

## RESEARCH ARTICLE

# Development and psychometric validation of a new tinnitus questionnaire for clinical use

Mohd Normani Zakaria<sup>1\*</sup>, Yue Jun Lau<sup>1</sup>, Wan Suhailah Wan Husain<sup>1</sup>, Cheu Lih Aw<sup>1</sup>, Nik Adilah Nik Othman<sup>1</sup>, Rosdan Salim<sup>2</sup>, Baharudin Abdullah<sup>2</sup>, Zuraida Zainun<sup>1</sup>, Wan Najibah Wan Mohamad<sup>1</sup>

<sup>1</sup>- Audiology Programme, School of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia

<sup>2</sup>- Department of Otorhinolaryngology, School of Medical Sciences, Universiti Sains Malaysia, Kubang Kerian, Malaysia

Received: 28 Dec 2016, Revised: 8 Mar 2017, Accepted: 8 Mar 2017, Published: 15 Apr 2017

(This article has been published in Auditory and Vestibular Research Journal, 2017)

## Abstract

**Background and Aim:** Self-administered questionnaires are clinically important to document how tinnitus affects the daily life of patients. In this regard, there is a need to have an alternative questionnaire that covers relevant aspects of tinnitus and related symptoms. The present study aimed to develop and validate a new tinnitus questionnaire known as Tinnitus Handicap Questionnaire or Borang Evaluasi Soal selidik Tinnitus (BEST) in Malay version.

**Methods:** The present study had two consecutive phases. In phase 1 of study, BEST questionnaire was initially developed in English and underwent forward and backward translation processes. Following relevant amendments, the final version of BEST (Malay version) was ready for subsequent tasks. It consists of 25 items categorized under 3M domain (mind, main and mental). In phase 2, 65 patients with tinnitus were recruited for determining the validity and reliability of BEST.

**Results:** Content validity index (CVI) of BEST ranged from 0.71-1.00. Endorsement rates of BEST were acceptable (<80%) for the majority of items. BEST was found to have good reliability as revealed by item-total correlation (0.22-

0.84), Cronbach's alpha (0.62-0.95), split half reliability (0.92) and correlation between domains ( $r=0.62-0.96$ ). It was correlated with Malay version of Depression Anxiety Stress Scales (BM DASS-21) ( $p<0.05$ ) but not with tinnitus audiometry ( $p>0.05$ ) implying good construct validity.

**Conclusion:** The BEST questionnaire has been proven valid and reliable to be used clinically, particularly among Malay-speaking population. Nevertheless, future studies are welcome to further support the findings obtained from the present study.

**Keywords:** Tinnitus; questionnaire; psychometric; validity; reliability

## Introduction

ringing in the ears or "tinnitus" is a common symptom among patients with ear diseases. Its prevalence ranged from 10% to 15% among adults [1,2]. If untreated, the quality of life of the affected individuals can be tremendously compromised. It can lead to serious psychological disturbances including depression, anxiety or even suicide attempts [3,4]. Clinically, obtaining the right information from patients suffering from tinnitus is crucial as its symptom may vary among individuals. To achieve this, the use of self-administered questionnaire is beneficial.

\* **Corresponding author:** Audiology Programme, School of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, 16150, Malaysia. Tel: 00609-7677691, E-mail: mdnorman@usm.my

Many types of self-administered tinnitus questionnaires have been developed for the past 25 years. Tinnitus Handicap Questionnaire (THQ), Tinnitus Reaction Questionnaire (TRQ) and Tinnitus Handicapped Inventory (THI) are examples of questionnaires that have been frequently cited in the literature and used commonly in tinnitus assessment [5-7]. They have been translated into different languages including French, Persian, Korean, Cantonese and many more [8-11].

These tools, however, are not without issues. The THQ has 27 items that are categorized under three factors. Its internal consistency is excellent [5] and test-retest reliability is good [12] but the scores range is broad (0 for “strongly disagree” to 100 for “strongly agree”). While this allows for more precise responses, it may pose difficulties to certain respondents in giving the “right” information [13]. On the other hand, the 26-item TRQ utilizes a 5-point scale (0-4 with 0 indicates “not at all” and 4 indicates “almost all of the time”), which is easier to score by the respondents. Notwithstanding, while the psychometric properties of TRQ are robust [6], it only focuses on the psychological distress related to tinnitus [7]. Moreover, the severity of tinnitus is not categorized [14]. The THI that consists of 25 items (categorized under three subscales) has been proven to be psychometrically strong. Its validity and reliability are excellent [7,9,14]. Nevertheless, different from TRQ, it employs a 3-point response category (“yes”, “sometimes” and “no”). In this regard, even though questionnaires with low response options (4-point and below) are simpler and faster to administer, they have been reported to be less valid, less reliable and less accurate than questionnaires with higher response categories [15,16]. Furthermore, unlike TRQ, item concerning “suicidal thinking” is not included in THI. This item is clinically important as it represents the catastrophic effect of tinnitus and an immediate referral to other professional (i.e. psychiatrist) might be required.

By considering these issues, there is a need to develop an alternative clinical questionnaire for tinnitus. This questionnaire should be valid,

reliable, fast and easy to administer. Validity is simply defined as the ability of a tool to measure what it claims to measure. On the other hand, a questionnaire is also considered to be reliable if its items are constructed consistently (e.g. good internal consistency). The present study aimed to develop and validate a new tinnitus questionnaire for clinical use. Since the tested subjects were Malaysians, a Malay version of the questionnaire was developed and tested in the present study.

## Methods

The current validation study had two consecutive phases. Phase 1 of the study was about developing the content of the questionnaire. In phase 2, the newly developed questionnaire was tested for its validity and reliability. Prior to the data collection, informed consent was obtained from all individual participants included in the study.

### *Phase 1*

The questionnaire to be developed was named Tinnitus Evaluation Questionnaire or Borang Evaluasi Soal selidik Tinitus (BEST) in Malay version. The items for BEST were initially constructed in English based on the current literatures on tinnitus and the available clinical questionnaires for tinnitus. The cultural factors were taken into account while selecting the items so that the items would be culturally appropriate. Six individuals (3 otorhinolarygologists, 2 audiologists and 1 undergraduate student) aged 23-43 years (3 males and 3 females) were involved in this process. After comprehensive meetings and discussions, the items of BEST were finalized. Based on the consensus, 25 selected items with three specific domains were included. At this stage, the first draft of BEST (English version) was ready for subsequent tasks.

The English version of BEST questionnaire was then translated into Malay version by two language experts from School of Languages, Literacies and Translation, Universiti Sains Malaysia (USM). The translation process was carried in such a way that the questionnaire would be free of jargon, clearly and simply stated, and

within the realm of respondents' abilities. Following this, a backward translation (Malay into English) task was performed by other three independent experts from the same school. After that, the two English versions of BEST were compared for item analyses. It was then found that the two versions of BEST showed high similarities in terms of content and meaning but with some differences in language use. Consequently, minor amendments were made on both English and Malay versions of BEST based on the recommendations by the experts. The refined version of BEST questionnaire was then complete and ready for subsequent validation tasks.

The refined English version of BEST is shown in Appendix 1 (front page of BEST) and Appendix 2 (back page of BEST). The Malay version of BEST is revealed in Appendices 3 and 4. The front page of BEST is composed of 25 items categorized under "3M" domains (mind, main and mental). This is the vital part of BEST and to be self-reported by the respondents. As revealed, the mind domain (Part A) consists of 7 items (1-7) and deals with the emotional impacts of tinnitus. The main domain (Part B) is comprised of 14 items (8-21) covering the effects of tinnitus on the main daily life activities. The mental domain (Part C) has 4 items (22-25) and deals with the extreme consequences of tinnitus. As shown, a 5-point response scale (0-4) is utilized in the BEST questionnaire (0 indicates "never", 1 indicates "rarely", 2 indicates "sometimes", 3 indicates "most of the time" and 4 indicates "all of the time"). The score for each domain is expressed in percentage. This is achieved by dividing the raw score by the maximum score for each domain (i.e. 28, 56 and 16 for mind, main and mental domains, respectively). By summing the raw scores from all the domains, the composite score is generated (also in percentage).

In addition, as an effort to guide clinicians in managing important information regarding tinnitus in busy clinics, specific items were constructed under "For Clinic Use" section on the back page of BEST (Appendices 2 and 4). As revealed, in the history taking part, relevant

items covering the important aspects of tinnitus are provided (e.g. onset of tinnitus, tinnitus psychoacoustic profiles, medical history etc.). Conditions that commonly coexist with tinnitus such as misophonia, hyperacusis and phonophobia are also included. Furthermore, tinnitus audiometry results (e.g. pitch matching, loudness matching, minimum masking level and residual inhibition) can be documented by clinical professionals in a systematic manner.

### *Phase 2*

In this second phase of study, the validity and reliability of the newly developed BEST questionnaire were tested. Specifically, the validity of BEST was determined by means of content validity and construct (convergent and divergent) validity. The internal reliability of BEST was tested with item-total correlations, Cronbach's alpha, split-half reliability and correlation between domains.

For the content validity task, 7 clinical experts from different but relevant disciplines were invited. As an effort to determine the content validity of the BEST questionnaire quantitatively, content validity index (CVI) was measured. To achieve this, the clinical experts were instructed to state their opinion on the relevancy of each item of BEST by choosing one of the following options: 1 for "not relevant", 2 for "somewhat relevant", 3 for "quite relevant" or 4 for "highly relevant". Both item-level CVI (I-CVI) and scale-level CVI (S-CVI) were determined in this task.

In the subsequent tasks, 65 Malay adults with complaint of tinnitus were recruited. They were selected randomly among patients who visited otorhinolaryngology and audiology clinics within Hospital Universiti Sains Malaysia (HUSM). All of them reported of having tinnitus (at least in one ear) and had no dizziness, neurological and psychiatric disturbances. Prior to BEST administration, they underwent routine audiological tests (otoscopy, tympanometry and pure tone audiometry) and tinnitus audiometry in a soundproof room within the audiology clinic, HUSM. For tinnitus audiometry, three psychoacoustic measurements were performed on

each participant: pitch matching, loudness matching and minimum masking level (MML). These measurements were carried out according to the established procedures [17] using a clinical audiometer (Madsen Itera II by GN Otometrics, Denmark) with TDH-39 headphone.

After completing the required audiological tests, the BEST questionnaire was administered to each participant. A short briefing was given to them on how to answer the questionnaire. They were advised to give honest answer for each question. For each participant, the time allocated for completing the questionnaire was about 15 minutes. The second part of BEST ("For Clinic Use") was completed by the researchers where relevant information related to tinnitus was documented.

For measuring the convergent validity of BEST, participants were instructed to fill in the Malay version of Depression Anxiety Stress Scales-21 (BM DASS-21). The original English version of DASS has 42 items [18] and the later version (DASS-21) is comprised of 21 items [19]. The 21-item DASS was reported to be as good as the original version [19]. By administering DASS, the three negative emotional states (depression, anxiety and stress) can be quantified at the same time [20]. Moreover, the DASS is free of cultural and religious differences making it suitable to be used in clinical and non-clinical samples [20-22]. The psychometric properties of DASS are also good. Its internal consistency and temporal stability were reported to be excellent [22]. Similarly, the BM DASS-21 had also been tested for its validity and reliability [20] and was considered suitable to be included in the present study. Each scale of BM DASS-21 consists of 7 items and the participants indicated their responses on a 4-point response category (0 for "never", 1 for "sometimes", 2 for "often" and 3 for "almost always").

#### *Data analysis*

Both descriptive and inferential statistics were used for data analyses. Percentage, mean, standard deviation (SD) and 95% confidence interval (CI) values were computed as applicable. For the content validity task, I-CVI and S-CVI

were calculated based on the methods described by Lynn [23]. For each of BEST items, the I-CVI was measured by dividing the number of experts who rated 3 or 4 (on the 4-point relevance scale) by the total number of experts. The S-CVI was determined by averaging all 25 I-CVI values. Prior to the use of inferential statistics, Kolmogorov-Smirnov test was used to check for the data normality. Since the data were found to be normally distributed, parametric analyses were then carried out. In the reliability analysis, Pearson product-moment correlation method was used to determine the item-total correlations and correlations between domains. For determining the internal consistency of BEST questionnaire, Cronbach's alpha and Guttman split-half reliability (with Spearman Brown correction) coefficients were measured. The Pearson correlation analysis was also utilized to determine the correlation between BEST and BM DASS-21 (convergent validity), as well as between BEST and tinnitus audiometric measurements (divergent validity). The p values of less than 0.05 were considered statistically significant. All data analyses were carried out with the Social Statistical Package for the Social Sciences (SPSS) software version 20 (SPSS Inc., Chicago, IL).

#### **Results**

Recall that in the content validity task, 7 clinical professionals (2 otorhinolaryngologists, 3 audiologists, 1 psychiatrist and 1 psychologist) aged 34-51 years (3 males and 4 females) participated. In this task, the I-CVI values for BEST items were found to be high and ranged from 0.71 to 1.00. Of 25 items in the BEST questionnaire, 21 of them (84%) revealed I-CVI of more than 0.80. The lowest I-CVI (0.71) was found for items 9, 11, 13, and 19. The S-CVI (or S-CVI/Ave) that provides a general measure of content validity of BEST questionnaire was found to be excellent (0.91).

In the next task, 65 Malay subjects aged 23-75 years (mean=52.1 years, SD=12.0 years, 33 females and 32 males) participated. The majority of them reported continuous type of tinnitus (92%) and the duration of tinnitus ranged from

**Table 1. Mean (standard deviation) and range of Malay version of BM Depression Anxiety Stress Scales -21 and tinnitus audiometric results (n=65)**

| Measurement                | Mean (SD)   | Range   |
|----------------------------|-------------|---------|
| <b>BM DASS-21</b>          |             |         |
| Depression                 | 3.0 (3.9)   | 0-18    |
| Anxiety                    | 4.0 (3.4)   | 0-13    |
| Stress                     | 4.5 (4.1)   | 0-17    |
| Total                      | 11.4 (10.6) | 0-48    |
| <b>Tinnitus audiometry</b> |             |         |
| Pitch (kHz)                | 4.3 (3.0)   | 0.25-12 |
| Loudness (dBSL)            | 9.5 (9.8)   | 0-36    |
| MML (dBSL)                 | 23.5 (13.9) | 0-60    |

0.25 to 19 years (mean=3.7 years, SD=4.7 years). Most of them reported a ringing type of tinnitus (52%), followed by hissing (30%), mixed (12%), pulsatile (4%) and humming (2%) sounds. Unilateral tinnitus was experienced by 86% of subjects and the remaining participants had bilateral tinnitus (14%). Across speech frequencies, hearing levels ranged from -5 to 90 dBHL and 0 to 100 dBHL for right and left ears, respectively. In the right ear, the mean hearing level for four-frequency average (0.5, 1, 2 and 4 kHz) was 24.5 (SD=11.5) dBHL. Whereas in the left ear, the respective mean hearing level

**Table 2. Mean (standard deviation), 95% confidence interval (CI) and range of BEST scores for each domain (n=65)**

| BEST domain   | Mean (SD)   | 95% CI    | Range |
|---------------|-------------|-----------|-------|
| Mind (%)      | 30.3 (22.6) | 24.8-35.8 | 0-100 |
| Main (%)      | 21.8 (19.1) | 17.2-26.5 | 0-80  |
| Mental (%)    | 16.8 (14.8) | 13.2-20.4 | 0-56  |
| Composite (%) | 23.4 (17.7) | 19.1-27.7 | 0-80  |

was 28.2 (SD=15.6) dBHL. The results for tinnitus audiometry and BM DASS-21 are revealed in Table 1.

Table 2 reveals the mean, SD, 95% CI and range of BEST score for each domain. Descriptively, the mind domain showed the highest score (mean=30.3%, SD=22.6%), while the lowest score was noted in the mental domain (mean=16.8%, SD=14.8%). Pearson correlation analyses revealed no significant association between age and the composite score (r=-0.20, p=0.381), mind (r=-0.29, p=0.192), main (r=-0.11, p=0.634) and mental (r=-0.28, p=0.207) domains. When the BEST outcomes were compared between males and females, independent t-test revealed insignificant statistical results (p>0.05).

Table 3 shows the endorsement rates for each of BEST items (for the ease of reporting, the items are presented in English version). As shown, for the mind domain (items 1-7), endorsement rates for a “never” response ranged from 15% to 71%; for a “rarely” response, 9% to 26%; for a “sometimes” response, 14% to 43%; for a “most of the time” response, 5% to 15% and for a “all the time” response, 2% to 15%. As for the main domain (items 8-21), the endorsement rates for a “never” response ranged from 35% to 72%; for a “rarely” response, 9% to 23%; for a “sometimes” response, 11% to 35%; for a “most of the time” response, 0% to 17% and for a “all the time” response, 0% to 9%. The mental domain (items 22-25) produced the highest endorsement rates. Specifically, the endorsement rates for a “never” response ranged from 23% to 94%; for a “rarely” response, 5% to 28%; for a “sometimes” response, 2% to 40%; for a “most of the time” response, 0% to 9% and for a “all the time” response, 0% to 8%.

As revealed in Table 4, the item-total correlation values for the BEST questionnaire ranged from 0.22 to 0.84. The Cronbach’s alpha values were 0.91, 0.92 and 0.62 for mind, main and mental domains, respectively. Further reliability analyses revealed that the internal consistency of BEST questionnaire was excellent (0.95 for the overall Cronbach’s alpha and 0.92 for the Guttman split-half reliability). In terms of

**Table 3. Endorsement rates (%) for each item of BEST questionnaire (n=65)**

| Item   | Endorsement rates (%) |            |               |                      |                  |
|--|-----------------------|------------|---------------|----------------------|------------------|
|  | Never (0)             | Rarely (1) | Sometimes (2) | Most of the time (3) | All the time (4) |
| <b>My tinnitus has:</b>  |                       |            |               |                      |                  |
| <b>1. Interfered with my daily routine.</b>  | 18                    | 22         | 37            | 9                    | 14               |
| <b>2. Made me unhappy.</b>   | 15                    | 18         | 43            | 15                   | 8                |
| <b>3. Caused me difficulty to concentrate.</b>   | 32                    | 26         | 32            | 6                    | 3                |
| <b>4. Made me depressed.</b>   | 34                    | 18         | 31            | 9                    | 8                |
| <b>5. Made me hot-tempered.</b>  | 49                    | 14         | 34            | 2                    | 2                |
| <b>6. Made me feel disappointed.</b>   | 54                    | 17         | 18            | 9                    | 2                |
| <b>7. Made me feel hopeless.</b>   | 71                    | 9          | 14            | 5                    | 2                |
| <b>8. Made me difficult to relax.</b>  | 45                    | 20         | 25            | 9                    | 2                |
| <b>9. Caused me to lose my appetite.</b>   | 72                    | 15         | 11            | 2                    | 0                |
| <b>10. Made me difficult to sleep.</b>   | 35                    | 17         | 35            | 9                    | 3                |
| <b>11. Interfered with my enjoyment of watching TV/listening to radio.</b>                           | 49                    | 17         | 22            | 9                    | 3                |
| <b>12. Interfered with my oral communication over the phone.</b>                                     | 46                    | 17         | 23            | 8                    | 6                |
| <b>13. Interfered with my ability to drive/ride motorcycle.</b>                                      | 69                    | 14         | 15            | 0                    | 2                |
| <b>14. Interfered with my religious activities.</b>  | 62                    | 22         | 12            | 3                    | 2                |
| <b>15. Interfered with my household responsibilities.</b>  | 60                    | 23         | 15            | 0                    | 2                |
| <b>16. Interfered with my job/study.</b>   | 60                    | 18         | 17            | 3                    | 2                |
| <b>17. Made me feel uncomfortable in my communication with others.</b>                               | 37                    | 22         | 26            | 12                   | 3                |
| <b>18. Interfered with my social activities such as attending ceremony, going for a picnic, etc.</b> | 65                    | 9          | 14            | 8                    | 5                |
| <b>19. Interfered with my outdoor activities such as exercising.</b>                                 | 69                    | 14         | 14            | 3                    | 0                |
| <b>20. Led me to avoid quiet situations.</b>   | 49                    | 14         | 14            | 17                   | 6                |
| <b>21. Led me to avoid noisy situations.</b>   | 43                    | 18         | 14            | 15                   | 9                |
| <b>22. Made me feel that I have physical health problems.</b>  | 57                    | 9          | 17            | 9                    | 8                |
| <b>23. Caused me headache/dizziness.</b>   | 23                    | 28         | 40            | 9                    | 0                |
| <b>24. Made me think that I am mentally ill.</b>   | 85                    | 8          | 6             | 2                    | 0                |
| <b>25. Led me to think of committing suicide.</b>  | 94                    | 5          | 2             | 0                    | 0                |

interdomain analysis, significant correlations were found between the domains of BEST ( $p < 0.05$ ) (Table 5). The highest correlation was found between the main domain and the

composite score ( $r = 0.96$ ). On the other hand, the lowest correlation was noted between the main domain and the mental domain ( $r = 0.62$ ). For measuring the construct validity of BEST

**Table 4. Item-total correlation and Cronbach’s alpha values for each of BEST domains (n=65)**

| <b>BEST</b>   |             |                               |                         |  |
|---------------|-------------|-------------------------------|-------------------------|--|
| <b>Domain</b> | <b>Item</b> | <b>Item-total correlation</b> | <b>Cronbach’s alpha</b> | <b>Cronbach’s alpha if item is deleted</b> |
| <b>Mind</b>   | 1           | 0.66                          | 0.91                    | 0.91                                       |
|               | 2           | 0.65                          |                         | 0.90                                       |
|               | 3           | 0.84                          |                         | 0.89                                       |
|               | 4           | 0.80                          |                         | 0.88                                       |
|               | 5           | 0.68                          |                         | 0.90                                       |
|               | 6           | 0.69                          |                         | 0.89                                       |
|               | 7           | 0.79                          |                         | 0.89                                       |
| <b>Main</b>   | 8           | 0.66                          | 0.92                    | 0.92                                       |
|               | 9           | 0.53                          |                         | 0.92                                       |
|               | 10          | 0.59                          |                         | 0.92                                       |
|               | 11          | 0.65                          |                         | 0.91                                       |
|               | 12          | 0.64                          |                         | 0.91                                       |
|               | 13          | 0.51                          |                         | 0.92                                       |
|               | 14          | 0.72                          |                         | 0.91                                       |
|               | 15          | 0.68                          |                         | 0.91                                       |
|               | 16          | 0.75                          |                         | 0.91                                       |
|               | 17          | 0.81                          |                         | 0.91                                       |
|               | 18          | 0.83                          |                         | 0.91                                       |
|               | 19          | 0.71                          |                         | 0.91                                       |
|               | 20          | 0.72                          |                         | 0.92                                       |
|               | 21          | 0.66                          |                         | 0.92                                       |
| <b>Mental</b> | 22          | 0.63                          | 0.62                    | 0.57                                       |
|               | 23          | 0.57                          |                         | 0.54                                       |
|               | 24          | 0.44                          |                         | 0.45                                       |
|               | 25          | 0.22                          |                         | 0.63                                       |

**Table 5. Pearson correlation coefficient (r) values when domains of BEST are compared (n=65)**

|           | Mind | Main  | Mental | Composite |
|-----------|------|-------|--------|-----------|
| Mind      | 1.00 | 0.77* | 0.66*  | 0.91*     |
| Main      |      | 1.00  | 0.62*  | 0.96*     |
| Mental    |      |       | 1.00   | 0.74*     |
| Composite |      |       |        | 1.00      |

\*Statistically significant at  $p < 0.05$

questionnaire, the convergent validity and divergent validity of BEST were determined. As shown in Table 6, significant correlations were found between BEST domains and BM DASS-21 scales ( $r=0.53-0.82$ ,  $p < 0.05$ ) implying good convergent validity of BEST. When the BEST outcomes were compared with tinnitus audiometric results, most of the analyses revealed no significant correlations between them ( $p > 0.05$ ). This indicates that the BEST questionnaire has good divergent validity.

### Discussion

In the present study, the new tinnitus questionnaire (BEST) was developed and constructed in such a way that it would cover the relevant and important aspects related to tinnitus. The BEST questionnaire utilized a 5-point response category for each item. For measuring human performance with questionnaires, 5-point and 7-point Likert scales are commonly used [24]. As mentioned earlier, scales with response categories of less than 5-point might be less accurate than the ones with higher response options. On the other hand, questionnaires with more response categories (7-point and higher), while are more accurate and reliable than those with less response options, might give rise to more confusions and prolonged response time [16]. In this regard, the 5-point scale was considered optimum for the BEST questionnaire.

In general, a particular questionnaire is considered to have acceptable content validity if the I-CVI is more than or equal to 0.70 [23]. In the

content validity task where 6 to 10 experts are involved, the questionnaire is said to have excellent content validity if the I-CVI and S-CVI are at least 0.78 and 0.90, respectively [25]. In the present study (with 7 experts), the majority of BEST items revealed I-CVI of more than 0.80 and the S-CVI was 0.91. This indicates that the BEST questionnaire has excellent content validity. Even though the remaining four items revealed lower I-CVI (0.71), this value is still within the acceptable range. This further implies that all items included in the BEST questionnaire are relevant for clinical use.

When the BEST questionnaire was administered to participants with tinnitus, the mean score was the highest in the mind domain, while the mental domain revealed the lowest mean score. These findings are in accordance with the previous studies on THI where higher scores were observed in the emotional subscale than in the catastrophic subscale [7-9,11]. Furthermore, the BEST questionnaire was not influenced by age and gender, which is also in line with the published studies on tinnitus questionnaires [7,9].

The endorsement rates were acceptable for the majority of BEST items except for items 24 ("My tinnitus has made me think that I am mentally ill") and 25 ("My tinnitus has led me to think of committing suicide"). As revealed in Table 3, the endorsement rates were 85% and 94% for items 24 and 25, respectively. Items with high endorsement rates ( $>80\%$ ) for one of the response options should be discarded as they are insensitive and unlikely to be discriminatory [7,26]. Nevertheless, in the present study, these items are retained as they are clinically important and represent the extreme effects of tinnitus.

In the reliability analysis, the lowest item-total correlation (0.22) was found for item 25. Again, this item is retained in the BEST questionnaire due to its clinical importance. In fact, this value is within the acceptable range as items with item-total correlation of more than 0.20 are considered appropriate and should be retained [26]. In general, to achieve acceptable internal consistency, the Cronbach's alpha of a particular questionnaire should be more than 0.70 [27]. In the

**Table 6. Convergent validity and divergent validity of BEST questionnaire when compared with BM Malay version of Depression Anxiety Stress Scales -21 and tinnitus audiometry (n=65)**

| BEST      | BM DASS-21 |         |        |       | Tinnitus audiometry |          |       |
|-----------|------------|---------|--------|-------|---------------------|----------|-------|
|           | Depression | Anxiety | Stress | Total | Pitch               | Loudness | MML   |
| Mind      | 0.74*      | 0.60*   | 0.73*  | 0.75* | -0.27               | 0.39*    | 0.09  |
| Main      | 0.74*      | 0.69*   | 0.75*  | 0.78* | -0.32*              | 0.28     | -0.06 |
| Mental    | 0.61*      | 0.58*   | 0.53*  | 0.62* | -0.16               | 0.08     | 0.04  |
| Composite | 0.79*      | 0.71*   | 0.78*  | 0.82* | -0.31*              | 0.32*    | 0.00  |

MML; minimum masking level, \*Statistically significant at  $p < 0.05$

present study, the overall Cronbach’s alpha and split-half reliability values were high ( $\alpha > 0.90$ ) implying that the BEST questionnaire has excellent internal consistency. The Cronbach’s alpha values were also high in the mind and main domains of BEST. The low alpha in the mental domain ( $\alpha = 0.62$ ) is perhaps due the small number of items in this particular domain (only four items). Previous studies on THI also revealed low Cronbach’s alpha values in the catastrophic subscale that consists of only five items ( $\alpha = 0.49-0.68$ ) [7,8,11]. The number of items has a pronounced effect on the Cronbach’s alpha: as the number of items in the questionnaire decreases, the Cronbach’s alpha decreases [27]. In fact, an alpha value of 0.50 might be considered sufficient for questionnaires with three items [27]. Therefore, the Cronbach’s alpha of 0.62 in the four-item mental domain revealed in the present study was considered appropriate indicating acceptable internal consistency.

The internal reliability of the BEST questionnaire was further demonstrated to be adequate as significant correlations were found between the domains ( $p < 0.05$ ). These findings are in line with the previous studies on THI [7,8]. Moreover, the study of Newman et al. [7] also revealed the lowest correlation between the functional and the catastrophic domains of THI ( $r = 0.65, p < 0.05$ ).

The construct validity of an assessment tool can be assessed by measuring its convergent validity and divergent validity. A newly developed tool

is said to have good convergent validity if it correlates well with another previously validated tool that measures the same construct [24]. In the present study, significant correlations were found between the BEST domains and the BM DASS-21 scales indicating that the BEST questionnaire has good convergent validity. Since psychological symptoms are common in patients with tinnitus [1,2], correlating the BEST questionnaire with the BM DASS-21 was considered appropriate. Significant correlations between tinnitus questionnaires and psychological measures were also revealed in the previous studies [7,9-11].

If a low correlation is found between two different tools that measure different constructs, the tool of interest is said to have good divergent validity [24]. For assessing the divergent validity of the BEST questionnaire, the correlations between the BEST domains and the tinnitus audiometric results (minimum masking level, tinnitus pitch and loudness) were determined. As expected, most of the results revealed insignificant correlations between them indicating good divergent validity of BEST questionnaire. In line with this, many studies have failed to demonstrate the relation between tinnitus questionnaires and tinnitus psychoacoustic measurements implying that these assessment tools measure different aspects of tinnitus [5,7,10]. It is worth noting that even though significant correlations were found in four conditions (“mind vs. loudness”, “main vs. pitch”, “composite vs.

pitch” and “composite vs. loudness”), the correlation coefficient values were low (<0.40) indicating weak correlations between the items.

The present study, nevertheless, is not without limitations. Since the number of subjects recruited in the present was modest (n=65), factor analysis was not carried out to further determine the construct validity of the BEST questionnaire. In this regard, for optimum outcomes in the factor analysis, at least 100 participants are required [28]. Further large-scale studies are encouraged to look at this issue. Furthermore, the severity ranges of BEST questionnaire were not determined in the present study. This particular aspect of BEST should be the focus of future research.

### Conclusion

A newly developed tinnitus questionnaire, known as BEST, has been validated accordingly using a series of validity and reliability analyses. It is now valid and reliable to be used clinically, at least among Malay-speaking population. By administering the BEST questionnaire, patients’ subjective perceptions on tinnitus in important domains can be conveniently documented. That is, the effect of tinnitus on their daily activities can be determined and consequently, appropriate clinical management can be suggested. Nevertheless, future studies are welcome to further support the findings obtained from the present study.

### Acknowledgements

This work was supported by Incentive Grant (I0874), Universiti Sains Malaysia.

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**Appendix 1**The front page of *BEST* questionnaire (English version)**Tinnitus Handicap Questionnaire (BEST)**

Name: \_\_\_\_\_ ID Number: \_\_\_\_\_ Date: \_\_\_\_\_

Gender: M / F Age: \_\_\_\_\_ Race: \_\_\_\_\_ Occupation: \_\_\_\_\_

This questionnaire is designed for patients with tinnitus to help identify the severity of tinnitus on their daily life activities. If you have episode of tinnitus, please answer all the questions by **circling the number** that best reflects the effect of tinnitus on your daily life activities.

| My tinnitus has:  | Never       | Rarely | Sometimes          | Most of the time | All the time |
|---|-------------|--------|--------------------|------------------|--------------|
| 1. Interfered with my daily routine.  | 0           | 1      | 2                  | 3                | 4            |
| 2. Made me unhappy.   | 0           | 1      | 2                  | 3                | 4            |
| 3. Caused me difficulty to concentrate.   | 0           | 1      | 2                  | 3                | 4            |
| 4. Made me depressed.   | 0           | 1      | 2                  | 3                | 4            |
| 5. Made me hot-tempered.  | 0           | 1      | 2                  | 3                | 4            |
| 6. Made me feel disappointed.   | 0           | 1      | 2                  | 3                | 4            |
| 7. Made me feel hopeless.   | 0           | 1      | 2                  | 3                | 4            |
| <b>Score A:</b>   | <b>/28</b>  |        | <b>Percentage:</b> |                  | <b>%</b>     |
| 8. Made me difficult to relax.  | 0           | 1      | 2                  | 3                | 4            |
| 9. Caused me to lose my appetite.   | 0           | 1      | 2                  | 3                | 4            |
| 10. Made me difficult to sleep.   | 0           | 1      | 2                  | 3                | 4            |
| 11. Interfered with my enjoyment of watching TV / listening to radio.                         | 0           | 1      | 2                  | 3                | 4            |
| 12. Interfered with my oral communication over the phone.                                     | 0           | 1      | 2                  | 3                | 4            |
| 13. Interfered with my ability to drive / ride motorcycle.                                    | 0           | 1      | 2                  | 3                | 4            |
| 14. Interfered with my religious activities.  | 0           | 1      | 2                  | 3                | 4            |
| 15. Interfered with my household responsibilities.  | 0           | 1      | 2                  | 3                | 4            |
| 16. Interfered with my job / study.   | 0           | 1      | 2                  | 3                | 4            |
| 17. Made me feel uncomfortable in my communication with others.                               | 0           | 1      | 2                  | 3                | 4            |
| 18. Interfered with my social activities such as attending ceremony, going for a picnic, etc. | 0           | 1      | 2                  | 3                | 4            |
| 19. Interfered with my outdoor activities such as exercising.                                 | 0           | 1      | 2                  | 3                | 4            |
| 20. Led me to avoid quiet situations.   | 0           | 1      | 2                  | 3                | 4            |
| 21. Led me to avoid noisy situations.   | 0           | 1      | 2                  | 3                | 4            |
| <b>Score B:</b>   | <b>/56</b>  |        | <b>Percentage:</b> |                  | <b>%</b>     |
| 22. Made me feel that I have physical health problems.  | 0           | 1      | 2                  | 3                | 4            |
| 23. Caused me headache / dizziness.   | 0           | 1      | 2                  | 3                | 4            |
| 24. Made me think that I am mentally ill.   | 0           | 1      | 2                  | 3                | 4            |
| 25. Led me to think of committing suicide.  | 0           | 1      | 2                  | 3                | 4            |
| <b>Score C:</b>   | <b>/16</b>  |        | <b>Percentage:</b> |                  | <b>%</b>     |
| <b>Composite Score:</b>   | <b>/100</b> |        |                    |                  |              |

**Appendix 2**

The back page of *BEST* questionnaire (English version)

**For Clinic Use**

**Tinnitus History:**

1. The onset of tinnitus: \_\_\_\_\_
2. Are you still experiencing tinnitus recently? Yes ( ) No ( )
3. Tinnitus (at present): Constant ( ) Better ( ) Worse ( )  
If better or worse, please specify: \_\_\_\_\_
4. Frequency of tinnitus: Rarely ( ) Sometimes ( ) Most of the time ( ) All the time ( )
5. Side of tinnitus: Right ( ) Left ( ) Both sides ( )  
Which side is worse? Right ( ) Left ( )
6. Type of tinnitus: Tonal ( ) Noise ( ) Pulsatile ( ) Other ( )  
Please specify: \_\_\_\_\_
7. Pitch of tinnitus: Low ( ) Medium ( ) High ( ) Multiple ( )  
Constant ( ) Varied ( ) If varied, please specify \_\_\_\_\_
8. Loudness of tinnitus: Soft ( ) Medium ( ) Loud ( )  
Constant ( ) Varied ( ) If varied, please specify \_\_\_\_\_
9. Tinnitus triggering factor(s): \_\_\_\_\_
10. Tinnitus modifying factor(s): \_\_\_\_\_
11. Hearing loss: None ( ) Right ( ) Left ( ) Both sides ( )
12. Hearing aid use: None ( ) Right ( ) Left ( ) Both sides ( )
13. Other relevant history: \_\_\_\_\_  
\_\_\_\_\_
14. Misophonia: Yes ( ) No ( ) If yes, please specify: \_\_\_\_\_
15. Hyperacusis: Yes ( ) No ( ) If yes, please specify: \_\_\_\_\_
16. Phonophobia: Yes ( ) No ( ) If yes, please specify: \_\_\_\_\_
17. Previous tinnitus treatment: Yes ( ) No ( ) If yes, please specify: \_\_\_\_\_

**Tinnitus Audiometry**

1. Type of hearing loss: None ( ) Conductive ( ) Sensorineural ( ) Mixed ( )
2. Degree of hearing loss: \_\_\_\_\_
3. Configuration of hearing loss: \_\_\_\_\_
4. Pitch matching: Right \_\_\_\_\_ Hz Left \_\_\_\_\_ Hz Right
5. Loudness matching: Right \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL Left \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL
6. Hearing threshold: Broadband noise: Right \_\_\_\_\_ dBHL Left \_\_\_\_\_ dBHL  
Narrow band noise: Right \_\_\_\_\_ Hz \_\_\_\_\_ dBHL Left \_\_\_\_\_ Hz \_\_\_\_\_ dBHL
7. Minimum masking level: Right \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL Left \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL
8. Residual inhibition: Full ( ) Partial ( ) None ( ) If present, please state the duration: \_\_\_\_\_ seconds

### Appendix 3

The front page of *BEST* questionnaire (Malay version)

#### Borang Evaluasi Soal selidik Tinitus (BEST)

Nama: \_\_\_\_\_ No. IC: \_\_\_\_\_ Tarikh: \_\_\_\_\_

Jantina: L / P Umur: \_\_\_\_\_ Bangsa: \_\_\_\_\_ Pekerjaan: \_\_\_\_\_

Borang soal selidik ini bertujuan untuk mengetahui tahap keterukan bunyi tinitus terhadap kehidupan seharian manusia. Sila jawab soalan berikut dengan **membulatkan nombor** yang paling sesuai untuk menggambarkan kesan bunyi tinitus terhadap kehidupan seharian anda.

| Tinitus menyebabkan:  | Tiada       | Jarang | Kadang-kala       | Kebanyakan masa | Sepanjang masa |
|---|-------------|--------|-------------------|-----------------|----------------|
| 1. Kehidupan seharian saya terganggu.   | 0           | 1      | 2                 | 3               | 4              |
| 2. Saya berasa tidak gembira.   | 0           | 1      | 2                 | 3               | 4              |
| 3. Saya sukar untuk memberi tumpuan.  | 0           | 1      | 2                 | 3               | 4              |
| 4. Saya berasa tertekan.  | 0           | 1      | 2                 | 3               | 4              |
| 5. Saya cepat marah.  | 0           | 1      | 2                 | 3               | 4              |
| 6. Saya berasa kecewa.  | 0           | 1      | 2                 | 3               | 4              |
| 7. Saya berasa putus asa.   | 0           | 1      | 2                 | 3               | 4              |
| <b>Skor A:</b>  | /28         |        | <b>Peratusan:</b> |                 | %              |
| 8. Saya sukar untuk berehat.  | 0           | 1      | 2                 | 3               | 4              |
| 9. Saya hilang selera makan.  | 0           | 1      | 2                 | 3               | 4              |
| 10. Saya sukar untuk tidur.   | 0           | 1      | 2                 | 3               | 4              |
| 11. Keseronokan saya menonton tv / mendengar radio terganggu.   | 0           | 1      | 2                 | 3               | 4              |
| 12. Komunikasi lisan saya melalui telefon terganggu.  | 0           | 1      | 2                 | 3               | 4              |
| 13. Keupayaan saya memandu kereta / menunggang motosikal terganggu.                                       | 0           | 1      | 2                 | 3               | 4              |
| 14. Aktiviti keagamaan saya terganggu.  | 0           | 1      | 2                 | 3               | 4              |
| 15. Tanggungjawab saya melakukankerja rumah terganggu.  | 0           | 1      | 2                 | 3               | 4              |
| 16. Prestasi kerja / pembelajaran saya terganggu.   | 0           | 1      | 2                 | 3               | 4              |
| 17. Saya berasa tidak selesa berkomunikasi dengan orang lain.   | 0           | 1      | 2                 | 3               | 4              |
| 18. Penglibatan saya dalam aktiviti sosial seperti menghadiri majlis, perkelahan dan sebagainya terganggu | 0           | 1      | 2                 | 3               | 4              |
| 19. Penglibatan saya dalam aktiviti luaran seperti bersenam terganggu.                                    | 0           | 1      | 2                 | 3               | 4              |
| 20. Saya mengelakkan diri daripada situasi yang senyap.   | 0           | 1      | 2                 | 3               | 4              |
| 21. Saya mengelakkan diri daripada situasi yang bising.   | 0           | 1      | 2                 | 3               | 4              |
| <b>Skor B:</b>  | /56         |        | <b>Peratusan:</b> |                 | %              |
| 22. Saya fikir bahawa saya mempunyai masalah kesihatan fizikal.   | 0           | 1      | 2                 | 3               | 4              |
| 23. Saya sakit kepala / pening.   | 0           | 1      | 2                 | 3               | 4              |
| 24. Saya fikir bahawa saya mengalami sakit mental.  | 0           | 1      | 2                 | 3               | 4              |
| 25. Saya terfikir untuk membunuh diri.  | 0           | 1      | 2                 | 3               | 4              |
| <b>Skor C:</b>  | /16         |        | <b>Peratusan:</b> |                 | %              |
| <b>Skor Komposit:</b>   | <b>/100</b> |        |                   |                 |                |

**Appendix 4**The back page of *BEST* questionnaire (Malay version)**Untuk Kegunaan Klinik****Sejarah Tinitus**

18. Tinitus bermula: \_\_\_\_\_
19. Adakah anda masih mengalami masalah tinitus kebelakangan ini? Ya ( ) Tidak ( )
20. Masalah tinitus (ketika ini): Kekal Sama ( ) Semakin Baik ( ) Semakin Teruk ( )  
Jika semakin baik atau semakin teruk, sila nyatakan: \_\_\_\_\_
21. Kekerapan tinitus: Jarang-jarang ( ) Kadang-kadang ( ) Selalu ( ) Setiap masa ( )
22. Lokasi tinitus: Kanan ( ) Kiri ( ) Kedua-dua belah ( )  
Bahagian mana yang lebih teruk? Kanan ( ) Kiri ( )
23. Jenis tinitus: Bunyi nada ( ) Bunyi bising ( ) Bunyi denyutan ( ) Lain-lain ( )  
Sila nyatakan: \_\_\_\_\_
24. Kenyaringan tinitus: Rendah ( ) Sederhana ( ) Tinggi ( ) Pelbagai ( )  
Kekal Sama ( ) Berubah-ubah ( ) Jika berubah-ubah, sila nyatakan: \_\_\_\_\_
25. Kekuatan tinitus: Perlahan ( ) Sederhana ( ) Kuat ( )  
Kekal Sama ( ) Berubah-ubah ( ) Jika berubah-ubah, sila nyatakan: \_\_\_\_\_
26. Faktor penyebab tinitus: \_\_\_\_\_
27. Faktor mempengaruhi tinitus: \_\_\_\_\_
28. Masalah pendengaran: Tiada ( ) Kanan ( ) Kiri ( ) Kedua-dua belah ( )
29. Penggunaan alat bantu pendengaran: Tiada ( ) Kanan ( ) Kiri ( ) Kedua-dua belah ( )
30. Sejarah pesakit yang berkaitan : \_\_\_\_\_
- 
31. Masalah tidak suka pada bunyi (*misophonia*): Ya ( ) Tidak ( ) Jika ya, sila nyatakan: \_\_\_\_\_
32. Masalah bunyi kedengaran kuat (*hyperacusis*): Ya ( ) Tidak ( ) Jika ya, sila nyatakan: \_\_\_\_\_
33. Masalah fobia pada bunyi (*phonophobia*): Ya ( ) Tidak ( ) Jika ya, sila nyatakan: \_\_\_\_\_
34. Sejarah rawatan tinitus yang lalu: Ya ( ) Tidak ( ) Jika ya, sila nyatakan: \_\_\_\_\_

**Audiometri Tinitus**

9. Jenis masalah pendengaran: Tiada ( ) Konduktif ( ) Sensorineural ( ) Campuran ( )
10. Tahap masalah pendengaran: \_\_\_\_\_
11. Konfigurasi masalah pendengaran: \_\_\_\_\_
12. Kesepadanan tahap kenyaringan tinitus (*pitch matching*): Kanan \_\_\_\_\_ Hz Kiri \_\_\_\_\_ Hz
13. Kesepadanan tahap kekuatan tinitus (*loudness matching*): Kanan \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL Kiri \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL
14. Ambang pendengaran bunyi bising: Jenis lebar (*broadband*): Kanan \_\_\_\_\_ dBHL Kiri \_\_\_\_\_ dBHL  
Jenis sempit (*narrow band*): Kanan \_\_\_\_\_ Hz \_\_\_\_\_ dBHL Kiri \_\_\_\_\_ Hz \_\_\_\_\_ dBHL
15. Tahap penopengan minimum (*minimum masking level*): Kanan \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL Kiri \_\_\_\_\_ dBHL / \_\_\_\_\_ dBSL
- Sisa perencatan (*residual inhibition*): Penuh ( ) Separa ( ) Tiada ( ) Jika ada, sila nyatakan tempoh: \_\_\_\_\_ s