached statistical significance ( $p < 0.05$ ).

### Confirmatory factor analysis

A confirmatory factor analysis was conducted to test whether the data could confirm the latent variables represented by the Functional (F), Emotional (E), and Catastrophic (C) subscales of the original version of the THI. The data were analysed using a principal components factor analysis with varimax rotation. First, a three-factor solution was examined to test whether the results were comparable to the subscales proposed by Newman et al. (1996). To ensure distinct subscales, the difference between the highest and the second highest factor loadings had to exceed 0.20 to be retained in the analysis. In the three-factor solution, eight items loaded on more than one factor, with the remaining three factors consisting of 9, 5 and 3 items, respectively. The results are given in Table VI. Also in Table VI it can be seen that the three factors only partially represent items of the

Table V. Pearson product-moment correlations among scores on THI-DK and tinnitus severity measures, psychological distress, and scores on personality questionnaires

<i>n</i> = 49	THI-Total	Functional	Emotional	Catastrophic
Tinnitus Loudness (VAS)	0.43**	0.31**	0.31**	0.56**
Tinnitus Annoyance (VAS)	0.52**	0.39**	0.43**	0.61**
Tinnitus Attention (VAS)	0.43**	0.33*	0.43**	0.44**
Tinnitus duration (mths)	-0.05	0.05	-0.06	-0.20
Sleep disturbance <sup>a</sup>	0.13	0.34*	0.05	0.18
Hyperacusis <sup>a</sup>	0.30*	0.17	0.27	0.35*
Vertigo <sup>a</sup>	0.19	0.22	0.08	0.17
Otalgia <sup>a</sup>	0.28*	0.35*	0.21	0.23
Tinnitus Loudness match	0.15	0.08	0.17	0.18
Tinnitus Pitch match	0.27	0.30	0.24	0.11
TCSQ (Maladaptive coping)	0.86**	0.77**	0.86**	0.70**
TCSQ (Effective coping)	0.05	0.15	-0.03	-0.13
TCSQ (Passive coping)	0.39*	0.43**	0.36*	0.20
Depression (BDI)	0.73**	0.70**	0.68**	0.60**
State Anxiety (STAI)	0.73**	0.68**	0.70**	0.63**
Trait Anxiety (STAI)	0.55**	0.51**	0.56**	0.41**
EPQ (Extraversion)	-0.13	-0.11	-0.16	-0.04
EPQ (Neuroticism)	0.55**	0.50**	0.56**	0.40**
EPQ (Psychoticism)	0.11	0.06	0.16	0.10
EPQ (Lying)	-0.05	0.08	-0.11	-0.01
Social Support	-0.18	-0.06	-0.22	-0.22
Age (yrs)	-0.14	-0.20	-0.18	-0.13

<sup>a</sup> Non-parametric (Spearman's Rho) correlations. \*  $p < .05$ , \*\*  $p < .01$ .

original three subscales. An additional factor analysis, using eigenvalues greater than 1 as criterion, yielded seven factors, with the first explaining 18.5%, and the remaining factors 15.2, 10.4, 10.3, 10.1, 5.8 and 5.7% of the variance (data not shown).

## Discussion

The results of the present investigation demonstrate that the Danish translation of the THI (THI-DK) has a good internal consistency reliability for the total scale ( $\alpha = 0.93$ ), which is identical to the internal reliability of the original version. Internal reliabilities of the Functional, Emotional, and Catastrophic response subscales are adequate ( $\alpha = 0.87, 0.88$ , and  $0.74$ ) and similar or higher than those of the original version. The lower alpha coefficient of the Catastrophic Response subscale is due to the smaller number of items constituting this dimension. The high intercorrelations found between the subscales of the THI were similar to those found for the original version of the questionnaire. This finding could question whether the subscales represent three distinct, underlying latent variables, and it should be noted that the

construction of the three subscales of the THI was not based on a factor analysis but on an examination of the content of each item (Newman et al., 1996). The results of our confirmatory factor analysis seem to confirm this suspicion, insofar as 8 out of the 25 items loaded on more than one factor, and the items loading on the remaining 3 factors only partially represented the subscales suggested by Newman et al. (1996). Another problem may be the use of the term "sometimes". This response format is vague, and the patients may have difficulties understanding it. Greater precision could perhaps have been achieved had a more precise format been used, e.g. a specific number of times a week.

As was observed for the original version, the Danish translation of the THI does not appear to be affected by age, gender, or hearing loss. Only low, non-significant correlations were found between THI scores and subjective rated loudness (0.18 to 0.08) and pitch (0.30 to 0.11). The corresponding results for the original version are (0.24 to 0.20) and (0.18 to 0.06), respectively. Our results showed moderate to strong relationships between the THI and depression as measured by the BDI. These findings are in concordance with previous reports of a relation-

Table VI. The results of the 3-factor solution of the 25 items of the Danish translation (THI-DK) of the Tinnitus Handicap Inventory (THI)<sup>a</sup>

Scale	Item	Factor		
		1	2	3
E	6	Do you complain a great deal about your tinnitus?	<u>0.76</u>	
C	11	Because of your tinnitus, do you feel that you have a terrible disease?	<u>0.75</u>	
E	16	Does your tinnitus make you upset?	<u>0.68</u>	
F	12	Does your tinnitus make it difficult for you to enjoy life?	<u>0.68</u>	
E	10	Because of your tinnitus, do you feel frustrated?	<u>0.67</u>	
E	22	Does your tinnitus make you feel anxious?	<u>0.63</u>	
E	3	Does your tinnitus make you angry?	<u>0.62</u>	
E	21	Because of your tinnitus, do you feel depressed?	<u>0.59</u>	
C	5	Because of your tinnitus, do you feel desperate?	<u>0.59</u>	
F	14	Because of your tinnitus, do you find that you are often irritable?	0.54	
F	18	Do you feel it difficult to focus your attention away from your tinnitus?	0.54	
E	25	Does your tinnitus make you feel insecure?		<u>0.78</u>
F	15	Because of your tinnitus, is it difficult for you to read?		<u>0.71</u>
F	4	Does your tinnitus make you feel confused?		<u>0.65</u>
F	1	Because of your tinnitus, is it difficult for you to concentrate?		<u>0.60</u>
F	24	Does your tinnitus get worse when you are under stress?		<u>0.58</u>
F	20	Because of your tinnitus, do you feel tired?		0.56
F	9	Does your tinnitus interfere with your ability to enjoy social activities?		0.55
E	17	Do you feel that your tinnitus has placed stress on your relationship?		0.54
F	13	Does your tinnitus interfere with your job or household responsibilities?		0.52
F	2	Does the loudness of your tinnitus make it difficult to hear people?		0.51
C	23	Do you feel that you can no longer cope with your tinnitus?		0.38
C	8	Do you feel as though you cannot escape your tinnitus?		<u>0.80</u>
C	19	Do you feel that you have no control over your tinnitus?		<u>0.76</u>
F	7	Because of your tinnitus, do you have trouble falling asleep at night?		<u>0.37</u>

\* F = Functional subscale, E = Emotional subscale, C = Catastrophic subscale. Items for which the factor loadings met the criterion of the difference between the highest and the second-highest factor loading  $>.20$  are underlined.

ship between depression and tinnitus severity (Kuk et al., 1990; Katon et al., 1993). In contrast, only a weak relationship between THI and depression was observed for the original version. This difference between the Danish and original sample may be explained by the higher depression scores ( $7.9 \pm 6.6$ ) and the higher mean THI-Total scores ( $40.0 \pm 22.3$ ) of the Danish sample, compared to the original US sample (BDI:  $5.9 \pm 5.7$ ; THI-Total:  $24.4 \pm 20.5$ ). In a recent study, Andersson & McKenna (1998) found a U-shaped relation between the BDI and tinnitus parameters, and interpreted the results according to a diathesis stress model in which a vulnerable person might develop tinnitus distress following a comparatively low degree of tinnitus while a more stress-tolerant person might bear higher degrees of tinnitus before seeking help. Such differences in sample characteristics could perhaps explain the difference found between the

Danish and the original version of the THI with respect to associations between THI and depression.

Strong to moderate correlations were also observed between the THI and the other questionnaires measuring psychological distress, e.g. state- and trait anxiety, as measured by the STAI, and neuroticism, as measured by the EPQ. Similar correlations were generally observed for THI-Total scores and scores on the three subscales, again suggesting that the subscales may not necessarily measure three distinct factors. The validity of the THI as a general measure of tinnitus-related distress seems, however, to be supported by our findings of strong correlations between the THI and maladaptive coping style, as well as by the absence of correlations between the THI and effective coping as measured by the TCSQ. The absence of correlations between the THI and the Lie

subscale of the EPQ suggest that the cognitive, emotional and social consequences of tinnitus measured by the THI are not sensitive to differences in social desirability, further supporting the reliability and validity of the questionnaire as a general measure of distress.

We found no significant correlations between the THI and the duration of tinnitus. This could suggest that while chronic tinnitus sufferers may be unable to adapt to their symptoms, longer duration, on the other hand, may not be associated with an increase in the adverse effects on daily living. Social support is generally thought to function as a "buffer" against distress associated with disease (Cohen & Wills, 1985), and previous investigations have found less marital cohesion to be associated with a greater tinnitus-related role dysfunction (Sullivan et al., 1994). It is therefore surprising that only weak, non-significant correlations were found between the THI and perceived social support. Our findings are in agreement with previous reports (Erlandsson et al., 1992) and suggest that the quality of perceived social support is only of minor importance to self-perceived tinnitus handicap.

In conclusion, we have demonstrated that the Danish translation of the THI seems to be a reliable and valid general measure of tinnitus-related distress. With respect to the subscales, our data suggest that the items of the subscales included in the original version of the THI may not represent distinct underlying latent variables, and further studies using the THI and other similar measures are needed to clarify whether specific tinnitus distress measures can be identified. Our data, however, suggest that the total score of the THI can be used to quantify the impact of tinnitus on daily living and serve as a valid outcome measure in the clinical setting and in treatment or rehabilitation studies, where reduction in self-perceived handicap is the desired outcome.

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