Research article

Standardized diagnostics for tinnitus at the Maastricht University Medical Center

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Introduction

Tinnitus can be defined as a continuous perception of a sound without an external source (1,2). Only 1 % of the tinnitus cases can be measured objectively. Objective tinnitus can be caused by arterial, arteriovenous or venous sources within the body. In all other cases the tinnitus is only perceived by the patient itself and subjective (3).

Approximately 10-15% of the general population suffers from tinnitus (4,5). Although not recognized by the general public, tinnitus is one of the most distressing and debilitating audiological disorders, which affects many aspects of daily life and is called decompensated tinnitus (1,3).

In 85% of the tinnitus cases, patients also suffer from hearing disabilities (6) and 35% of these patients experience moderate to severe hearing loss (7). Forty percent of the tinnitus patients develop hyperacusis or intolerance to environmental sounds (8).

Tinnitus can be associated with a variety of psychological and psychiatric disorders like emotional distress and clinical depression (2,9,10). Studies show that 48-60% of patients with chronic tinnitus have an associated diagnosis of depression. Mood disorders, reduced concentration, irritability and loss of control are also correlated with tinnitus severity (11). Most studies indicate a relationship between tinnitus annoyance and the presence of certain psychiatric diagnoses and specific personality traits, like anger and frustration (2,8,12–14).

The exact pathophysiology of tinnitus is unknown. A general accepted hypothesis is that tinnitus appears as a reaction on spontaneous anomalies or changes in neural activity along the auditory paths in the brain (15). High percentages of tinnitus appearing in the course of cochlear pathologies suggest that tinnitus, at least partially, originates at the cochlear level (4). Tinnitus can also possibly be explained by Jastreboffs' model (16), tinnitus is a problem of distinguishing functional connections between the auditory and the limbic and autonomic nervous systems. By trying to achieve habituation of tinnitus-evoked reactions and subsequently habituation of perception, tinnitus can possibly be eliminated (16).

Because of great heterogeneity of tinnitus with respect to clinical features and underlying pathophysiological mechanisms, there is a great variety in treatment and its' efficacy (1,17,18).

Due to the lack of objective tests to diagnose tinnitus, diagnosis is largely based on the patients' report of symptoms (8,19,20). Effective management of tinnitus complaints is often a lengthy process, involving numerous disciplines (1). Therefore, appropriate diagnostics is important to improve the patients' quality of life. As there is no curative treatment, care is primarily directed towards management and amelioration of the conditions' deleterious effects. Because tinnitus is mostly chronically, the main goals of treatment are to enhance the patients' understanding and encouraging the patient to pay less attention to the tinnitus and to gain control over it (8).

Maastricht University Medical center (MUMC) has designed a diagnostic and intervention model in which every tinnitus patient follows a structured pathway. This standardized diagnostic protocol is based on usual care for tinnitus. A flowchart of the multidisciplinary model can be found in Figure 1. The diagnostic model is a first step in standardizing multidisciplinary tinnitus-care. The goal is to reduce the disability and distress of the tinnitus for every single patient. *("Figure 1 around here")*

The aim of this study was to take a first step in standardizing tinnitus care. Therefore it was important to know whether the multidisciplinary approach is effective and efficient.
The primary research question was to determine the efficacy of the diagnostic MUMC tinnitus-model, based on the Tinnitus Questionnaire (TQ) and Hospital Anxiety and Depression Scale (HADS) and the Consumer Quality Index (CQI).
Secondary research questions and hypotheses were:

1. How does the TQ relate to the HADS (correlation), and is disability and distress of tinnitus influenced by anxiety and depression, measured by the TQ?
    Hypothesis: Anxiety and depression, measured by HADS, have a negative influence on the disability and distress of tinnitus, measured by the TQ.
2. Will disability and distress caused by tinnitus decrease, as a consequence of the multidisciplinary approach, in which the score of the TQ and the HADS determine the followed route.
    Hypothesis: The multidisciplinary approach, in which the score of the TQ and the HADS determine the followed route, has a positive effect on tinnitus disability and distress, measured by the TQ. The positive results can be described to the intervention and not to time or other interventions.
3. How can the multidisciplinary approach be improved, based on patients' evaluations?
    a. How long did it take to follow the protocol?
    b. What were patients' experiences and what suggestions do they have to improve the protocol, based on the CQI?

Method

Study design and participants

The study design was a prospective cohort study, without control-group. A group of tinnitus patients was followed over time. Existing files and data were studied and analyzed quantitatively.

According to the classification of Centre of evidence-based Medicine (CEBM) this study was a level III study (21). The study was performed at MUMC, at the Department of Otolaryngology and Head and Neck Surgery. The included population were patients with tinnitus, living in the zip code area or patients secondary or tertiary redirected from another zip code area. All patients were included, there were no exclusion criteria.

It was a mixed population, with variety in severity and experienced disability and distress.

Measuring and outcomes

The main outcome was the efficacy of the diagnostics model, measured by the TQ and HADS. CQI was used to examine patients' satisfaction. Both TQ and HADS questionnaires are highly correlated and give good insight in the impact of tinnitus on patients' quality of life (22).

The Dutch TQ is a validated instrument for the quantification of tinnitus complaints (23). The tinnitus questionnaire can be used to identify determining factors of a patient's life, affected by tinnitus. The TQ contains scales for measuring emotional and cognitive distress, intrusiveness, auditory perceptual difficulties, sleep disturbances, and associated somatic complaints (24).

The TQ is valid for measuring disease-specific health-related quality of life (1,22).

Answers are represented on an ordinal scale and can be divided in four gradations. The level gradations are arbitrary. Scores are on ratio level. A change in score of +1 to -5 points is considered to be clinically relevant (24).

The Dutch HADS is developed as a self-report to detect presence and severity of mild mood disorders in non-psychiatric hospital out-patients (23).

The questionnaire contains fourteen questions, seven questions are related to depression, seven questions are related to anxiety. Each item has four response possibilities, ordered in frequency or severity. Questions and responses are either formulated positive (six items) or negative (eight items). Minimum score is zero, maximum score is twenty-one, and high scores mean that the mentioned characteristic are highly present. Sum scores on the subscales can be identified as non-cases (score ≤ 7), doubtful cases (score 8-10) or definite cases (score ≥ 11). The HADS has good reliability and validity (1). Answers are presented on an ordinal scale, scores on ratio level (25). For HADS there is a clinical relevant difference in disability and distress when scores change +/- 1.5 points (26,27).

Based on the scores on TQ and HADS patients followed a specific route in the diagnostic model (figure 1) for optimal diagnostics (28). Patients with a TQ < 47 and HADS < 11 were invited for an information meeting. A TQ score <47 and HADS ≥ 11 indicated a redirection to a psychiatrist. If patients scored TQ ≥ 47 and HADS < 11, they received an invitation for an audiological and psychosocial intake. Patients with a TQ ≥ 47 and HADS ≥ 11 were invited for all intakes and a psychological or psychiatric consult.

The Consumer Quality Index (CQI) is a standardized method to measure client experiences in health-care. The CQ-index is used to gather reliable, valid and comparable information about the quality of care from clients' perspective. The used CQI is an adjusted version of the CQI for audiological centers. Answers are presented on nominal, ordinal and ratio scale.

Procedures

Data were analyzed in groups. Group I was the overall group (n = 488). In time minor logistic changes have been made in the model. Therefore group I was divided into two groups. Group II were all patients included between March 21st 2013 and February 27th 2014 (date referral), group III were all patients included between March 5th 2014 and October 3rd 2014 (date referral), after the revision. All patients in group III received the TQ and HADS again for post-test measurement. This group also received the CQI. Group IV were all respondents who returned the second questionnaires (TQ and HADS) and CQI (Figure 2).

("Figure 2 around here")

Besides the research questions, the prevalence of anxiety and depression in the tinnitus population at the MUMC was related to the general population. Finally the psychiatric group (HADS ≥ 11) was evaluated separately.

Statistical analysis

For calculating the correlation and predictive value between TQ and HADS in group I, Pearson Correlation and regression analysis were used. Tinnitus severity was defined as dependent variable for the regression analysis. Anxiety and depression were defined as independent variables. Any effect before and after intervention in group III was measured by using a paired-sample t-test.

First the time span of the whole protocol was calculated in group I (n = 278). Patients were excluded when date of start and/ or date of end was not known, including those patients for whom the protocol had not ended yet. Second the time span for group II and group III was calculated separately, to see if the first revision of the protocol had any effect on the time span. One patient was excluded from group III for outlier reasons.

In group IV overall grades for services were calculated, based on the CQI. Correlations were calculated between TQ levels and grades, to see if the level of complaints correlated with given

grades. Next correlations were calculated between gender, education, and general health and given grades. Individual unsatisfactory grades (≤5) were analyzed separately.

In the next step, questions regarding the time span, the provision of information, the staff and coordination were clustered to see what points of improvement could be found. Both in intake and in CQI questions about loudness, awareness and annoyance of tinnitus were asked. To detect consistency in experienced loudness, awareness, and annoyance, a paired-sample t-test was used.

For measuring the prevalence of anxiety and depression in the tinnitus population included in the study, total scores per subcategory of HADS-categories were calculated.

Patients who were redirected to psychiatry also were analyzed as a subgroup, using a one-sample t-test.

Regulation statement

This study was conducted according to the principles of the Declaration of Helsinki (version 64th, October 2013) (29), the law describing rights and duties of clients in medical care (Wet op de geneeskundige behandelovereenkomst, WGBO), the law for protection of privacy (Wet bescherming persoonsgegevens, Wbp) and the code of conduct of Health Care Research (Gedragscode Gezondheidsonderzoek).

Results

Descriptive data

A total of 488 patients were included, 60.7% was male. The mean age was 56.08 years, with a range between 14 and 87 years. The mean score on TQ was 42.44 (SD 13.82), the mean score on HADS-A was 6.89 (SD 4.45) and the mean score on HADS-D was 7.33 (SD 4.76) (Table 1 and 2). *("Table 1 and 2 around here")*

Table 1 shows that 11.3% of the participants scored in the highest category of the HADS (HADS-H), which means they had severe problems concerning anxiety and/ or depression related to the tinnitus. Of the examined population 19.1% experienced anxiety (≥ 11 on HADS-A) and about 25% experienced depression (≥11 on HADS-D).

Figure 3 gives an overview of all included patients and shows the profile of the protocol.

Two hundred and one patients scored equal or above 47 on TQ. Of these patients 102 patients scored equal or above 11 points on HADS (Figure 3). *("Figure 3 around here")*

Correlation, regression analysis and effect intervention

The correlation between TQ and HADS was strongly positive (R = .659, p = 0.001). Regression analysis showed a predictive value for HADS-A for TQ (R^2 = .323) and HADS-D for TQ (R^2 = .419). A combination of HADS-A and HADS-D showed an even higher predictive value for TQ (R^2 = .431) (Table 3).

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In group III 147 patients repeated the TQ, 145 patients repeated the HADS. On TQ the mean decrease was 4.2 points (CI 1.904-6.545, p =.000) (Table 4). For patients with chronically decompensated tinnitus, the mean decrease was 9.6 points (CI 5.486-13.774, p = .000) (Table 5). Change in HADS-A was 1.9 (CI -1.006-4.720, p = .185) and 1.2 in HADS-D (CI -.422-2.850, p = .133) (Table 6). *("Tables 3-6 around here")*

Timespan

For group I the mean timespan for following the complete protocol was 4.0 months (SD 3.3). The median was 3.0 with a range from 1 to 22 months. In group II the mean timespan was 5.2 months (SD 3.7), with a range from 1 to 22. The median for this group was 4.0.

The mean timespan in group III was 3.2 months (SD 2.7), the median was 3.0 months and the range between 1 to 18 months. All groups were normally distributed.

Patient satisfaction

The mean overall grade for information and communication in the tinnitus team was 7.84 (SD 1.57, median 8.0), for expertise the general grade was 8.10 (SD 1.39, median 8.0), for service at the audiological center the grade was 7.99 (SD 1.62, median 8.0) and for overall tinnitus team the grade was 7.89 (SD 1.59, median 8.0) (Figure 4). *("Figure 4 around here")*

No significant differences were found between TQ groups (Table 7). *("Table 7 around here")*

Gender, education and general health did not correlate to given grades. All individual unsatisfactory grades were given by male respondents. Furthermore, there were no agreements in this group on TQ and HADS scores (n=9).

Regarding the time span, 50% of the patients had to wait six weeks or longer for the first appointment. Nine percent of the patients thought this was a big problem, 26% a small problem. Concerning the provision of information, mostly information was comprehensible and advice was useful. Approximately 95% of the patients valued the co-workers positively, on expertise and listening skills. Not all patients felt that they could not think along regarding the treatment (28%), referral (10%) and aids (35%)

In group IV loudness of tinnitus showed a significant strong positive correlation (.683, α 0.01) but no significant difference between TRI and CQI scores (0.127). Awareness and annoyance of tinnitus showed significant strong positive correlations (.586 and .624, α 0.01) and significant differences between TRI and CQI scores (0.027 and 0.000, α 0.05) (Table 8-9).

("Tables 8 and 9 around here")

A total of 23 patients (group III) was redirected to a psychiatrist. Fourteen of them repeated the questionnaires. The mean change on HADS-A for this subgroup was 1.9 (CI -1.006-4.720, p = .185). On HADS-D the mean change was 1.2 (CI -.422-2.850, p = .133).

Discussion

This study provides sufficient information that the multidisciplinary diagnostic and treatment approach for tinnitus used at the MUMC is effective, valuable and highly appreciated by patients, based on objective measurement of disability and distress and subjective patients' satisfaction. Moreover, the results are relevant for clinical practice.

A strong positive correlation is found between TQ and HADS. Tinnitus can cause anxiety and depression, which can cause more awareness of the tinnitus, which can cause more disability and distress (19). Furthermore a multidisciplinary approach instigates a decrease of disability and distress caused by tinnitus. In the complete population no significant improvement is seen, but patients with decompensated tinnitus show significant improvements after consulting the tinnitus team. Both changes in HADS-A and HADS-D are not significant and clinically not relevant, also in the psychiatric subgroup. In this subgroup the mean drop on TQ was 5 points. This appears to be clinically significant, because a change of +1 to -5 is clinically relevant (24), but the confidence intervals are both negative and positive. Compared to the study of Cima et al. (2012) the mean drop on TQ in this study, based on usual care, is considerably large. Cima found a TQ drop of maximum 6 points after 12 months (1), in this study the mean drop is 9 points for patients with decompensated tinnitus, with an average timespan of 4 months. Differences can be explained by the fact that Cima examined a larger group of participant, which can lead to more spreading in TQ scores. But she also proved a further decrease of disability and distress on long term. Thus, in this study further decrease of complaints is possible by extrapolation. Furthermore, in this study multidisciplinary care is integrated and is custom-made, while Cima used a steady protocol for all patients. This personalized and multidisciplinary approach can lead to more decrease on TQ scores on long term.

Next, the timespan to follow the complete protocol is shortened with 2 months, after the first revision, which can imply more efficiency. Based on patient's evaluations, most patients are satisfied with the approach and the appreciation does not depend on the degree of complaints (TQ-scores). Comments are given like: *"pleasurable and explorative", "competent, although disability is still present"* and *"very content, help was adequate".* Although the tinnitus-team itself thinks the timespan can be improved, this is not the biggest issue for patients. Shared decision making is marked most often as unsatisfactory by patients.

In addition, approximately 5.5% of the Dutch population is medically diagnosed with severe anxiety and/ or depression and takes medication (30). Compared to this number, the prevalence in this tinnitus population is higher, which is also found in earlier research (2,8,10–14,18–20,25,28).To detect a possible effect of the psychiatric intervention, a larger

group of participants is necessary. Based on a power analysis (80%, sample t-test with α = 0.05) a minimum of 90 patients is needed to determine any effect.

In the clinical practice guidelines for tinnitus (31) is recommended that a historical examination is necessary to identify conditions that may relieve the tinnitus. An audiological inquiry is suggested and it is important to distinguish whether the tinnitus is bothersome or not. Patients should be informed about management strategies, hearing aids should be advised if tinnitus is associated with hearing loss and cognitive behavioral therapy is indicated in case of bothersome tinnitus (31). The TQ and HADS, used in this study, are appropriate instruments to measure the disability and distress of the tinnitus. To provide the best care and optimize the use of questionnaires like TQ and HADS, a multidisciplinary approach is indicated (1,32). Curative treatment for tinnitus is not available, but several treatments are proven effective (1,3,4,6,33).

All aspects mentioned in the guidelines and literature, can be found in the tinnitus-model used at the MUMC. The aim of the MUMC tinnitus-model is in line with the aim of the clinical guidelines, to improve patient care multidisciplinary and mitigate the personal and social effects of the tinnitus. Selection and timing of diagnostic testing and referral to other medical disciplines to identify potential underlying pathology are included. Effects of treatment can be evaluated and measured to determine the decrease of the disability and distress of the tinnitus (31). The tinnitus-model is based on usual care, for which evidence is available, like cognitive behavioral therapy, tinnitus retraining therapy and the use of hearing aids.

A strength of this study is a comparatively large sample size and all groups are normally distributed, which can justify generalization. Another strength is the use of instruments (TQ, HADS) to quantify disability and distress caused by tinnitus. The fact that patient satisfaction (CQI) is involved in this study to detect possible improvements besides clinical findings, is a third strength. Patient satisfaction contributes to a continuous relationship with the practioner, the option of additional care from the same practioner when needed and a commitment.

The study has also limitations. Specialized diagnostics includes several elements and which of the specific elements contribute to the overall effect is hard to find. Second, there is no control group to exclude that changes in patients are only caused by the use of the MUMC model. Therefore a comparison with tinnitus-care in another clinic is to be advised. Third the group of patients redirected to psychiatry is too small to determine any effect. More patients were redirected, but dropped out during the process. It is not clear why they dropped out or refused to see a psychiatrist. It is recommended to examine the loss-to-follow-up. Finally patient's satisfaction is only examined in patients from group III, and drop-outs may not have returned the CQI questionnaire. Therefore generalization of patient's satisfaction is difficult. But the response-rate is sufficient (45%) and some unsatisfied patients returned the questionnaire. The insufficient scores are included and still the scores for patient satisfaction

are more than sufficient. Only few research has been done about tinnitus-care and patient satisfaction. Zarenoe (2014) reports that hearing aids are mostly not seen as treatment (34) and therefore these patients are not always satisfied about received care. This can also be the case in this study. Complementary, patients are willing to accept a wide variety of treatment, even invasive if this gives complete relief of disability and distress (35). Recommendations can be made for further research to improve the model and process, in the multidisciplinary approach for tinnitus care. The results in this study show that the shared-decision-making process doesn't work as it is meant to be, or at least patients do not encounter it as it should be. It is recommended to examine why this process doesn't work optimally and how it can be improved. As mentioned before, the loss-to-follow-up needs to be examined, as well why patients refuse to go the psychiatrist or drop-out. In addition, to determine if the psychiatric pathway is effective, a larger group of patients in this route should be followed and examined. It can also be worthwhile to examine more specifically why individual patients are not satisfied with the received care.

Suggestions can be made to combine several questions in the CQI. High correlations were found between the separate grades for different aspect within the tinnitus team. When patients are satisfied about the information and communication, the expertise and the service, it is to be expected that the overall grade for the tinnitus team will comparable.

To conclude, to improve patients' quality of life, effective management of tinnitus complaints can be shortened by the use of the MUMC diagnostic model. Decrease of disability and distress remains the goal of the approach. Therefore improvements regarding waiting time and shared-decision-making should be considered carefully.

Because this research is an example of best practice, the findings can lead to consensus in a standardized policy about best practice in diagnostics, the implementation of standardized tinnitus assessment nationwide and standard choices in referral trajectories and treatment.

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Figure 1: Flowchart diagnostic model

Legend:
Audiometry: T (tone audiometry), S (speech audiometry), Tymp (tympanometry)
TQ: tinnitus questionnaire
HADS: Hospital Anxiety and Depression scale
ENT: ear, nose and throat doctor
CGT: cognitieve gedragstherapie
TI: tinnitus inventarisatie

Start

1. Referral with main complaint tinnitus

2. Triage by ENT doctor

2a. ENT outpatient clinic sends questionnaires and plans ENT consult

2b. Returned questionnaires: review TQ, HADS and document

3a. Audiometry (T/S/Tymp/Reflexen) + Tinnitusanalysis

3b. ENT Consult

3c.Extra medical examination

4. TQ
≥ 47   < 47

HADS ≥ 11 Yes

HADS ≥ 11 Yes

Psycosocial intake

Psychosocial intake

Referral to psychiatrist

Tinnitus education Yes

Psychiatric intake

Audiological intake

Information meeting

Exit + patient satisfaction

Exit + patient satisfaction

5. Consultation

Exit + patient satisfaction + TQ/HADS

| Psychologist | CGT | Social worker | Audiological intervention | Research (TI) |

Exit + patient satisfaction + TQ/HADS

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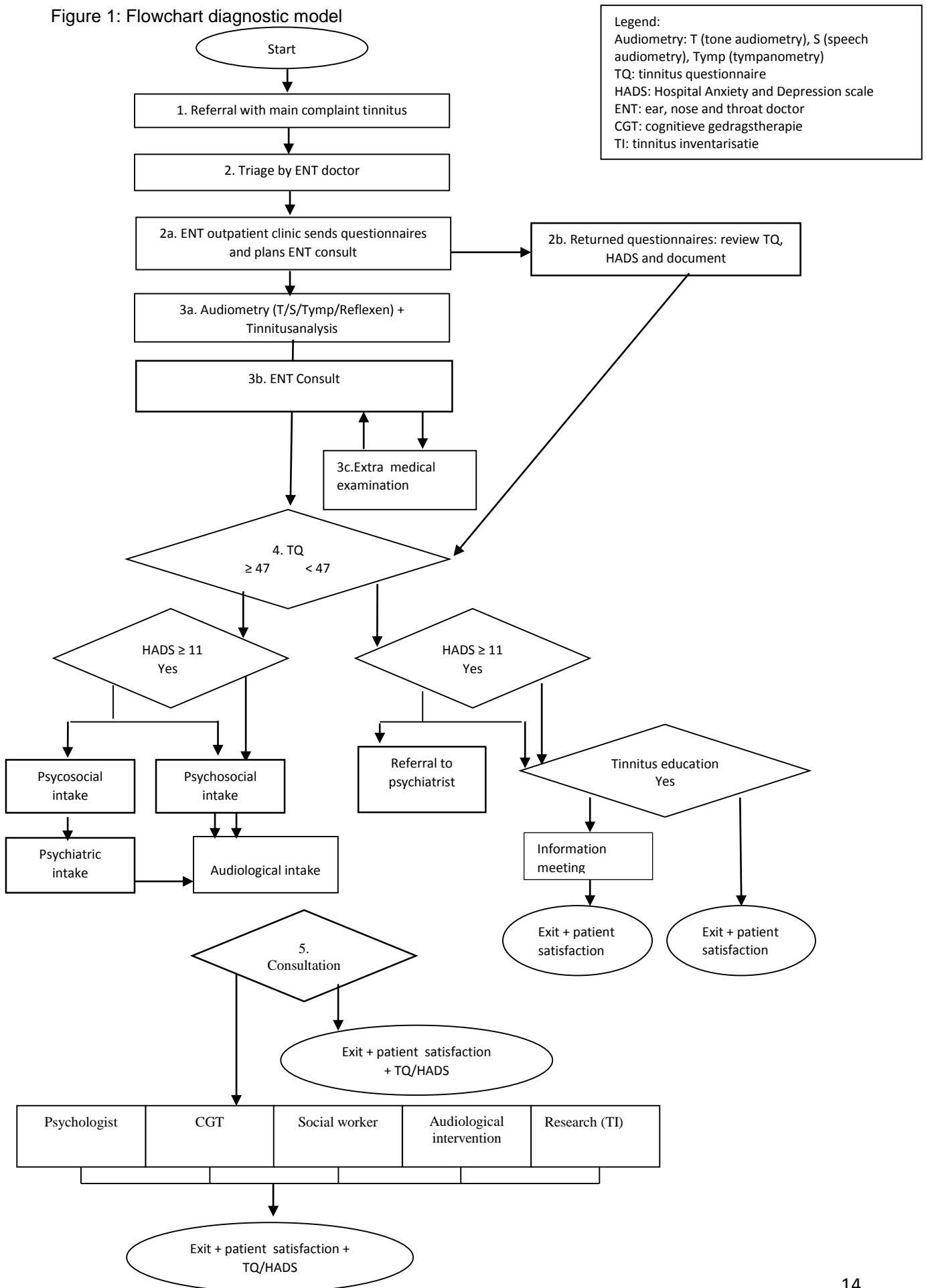
Figure 2: Arrangement of groups

Complete time span of study: March 2013 - October 2014 (Group I; all included patients (n = 488))

Patients included between March 2013
And February 2014 (Group II; n = 212)

Patients included between March 2014 and
October 2014 (Group III; n = 276)

Respondents second questionnaires TQ and HADS
and CQI questionnaire out of group III
(Group IV; n = 124)

Table 1: Patient characteristics (total group)

CHARACTERISTICS	OVERALL	MALE	FEMALE
Total number of patients	488	296 (60,7%)	192 (39,3%)
Age	56.08 (14-87, SD 13.82)	55.74 (14-87, SD 13.25)	56.60 (16-86, SD 14.67)
TQ score	42.44 (4-84, SD 17.58)	42.91 (4-84, SD 17.75)	41.71 (5-81, SD 17.34)
Grade 1	131 (26.8%)		
Grade 2	156 (32.0%)		
Grade 3	119 (24.4%)		
Grade 4	82 (16.8%)		
Mean HADS-A	6.89 (0-21, SD 4.45)	7.00 (0-21, SD 4.55)	6.72 (0-19, SD 4.30)
HADS-A			
Score 0-10	395 (80.9%)		
Score 11-14	60 (12.3%)		
Score 15-21	33 (6.8%)		
Mean HADS-D	7.33 (0-20, SD 4.76)	7.60 (0-20, SD 4.69)	6.90 (0-20, SD 4.85)
HADS-D			
SCORE 0-10	363 (74.4%)		
SCORE 11-14	83 (17.0%)		
SCORE 15-21	42 (8.6%)		
HADS-H			
SCORE 0-10	399 (69.5%)		
SCORE 11-14	94 (19.3%)		
SCORE 15-21	55 (11.3%)		

Data are mean (range, SD) or n (%)

Table 2: Patient characteristics per subgroup

CHARACTERISTICS	GROUP I	GROUP II	GROUP III	GROUP IV
Total number of patients	488	212 (43,4%)	276 (56,6%)	124 (25,4%)
Age	56.08 (14-87, SD 13.82)	57.05 (22-87, SD 12.05)	55.29 (14-86, SD 15.01)	55.02 (16-84, SD 14.09)
Mean score TQ	42.44 (4-84, SD 17.58)	45.41 (4-84, SD 17.36)	39.93 (2-82, SD 17.00)	38.94 (5-81, SD 17.98)
Grade 1	131 (26.8%)	44 (20.8%)	84 (30.4%)	43 (34.7%)
Grade 2	156 (32.0%)	64 (30.2%)	93 (33.7%)	40 (32.3%)
Grade 3	119 (24.4%)	59 (27.8%)	66 (23.9%)	25 (20.2%)
Grade 4	82 (16.8%)	45 (21.2%)	33 (12.0%)	16 (12.9%)
Mean HADS-A	6.89 (0-21, SD 4.45)	7.12 (0-21, SD 4.70)	6.61 (0-20, SD 4.13)	6.68 (0-20, SD 4.52)
HADS-A				
Score 0-10	395 (80.9%)	163 (77.6%)	231 (83.7%)	104 (83.9%)
Score 11-14	60 (12.3%)	30 (14.3%)	32 (11.6%)	12 (9.7%)
Score 15-21	33 (6.8%)	17 (8.1%)	13 (4.7%)	8 (6.5%)
Mean HADS-D	7.33 (0-20, SD 4.76)	7.82 (0-20, SD 4.88)	6.94 (0-20, SD 4.55)	6.98 (0-20, SD 4.88)
HADS-D				
SCORE 0-10	363 (74.4%)	146 (69.5%)	215 (77.9%)	95 (76.6%)
SCORE 11-14	83 (17.0%)	43 (20.5%)	42 (15.2%)	17 (13.7%)
SCORE 15-21	42 (8.6%)	21 (10.0%)	19 (6.9%)	12 (9.7%)
HADS-H				
SCORE 0-10				
SCORE 11-14	399 (69.5%)	137 (65.2%)	200 (72.5%)	88 (71.0%)
SCORE 15-21	94 (19.3%)	47 (22.4%)	49 (17.8%)	20 (16.1%)
	55 (11.3%)	26 (12.4%)	27 (9.8%)	16 (12.9%)

Data are mean (range, SD) or n (%)

Overall = group I, patients included between March 21st 2013 and February 27th 2014 (date referral) = group II, patients included between March 5th 2014 and October 3rd 2014 (date referral) = group III, respondents second questionnaires and CQI (out of group III) = group IV
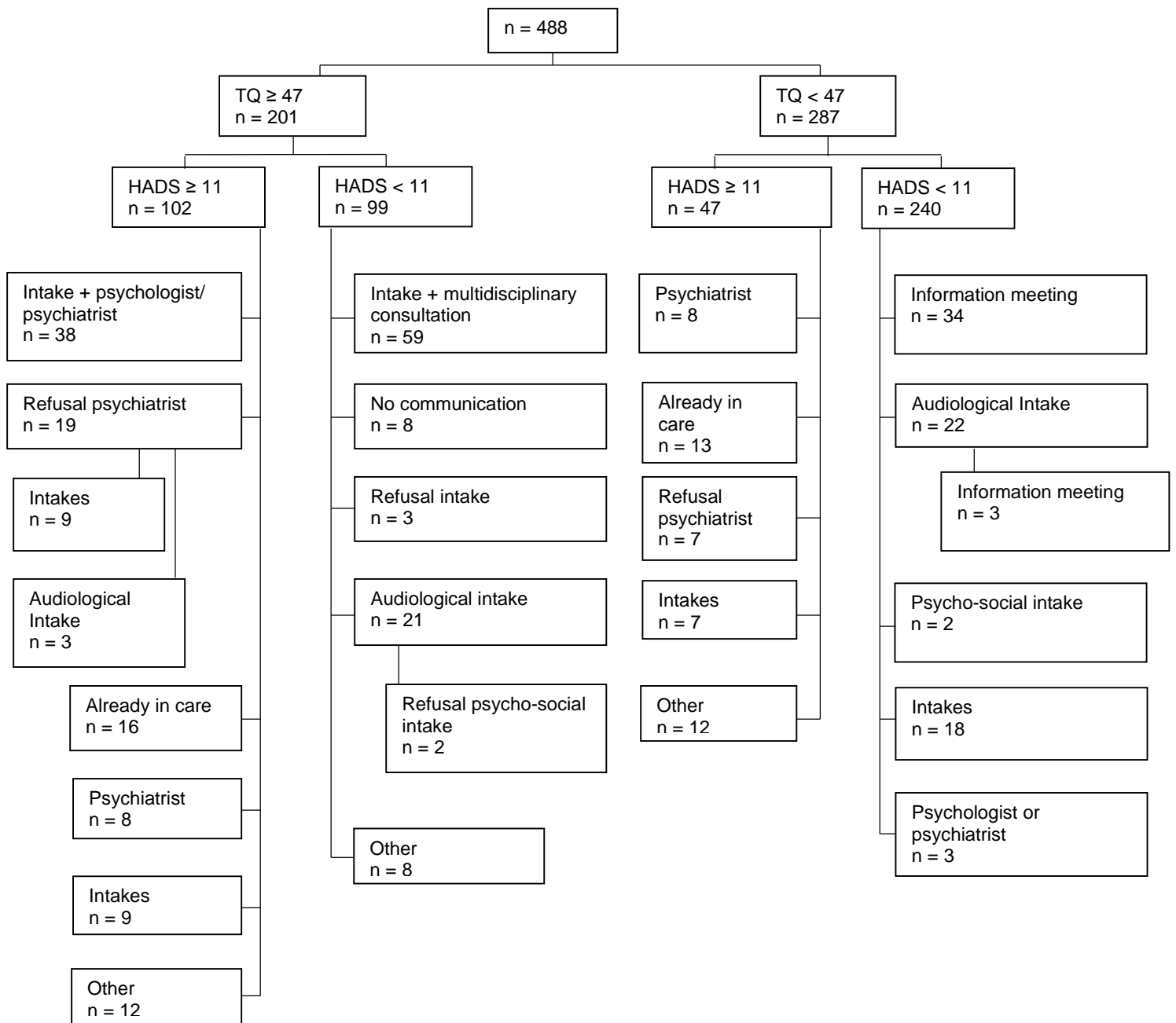
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Figure 3: Flowchart participants

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Table 3; Regression analysis: dependent variable TQ (n = 488)

Independent variable	R*	R²	Significance
HADS-A	.568	.323	.000
HADS-D	.648	.419	.000
HADS-T	.659	.431	.001

Correlation coefficient P = 0.01

Table 4: Comparison TQ and HADS before and after intervention

	N	Before intervention Mean, SD	After intervention Mean, SD	Δ CI (95%)	Significance
TQ	147	40.494 (17.02)	36.27 (18.36)	4.224 (1.904-6.545)	.000**
HADS-A	145	6.72 (4.470)	6.21 (3.914)	.517 (-.078-1.112)	.088
HADS-D	145	7.08 (4.663)	7.23 (4.512)	-.152 (-.785-.481)	.636

SD = standard deviation, CI = confidence interval,
*** Significant at the 0.01 level*

Table 5: Comparison TQ before and after intervention in chronically decompensated patients

|	N	Before intervention Mean, SD	After intervention Mean, SD	Δ CI (95%)	Significance
TQ 3	35	54.11 (4.020)	46.60 (16.527)	7.514 (1.827-13.202)	.000**
TQ 4	19	67.11 (4.898)	53.58 (13.222)	13.562 (7.902-19.150)	.011*
TQ 3+4	54	58.69 (7.598)	49.06 (15.681)	9.630 (5.486-13.774)	.000**

SD = standard deviation, CI = confidence interval
* Significant at the 0.05 level, ** Significant at the 0.01 level

Table 6: Comparison TQ and HADS before and after intervention in patients referred to psychiatry

	N	Before intervention Mean, SD	After intervention Mean, SD	Δ CI (95%)	Significance
HADS-A	14	12.79 (3.293)	10.93 (3.293)	1.857 (-1.006-4.720)	.185
HADS-D	14	13.29 (4.215)	12.07 (4.215)	1.214 (-.422-2.850)	.133
TQ-psychiatric	14	57.43 (13.483)	52.43 (17.496)	5.00 (-3.855-13.855)	.244

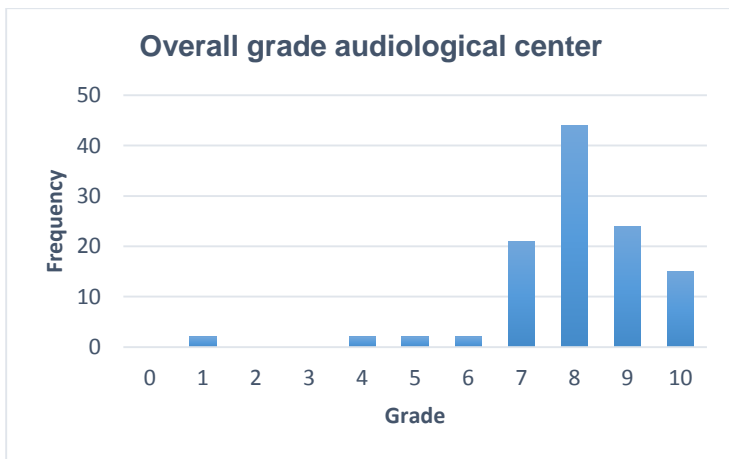*SD = standard deviation, CI = confidence interval*
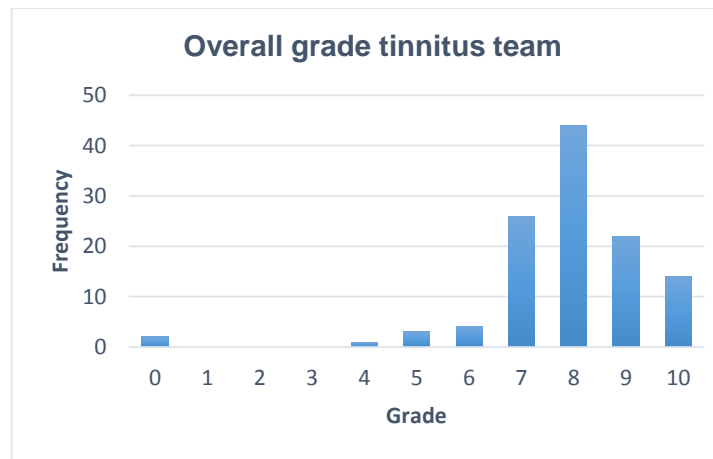
Figure 4; Overall grades
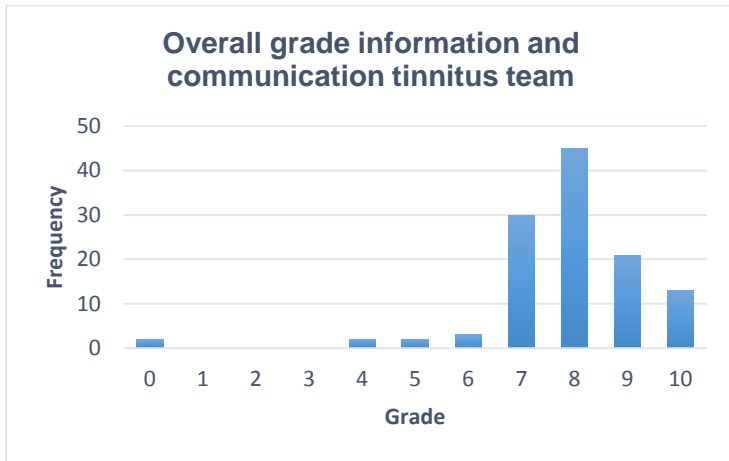
Overall grade information and communication in tinnitus team (mean = 7.84, median = 8.0, standard deviation 1.57, n = 118)
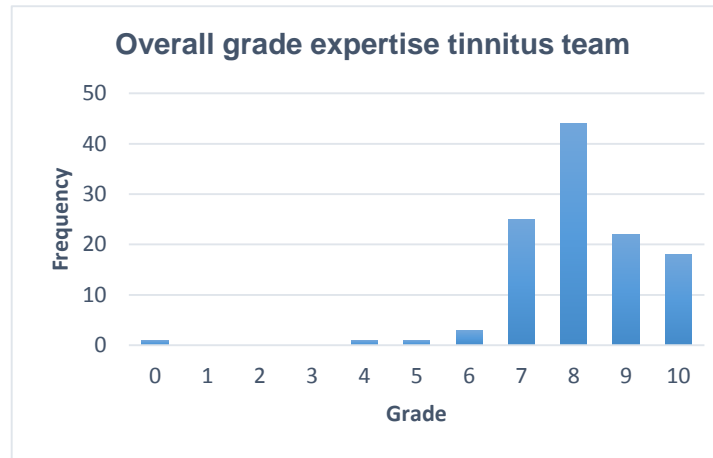
Overall grade expertise tinnitus team (mean = 8.10, median = 8.0, standard deviation = 1.39, n = 115)

Overall grade service audiological center (mean = 7.99, median = 8.0, standard deviation = 1.62, n = 112)

Overall grade tinnitus team (mean = 7.89, median = 8.0, standard deviation = 1.59, n = 116)

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Table 7: Correlation TQ group and grades

	TQ group	Grade tinnitus team information and communication	Grade expertise tinnitus team	Grade audiological center	Overall grade tinnitus team
TQ group		-.022 (n=118)	-.068 (n=115)	0.023 (n=112)	0.009 (n=116)
Grade tinnitus team information and communication	-.022 (n=118)		.852** (n=114)	.623** (n=111)	.933** (n=115)
Grade expertise tinnitus team	-0.068 (n=115)	.852** (n=114)		.539** (n=109)	.840** (n=112)
Grade audiological center	0.023 (n=112)	.623** (n=111)	.539** (n=109)		.635** (n=110)
Overall grade tinnitus team	0.009 (n=116)	.933** (n=115)	.840** (n=112)	.635** (n=110)	

*** Correlation is significant at the 0.01 level (2-tailed)*

Table 8; Correlations TRI and CQI scores on loudness, awareness and annoyance of tinnitus

	N	Correlation	Significance
Loudness CQI - loudness TRI	107	.683	.000
Awareness CQI - awareness TRI	113	.586	.000
Annoyance CQI – annoyance TRI	111	.624	.000

*** Correlation is significant at the 0.01 level (2-tailed)*

Table 9; Paired sample t-test on TRI and CQI scores on loudness, awareness and annoyance of tinnitus

	Paired differences					
				95% confidence interval of the difference		
	Mean	Standard deviation	Standard error mean	Lower	Upper	Significance (2-tailed)
Loudness CQI - loudness TRI	-2.98 (n=106)	19.99	1.93	-6.81	.86	.127
Awareness CQI - awareness TRI	-5.82 (n=112)	27.66	2.60	-10.98	-.67	.027**
Annoyance CQI – annoyance TRI	-13.18 N=110)	27.89	2.65	-18.43	-7.93	.000**

*** Significant at the 0.05 level (2-tailed)*

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Samenvatting

Titel: Gestandaardiseerde diagnostiek voor tinnitus patiënten in Maastricht Universiteit Medisch Centrum

Achtergrond: Tinnitus is een continue perceptie van geluid, zonder externe geluidsbron, met een prevalentie van 10-15% in de populatie. Tinnitus kan geassocieerd worden met een variëteit aan psychische en psychiatrische stoornissen. Door de onzekere pathofysiologie en heterogeniteit, is diagnostiek vooral gebaseerd op symptomen van patiënten. Maastricht Universiteit Medisch Centrum (MUMC) heeft een diagnostiek en interventie model ontwikkeld, gebaseerd op gebruikelijke zorg.

Doel en onderzoeksvraag: Het doel van de studie was een eerste stap richting gestandaardiseerde tinnitusdiagnostiek. De hoofdvraag was het bepalen van functionaliteit van het MUMC tinnitusmodel, gebaseerd op de Tinnitus Questionnaire (TQ), Hospital Anxiety and Depression Scale (HADS) en Consumer Quality Index (CQI).

Methode: In een prospectieve cohortstudie zonder controlegroep, zijn de TQ en HADS geanalyseerd om effecten te bepalen, correlaties en regressieanalyse werden uitgevoerd. CQI data zijn gebruikt om patiënttevredenheid te onderzoeken. Waarderingen werden berekend, TQ gradaties en waarderingen werden gecorreleerd en vragen met betrekking tot tijdspad, informatievoorziening, deskundigheid en coördinatie werden geclusterd om verbeterpunten te ontdekken.

Resultaten: Correlatie tussen TQ en HADS was sterk positief, HADS had een voorspellende waarde voor de TQ. Het gemiddelde cijfer voor informatie en communicatie in het tinnitusteam was 7,84, voor deskundigheid 8,10, voor service van het audiologisch centrum 7,99 en voor tinnitusteam algemeen 7,89. Patiënten waren niet allemaal tevreden over shared-decision-making.

Conclusie: De resultaten laten zien dat het MUMC tinnitus model doeltreffend is en een goede eerste stap is richting gestandaardiseerde zorg voor tinnitus patiënten.

Aanbevelingen: Verbeteringen met betrekking tot wachttijd en shared-decision-making moeten met zorg bekeken en overwogen worden.

Sleutelwoorden: Tinnitus, diagnostiek, kwaliteit-van-leven, gestandaardiseerd-proces

Abstract

Title: Standardized diagnostics for tinnitus at the Maastricht University Medical Center

Background: Tinnitus can be defined as a continuous perception of a sound without an external source, with a prevalence of 10-15% in the general population. Tinnitus can be associated with a variety of psychological and psychiatric disorders. Caused by the uncertain pathophysiology and heterogeneity, diagnostics is largely based on patients' report of symptoms. Maastricht University Medical Center (MUMC) has designed a diagnostic and intervention model for tinnitus, based on usual care.

Aim and research questions: The aim of the study was to take a first step in standardizing tinnitus diagnostics. The main research question was to determine the efficacy of the MUMC tinnitus model, based on the Tinnitus Questionnaire (TQ), Hospital Anxiety and Depression Scale (HADS) and Consumer Quality Index (CQI).

Method: In a prospective cohort study without control group, TQ and HADS were analyzed to determine effects and correlations and regression analysis were performed. CQI data were studied to examine patient satisfaction. Overall grades were calculated, TQ gradations and grades were correlated and questions regarding time span, the provision of information, the staff and coordination were clustered to discover points for improvement.

Results: Correlation between TQ and HADS was strongly positive, HADS showed a predictive value for TQ. The mean overall grade for information and communication in the tinnitus team was 7.84, for expertise the general grade was 8.10, for service at the audiological center the grade was 7.99 and for overall tinnitus team the grade was 7.89. Patients were not satisfied about shared-decision-making.

Conclusion: The results show that the MUMC tinnitus model is an effective model and is a good first step towards standardized care for tinnitus patients.

Recommendations: Improvements regarding waiting time and shared-decision-making should be considered carefully.

Keywords: Tinnitus, diagnostics, quality-of-life, standardized-process