ORIGINAL ARTICLE

Translation and Cultural Adaptation of the Malay Version of the Noise Exposure Questionnaire (M-NEQ)

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Noise-induced hearing loss (NIHL); Noise Exposure Questionnaire (NEQ); Malay language adaptation; Cross-cultural translation; Questionnaire validation; Content validity; Face validity

ABSTRACT

Background: Noise-induced hearing loss (NIHL) remains a significant global health issue, yet self-assessment tools for individual noise exposure are limited in Malaysia. The Noise Exposure Questionnaire (NEQ), originally developed by Johnson et al., has been validated in multiple languages but has not been adapted for Malay speakers. This study aimed to translate, culturally adapt, and validate the Malay version of the NEQ (M-NEQ) for use among the Malaysian population.
Methods: A cross-sectional study was conducted involving forward–backward translation, expert review, and validation phases. Two independent forward and backward translations were harmonized through consensus meetings. Content validation was performed by eight expert audiologists using a four-point relevance scale, while face validation involved ten lay participants from diverse backgrounds assessing clarity and comprehensibility. Item-level and scale-level Content Validity Index (I-CVI and S-CVI/Ave) and Face Validation Index (I-FVI and S-FVI/Ave) were calculated.
Results: The I-CVI values ranged from 0.87 to 1.00, with an overall S-CVI/Ave of 0.98, indicating excellent content validity. Face validation yielded I-FVI scores between 0.90 and 1.00, and an S-FVI/Ave of 0.97, demonstrating high clarity and comprehensibility. Minor revisions were made to enhance linguistic precision and cultural relevance.
Conclusion: The Malay version of the NEQ (M-NEQ) was successfully adapted and validated, showing strong content and face validity. It represents a promising tool for assessing daily noise exposure in occupational and recreational settings among Malaysian adults. Further research is recommended to evaluate its reliability and construct validity in broader populations.

INTRODUCTION

Noise-induced hearing loss (NIHL) is a growing global health concern, resulting from both occupational and recreational sources of noise exposure. According to the World Health Organization (WHO, 2024), over 1.5 billion people worldwide are affected by hearing loss, with projections indicating that more than 700 million individuals may experience disabling hearing loss by 2050. NIHL alone impacts approximately 5% of the global population. To mitigate these risks, regulatory bodies such as the Occupational Safety and Health Administration (OSHA) 2019 recommend limiting daily noise exposure to an average of 85 decibels over an eight-hour workday.

While industrial environments are commonly associated with hearing loss, increasing evidence highlights the risks posed by everyday activities such as listening to music at high volumes through headphones, attending concerts, and exposure to urban noise from public transportation (Neitzel & Fligor, 2019; Osmanoğlu et al., 2024). These non-occupational sources contribute significantly to cumulative noise exposure, underscoring the need for accurate individual-level assessment tools to identify NIHL risk and support preventive strategies.

However, tracking personal noise exposure over time remains challenging due to the limited availability of reliable self-assessment instruments. In response to this gap, Johnson et al. (2017) developed the Noise Exposure Questionnaire (NEQ), a standardized tool designed to estimate annual noise exposure (ANE) from both occupational and recreational sources. The NEQ has been successfully adapted into several languages, including Mandarin (Han et al., 2022) and Portuguese (Oliveira et al., 2023), with studies consistently demonstrating its strong validity and reliability.

Given the effectiveness of the NEQ in diverse populations, this study aims to translate, culturally adapt, and validate a Malay-language version of the NEQ (M-NEQ) for use among Malay speakers in Malaysia. The adaptation seeks

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to ensure linguistic clarity, cultural relevance, and applicability to everyday noise experiences in both occupational and non-occupational contexts.

To date, no self-reported tools for evaluating daily noise exposure have been adapted specifically for the Malay-speaking population. Although Razali et al. (2022) developed and validated a combined noise and chemical exposure questionnaire for hospital workers in Malaysia, their instrument is tailored to occupational settings and includes chemical exposure components. In contrast, the present study focuses exclusively on noise exposure and is designed for broader use across the general population, addressing a critical gap in assessing environmental and lifestyle-related noise exposure in the Malaysian context.

MATERIALS AND METHODS

Study Design

This study employed a cross-sectional design, allowing data collection at a single point in time from diverse participant groups. This approach was appropriate for evaluating the quality, clarity, and relevance of the translated questionnaire without manipulating variables or tracking participants longitudinally (Wang & Cheng, 2020). The primary objective was to ensure that the Malay version of the Noise Exposure Questionnaire (M-NEQ) was linguistically accurate, culturally appropriate, and comprehensible to the target population.

Study Population and Sample Size

The translation of the M-NEQ followed a structured process involving two forward translators and two backward translators. The forward translators, both with audiology backgrounds, ensured accurate translation of technical terminology. In contrast, the backward translator, without an audiology background, provided an unbiased retranslation into the source language (Tsang et al., 2017). All translators were proficient in both Malay and English.

To ensure consistency, two audiology experts with experience in noise-induced hearing loss (NIHL) harmonized the forward translations. A harmonization meeting was conducted with the researcher, both audiology experts, and one representative from each translation team to review the translated items, resolve discrepancies, and ensure fidelity to the original questionnaire.

Content validation was conducted by eight audiologists, each with over five years of professional experience, including three with direct experience in NIHL. For face validation, ten participants from the target population were recruited, including dentists, occupational safety and health (OSH) personnel, engineering academics, and university students who reported daily use of personal listening devices at approximately 50% of maximum volume. All participants were proficient in both Malay and English.

Sampling Method

A purposive sampling strategy was employed to recruit individuals who met specific criteria relevant to the study. This method ensured the inclusion of participants with adequate language proficiency and domain knowledge for the translation and validation processes. It also facilitated the collection of meaningful and relevant feedback (Palinkas et al., 2015).

Instrumentation

This study involved the translation and validation of the Noise Exposure Questionnaire (NEQ), originally developed by Johnson et al. (2017) in English. The NEQ comprises 11 items designed to estimate individual exposure to hazardous noise from occupational and recreational sources. Items assess typical noise exposure behaviors, such as the use of power tools, attendance at loud events, and use of personal listening devices—factors contributing to NIHL.

Study Procedure

This study consisted of three main phases: (i) adaptation, (ii) translation, and (iii) validation, as illustrated in Figure 1.

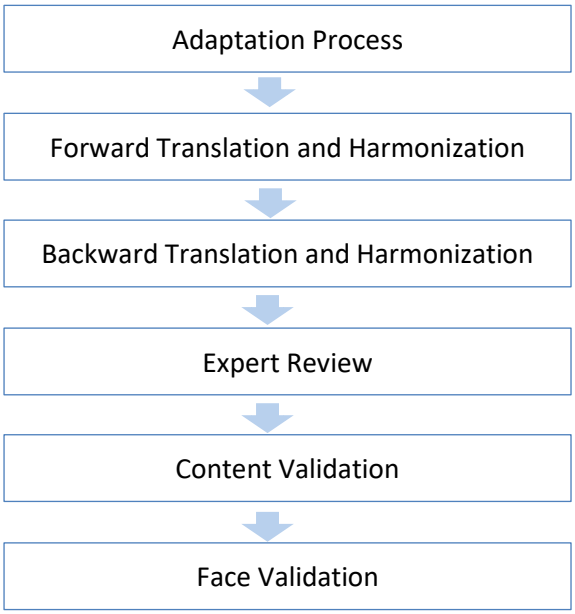

Figure 1: The study procedure flowchart

Adaptation Process

At the outset of the study, an adaptation process was undertaken to modify the original questionnaire to ensure cultural relevance and appropriateness for the Malaysian context. It involved omitting, rephrasing, and combining certain questionnaire items. The original Noise Exposure Questionnaire (NEQ) was systematically reviewed in consultation with the research supervisor. All modifications were mutually agreed upon during the review process. The final adapted version was compiled using Microsoft Excel in preparation for the subsequent translation phase.

Translation Process

The translation process was conducted in five stages: (i) forward translation, (ii) harmonization of the forward translations, (iii) backward translation, (iv) harmonization of the backward translations, and (v) expert review of both forward and backward translations to resolve discrepancies and ensure conceptual equivalence with the original version.

Forward Translation and Harmonization

The original Noise Exposure Questionnaire was independently translated into the Malay language by two forward translators. The NEQ was compiled into an Excel document and was distributed to the professional translators via email. Each translator submitted their respective versions via the researcher's email for review. To harmonize the translations, the researcher compared both versions and identified differences in word choices and phrasing. The most contextually appropriate terms were selected to ensure clarity and alignment with the original meaning. A series of discussions was subsequently held with the research supervisor to review the selected terms and resolve any uncertainties. Amendments were made based on mutual agreement. As a result, a harmonized Malay version of the forward translation was finalized for the next phase of the study.

Backward Translation and Harmonization

During this stage, the harmonized forward-translated questionnaire was independently translated back into English by two professional backward translators who were not from an audiology background and were unfamiliar with the original questionnaire. Similarly, the harmonized Malay questionnaire was compiled into an Excel document and emailed to the professional backward translators. Both translators submitted their translations via the researcher's email. The researcher compared both backward translations and identified variations in wording. The most contextually accurate and semantically equivalent terms were selected to ensure the meaning closely reflected that of the original English version. A series of discussions was subsequently held with the research supervisor to verify that the chosen wording accurately represented the intent of the original questionnaire. Amendments were made based on mutual agreement, and the harmonized backward-translated version was finalized for expert review.

Expert Committee Review

A final comparison between the original English version, harmonized forward-translated, harmonized backward-translated questionnaire was conducted during an online meeting with the expert panels. The purpose of this review was to identify and resolve any discrepancies between the original and translated versions to ensure conceptual and linguistic equivalence. Throughout this process, the expert panels discussed differences in wording and interpretation. Revisions, including the rephrasing of certain items and the addition of clarifying terms, were made where necessary to enhance accuracy, clarity, and cultural appropriateness. The review concluded when a consensus was reached on all items, resulting in a finalized version of the Malay Noise Exposure Questionnaire (M-NEQ) ready for validation.

Validation

Finally, the questionnaire was prepared for content and face validation. The validity of the questionnaire was assessed through content and face validation processes. The Malay translated questionnaire was compiled in

Microsoft Word format and distributed to the validators via email. Clear instructions in Malay were provided to facilitate understanding. The returned documents were then analyzed based on the validators' scores and qualitative feedback.

Content Validation

A total of eight content validators were chosen based on the proposed inclusion criteria. Their task was to rate the relevance of the questionnaire items using the following scoring system; i) 1-irrelevant, ii) 2-somewhat relevant, iii) 3-quite relevant, and iv) 4-highly relevant. This is done to test the relevance of the components and to ensure that the items accurately reflect the domain. After the content validation survey form was received back from the content validators, the Content Validity Index (CVI) at item level (item-level content validity index (I-CVI)) and at scale level (scale-level content validity index (S-CVI)) were calculated. In addition, content validators' feedback was also considered to improve the items in the questionnaire further.

Face Validation

A total of ten target users were recruited as face validators based on the proposed inclusion criteria. Their task was to rate the clarity and comprehensibility of the questionnaire components using the following scoring system: i) 1-not clear and cannot be understood, ii) 2-somewhat clear and can be understood, iii) 3-clear and easily understood, and iv) 4-very clear and very easy to understand. After the face validators returned the face validation survey forms, the Face Validation Index (FVI) at the item level (item-level face validation index (I-FVI)) and the scale level (scale-level face validity index (S-FVI)) were calculated. Modifications to the components were also conducted based on suggestions from the face validators.

Data Analysis

Content Validity Index (CVI)

The I-CVI and S-CVI were calculated according to the score given by the experts. Questionnaire components with a score of 3 and 4 were considered relevant and equal to 1, whilst a score of 1 or 2 were considered irrelevant and equal to 0. According to Yusoff (2019), for a panel of at least six experts, an I-CVI value of 0.83 or higher is considered satisfactory. Similarly, Polit & Beck (2006) recommend an acceptable I-CVI threshold of not less than 0.83 when six or more experts are involved. Meanwhile, the acceptable value for S-CVI/Ave was recommended of 0.9 or higher.

Equation for I-CVI:

$$\text{I-CVI} = \frac{The\ number\ of\ experts\ giving\ rating\ 3\ or\ 4}{Total\ number\ of\ experts}$$

Equation for S-CVI/Ave:

$$\text{S-CVI} = \frac{The\ sum\ of\ I{-}CVI}{Total\ number\ of\ items}$$

Face Validation Index (FVI)

The I-FVI and S-FVI were calculated according to the score given by the experts. For each questionnaire item, scores of 3 and 4 were considered relevant and assigned a value of 1, while scores of 1 or 2 were considered irrelevant and assigned a value of 0. An I-FVI greater than 0.80 and an S-FVI exceeding 0.83 would be considered as acceptable levels of face validity (Rahman et al. (2021).

Equation for I-FVI

$$\text{I-FVI} = \frac{The\ number\ of\ experts\ giving\ rating\ 3\ or\ 4}{Total\ number\ of\ experts}$$

Equation for S-FVI/Ave:

$$\text{S-FVI} = \frac{The\ sum\ of\ I{-}FVI}{Total\ number\ of\ items}$$

RESULTS

Adaptation Process

During the adaptation process, several changes were made to the original questionnaire to ensure cultural appropriateness for the Malaysian context. These changes involved omitting, rephrasing, and combining certain item.

Under the omission category, the word "snowmobiles" in Item 4a was removed as it is not relevant or commonly used in Malaysia. No replacement was made since the other listed examples such as motorcycles, jet skis, and speed boats were already sufficient to convey the intended meaning.

Items 10 and 11, which originally referred to noisy paid jobs during and outside the summer months, were rephrased and combined into a single item. This adaptation was necessary due to the absence of a summer break concept in the Malaysian context. The revised item refers to any noisy paid work conducted within the past year, including work undertaken during school holidays or other free time.

These changes were made while maintaining the original intent of the questionnaire, ensuring that the revised

items were culturally relevant, easier to understand, and applicable to the local context.

Table 1: Adaptation categories

Adaptation categories	Items	Changes	
		From	To
Omission	3a	How often did you ride/operate motorized vehicles such as motorcycles, jet skis, speed boats, snowmobiles, or four-wheelers?	How often did you ride/operate motorized vehicles such as motorcycles, jet skis, speed boats, snowmobiles, or four-wheelers?
	11a	Other than during the summer, over the past year, did you work one or more noisy paid jobs, such as in construction, farming, a factory, lawn service, carwash, or other indoor or outdoor job working around loud equipment or machinery? By noisy job, we mean sounds so loud that you had to shout or speak in a raised voice to be heard at arm's length.	[Merged with Q10] Adapted into one general question covering "the past year", without seasonal distinction.
Rephrasing	10a	Now think back to this past summer. Over the summer months, did you work a noisy paid job, such as in construction, farming, a factory, lawn service, carwash, or other indoor or outdoor job working around loud equipment or machinery? By noisy job, we mean sounds so loud that you had to shout or speak in a raised voice to be heard at arm's length.	In the past year, did you work a noisy paid job, such as in construction, farming, a factory, lawn service, carwash, or other indoor or outdoor job working around loud equipment or machinery? By noisy job, we mean sounds so loud that you had to shout or speak in a raised voice to be heard at arm's length.

Translation and Harmonization Process

The translation process successfully resulted in a harmonized and culturally adapted Malay version of the NEQ. During the expert review, several items were identified for improvement. The expert panel recommended revisions mainly involving rewording for semantic clarity and alignment with Malaysian linguistic norms. As a result, changes were made to multiple items across the questionnaire. These revisions helped improve the comprehensibility of the items for the public, especially in the context of self-reporting noise exposure. The changes made to the following expert review are presented in Tables 2 and 3 below.

Table 2: Original NEQ, Harmonized Malay translated, Harmonized English Translated, and Harmonized Malay following expert review

Items	Original NEQ	Harmonized Forward Translation	Harmonized Backward Translation	Harmonized Forward Translation (2)
1a	Outside of a paid job, how often did you use power tools, chainsaws, or other shop tools?	Di luar waktu bekerja, berapa kerapkah anda menggunakan peralatan kuasa elektrik seperti gergaji elektrik atau alat bengkel lain?	Outside of a paid job, how often did you use power tools such as electric saws or other workshop equipment?	Di luar waktu bekerja, berapa kerapkah anda menggunakan peralatan kuasa elektrik seperti gergaji elektrik atau alat bengkel lain?
1b	If you used power tools, on average, how many hours did each time/session last?	Jika anda menggunakan peralatan tersebut, berapa lamakah sesi penggunaannya?	If you use power tools, how long did each usage last?	Jika anda menggunakan peralatan kuasa elektrik tersebut, berapa lamakah sesi penggunaannya?

1c	If you used power tools, how often did you wear earplugs or earmuffs during this activity?	Jika anda menggunakan peralatan kuasa elektrik, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you use power tools, how often did you wear hearing protection during this activity?	Jika anda menggunakan peralatan kuasa elektrik, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
2a	Outside of a paid job, how often did you drive heavy equipment or use loud machinery (such as tractors, trucks, or farming or lawn equipment like mowers/leaf blowers)?	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan pertanian/penjagaan rumput seperti mesin pemotong rumput/pam daun?	Outside of a paid job, how often did you drive or operate heavy machinery such as tractors, trucks, or agricultural/landscaping equipment like lawnmowers?	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan perladangan/penjagaan rumput seperti mesin pemotong rumput/pam daun?
2b	If you drove/used loud machinery, on average, how many hours did each time/session last?	Jika anda memandu atau menggunakan jentera berat tersebut, berapa lamakah sesi penggunaannya?	If you drove or operated heavy machinery, how long did each usage last?	Jika anda memandu atau menggunakan jentera berat tersebut, berapa lamakah sesi penggunaannya?
2c	If you drove/used machinery, how often did you wear earplugs or earmuffs during this activity?	Jika anda memandu atau menggunakan jentera berat, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you drove or operate heavy machinery, how often do you wear hearing protection during this activity?	Jika anda memandu atau menggunakan jentera berat, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
3a	How often did you attend car/truck races, commercial/high school sporting events, music concerts/dances or any other events with amplified public announcement (PA)/music systems?	Berapa kerapkah anda menghadiri acara seperti perlumbaan kereta/lori, acara sukan, konsert muzik, atau acara lain dengan sistem pembesar suara?	How often did you attend events such as car/truck races, sports events, music concerts, or other events with amplified public announcement (PA)/music systems?	Berapa kerapkah anda menghadiri acara seperti perlumbaan kereta/lori, acara sukan, konsert muzik, atau acara lain yang menggunakan sistem pembesar suara?
3b	If you attended these events, on average, how many hours did each time/session last?	Jika anda menghadiri acara ini, berapa lamakah sesi tersebut berlangsung?	If you attended these events, how long did they usually last?	Jika anda menghadiri acara ini, berapa lamakah sesi tersebut berlangsung?
3c	If you attended these events, how often did you wear earplugs or earmuffs during this activity?	Jika anda menghadiri acara ini, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you attended these events, how often did you wear hearing protection during these activities?	Jika anda menghadiri acara ini, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
4a	How often did you ride/operate motorized vehicles such as motorcycles, jet skis, speed boats, snowmobiles, or four-wheelers?	Berapa kerapkah anda menggunakan kenderaan bermotor seperti motosikal, jet ski, bot laju, atau motor bertayar empat?	How often did you use motor vehicles such as motorcycles, jet skis, speedboats, or all-terrain vehicles?	Berapa kerapkah anda menggunakan kenderaan bermotor seperti motosikal, jet ski, bot laju, atau kenderaan empat roda?
4b	If you rode motorized vehicles, on average, how many hours did each time/session last?	Jika anda menggunakan kenderaan bermotor tersebut, berapa lamakah sesi penggunaannya?	If you use these motor vehicles, how long did each session last?	Jika anda menggunakan kenderaan bermotor tersebut, berapa lamakah sesi penggunaannya?
4c	If you rode motorized vehicles, how often did you wear earplugs or earmuffs during this	Jika anda menggunakan kenderaan bermotor, berapa kerapkah anda memakai alat pelindung	If you use motor vehicles, how often do you wear hearing protection during this activity?	Jika anda menggunakan kenderaan bermotor, berapa kerapkah anda memakai alat pelindung

	activity?	pendengaran semasa aktiviti ini?		pendengaran semasa aktiviti ini?
5a	How often did you ride in or pilot small aircraft/private airplanes?	Berapa kerapkah anda menaiki atau membawa pesawat kecil/pesawat peribadi?	How often did you ride in or pilot a small aircraft/private plane?	Berapa kerapkah anda menaiki atau membawa pesawat kecil/pesawat peribadi?
5b	If you flew airplanes, on average, how many hours did each time/session last?	Jika anda menaiki pesawat, berapa lamakah sesi penerbangan tersebut?	If you ride in an aircraft, how long did the flight session last?	Jika anda menaiki pesawat, berapa lamakah sesi penerbangan tersebut?
5c	If you flew airplanes, how often did you wear earplugs or earmuffs during this activity?	Jika anda menaiki pesawat, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you ride in an aircraft, how often did you wear hearing protection during this activity?	Jika anda menaiki pesawat, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
6a	How often were you around or did you shoot firearms such as rifles, pistols, shotguns, etc.?	Berapa kerapkah anda menggunakan atau berada berhampiran senjata api seperti senapang,, pistol, senapang patah atau sebagainya?	How often did you use or be near firearms such as rifles, pistols, shotguns, or similar weapons?	Berapa kerapkah anda menggunakan atau berada berhampiran senjata api seperti senapang, pistol, senapang patah atau sebagainya?
6b	If you were around/shot firearms, on average, how many shots did you fire each time/session?	Jika anda menggunakan senjata api tersebut, berapa banyakkah tembakan yang anda lepaskan semasa sesi itu?	If you used firearms, how many shots did you fire during the session?	Jika anda menggunakan senjata api tersebut, berapa banyakkah tembakan yang anda lepaskan semasa sesi itu?
6c	If you were around/shot firearms, how often did you wear earplugs or earmuffs while shooting?	Jika anda menggunakan senjata api tersebut, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you used these firearms, how often do you wear hearing protection while shooting?	Jika anda menggunakan senjata api tersebut, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
7a	How often did you play a musical instrument?	Berapa kerapkah anda bermain alat muzik?	How often did you play a musical instrument?	Berapa kerapkah anda bermain alat muzik?
7b	If you played, please tell us what musical instrument:	Jika anda bermain alat muzik, sila nyatakan alat muzik tersebut:	If you played a musical instrument, please specify the instrument:	Jika anda bermain alat muzik, sila nyatakan alat muzik tersebut:
7c	If you played a musical instrument, on average, how many hours did each time/session last?	Jika anda bermain alat muzik, berapa lamakah setiap sesi berlangsung?	If you played a musical instrument, how long did each session last?	Jika anda bermain alat muzik, berapa lamakah setiap sesi berlangsung?
7d	If you played a musical instrument, how often did you wear earplugs or earmuffs while playing?	Jika anda bermain alat muzik, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?	If you played a musical instrument, how often do you wear hearing protection while playing?	Jika anda bermain alat muzik, berapa kerapkah anda memakai alat pelindung pendengaran semasa aktiviti ini?
8a	How often did you listen to music, radio programs, etc. using personal headsets or earphones?	Berapa kerapkah anda mendengar muzik, program radio, dan lain-lain menggunakan “headphone” atau “earphone”?	How often did you listen to music, radio programmes, or other audio using headphones or earphones?	Berapa kerapkah anda mendengar muzik, program radio, dan lain-lain menggunakan fon kepala atau fon telinga?
8b	If you listened through earphones, on average, how many hours did each time/session last?	Jika anda mendengar melalui “headphone” atau “earphone”, secara purata, berapa lamakah setiap sesi berlangsung?	If you listened using headphones or earphones, how long did each session last?	Jika anda mendengar melalui fon kepala atau fon telinga, berapa lamakah setiap sesi berlangsung?
9a	Other than music concerts and headset use (already	Selain konsert muzik dan penggunaan “headphone”	Besides music concerts and headphone use (as	Selain konsert muzik dan penggunaan fon kepala

	covered in questions 3 and 8), how often did you listen to music, radio programs, etc. from audio speakers in a car or at home?	(seperti yang disebut dalam soalan 3 dan 8), berapa kerapkah anda mendengar muzik, program radio, dan lain-lain melalui pembesar suara di rumah atau dalam kereta?	mentioned in questions 3 and 8), how often did you listen to music, radio programmes, and other audio through speakers at home or in the car?	(seperti yang disebut dalam soalan 3 dan 8), berapa kerapkah anda mendengar muzik, program radio, dan lain-lain melalui pembesar suara di rumah atau dalam kereta?
9b	If you listened via speakers, on average, how many hours did each time/session last?	Jika anda mendengar melalui pembesar suara, berapa lamakah setiap sesi berlangsung?	If you listened through speakers, how long did each session last?	Jika anda mendengar melalui pembesar suara, berapa lamakah setiap sesi berlangsung?
10a	Now think back to this past summer. Over the summer months, did you work a noisy paid job, such as in construction, farming, a factory, lawn service, carwash, or other indoor or outdoor job working around loud equipment or machinery? By noisy job, we mean sounds so loud that you had to shout or speak in a raised voice to be heard at arm's length.	Adakah anda bekerja dalam keadaan terdedah kepada bunyi yang bising, seperti di tapak pembinaan, pertanian, kilang, perkhidmatan landskap, mencuci kereta, atau pekerjaan lain yang melibatkan peralatan atau mesin yang kuat? (Dengan pekerjaan bising, kami maksudkan bunyi yang begitu kuat sehingga anda perlu menjerit atau bercakap dengan suara kuat untuk didengari pada jarak yang dekat)	Did you work in an environment exposed to loud noise, such as at a construction site, farm, factory, landscaping service, car wash, or other jobs involving loud equipment or machinery? (By noisy work, we mean sounds so loud that you have to shout or speak loudly to be heard at close range.)	Adakah anda bekerja dalam keadaan terdedah kepada bunyi yang bising, seperti di tapak pembinaan, perladangan, kilang, perkhidmatan mesin rumput, mencuci kereta, atau pekerjaan lain yang melibatkan peralatan atau mesin yang kuat? (Dengan pekerjaan bising, kami maksudkan bunyi yang sangat kuat sehingga anda perlu menjerit atau bercakap dengan suara kuat untuk didengari pada jarak yang dekat)
10b	If yes, please describe this noisy job:	Jika ya, sila nyatakan pekerjaan tersebut:	If yes, please specify the noisy job:	Jika ya, sila nyatakan pekerjaan tersebut:
10c	If you worked a noisy job, please estimate the number of hours you worked in a typical week:	Jika anda bekerja di tempat yang bising, sila anggarkan jumlah jam anda bekerja dalam satu minggu:	If you worked in a noisy environment, please estimate the number of hours you work per week:	Jika anda bekerja di tempat yang bising, sila anggarkan jumlah jam anda bekerja dalam satu minggu:
10d	If you worked a noisy job this summer, did your employer give you earplugs or earmuffs to wear at work?	Adakah majikan anda menyediakan alat pelindung pendengaran untuk digunakan semasa bekerja?	Did your employer provide hearing protection equipment for use while working?	Adakah majikan anda menyediakan alat pelindung pendengaran untuk digunakan semasa bekerja?
10e	How often did you wear earplugs or earmuffs when around loud noise at this summer job?	Berapa kerapkah anda memakai alat pelindung pendengaran semasa bekerja dalam persekitaran yang bising?	How often did you wear hearing protection while working in a noisy environment?	Berapa kerapkah anda memakai alat pelindung pendengaran semasa bekerja dalam persekitaran yang bising?

Table 3: Changes in translation made following the expert reviewal

Items	Harmonized Forward Translation	Harmonized Forward Translation (2)	Changes	
			From	To
2a	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan pertanian/penjagaan rumput seperti mesin pemotong rumput/pam daun?	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan perladangan/penjagaan rumput seperti mesin pemotong rumput/pam daun?	pertanian	perladangan
3a	Berapa kerapkah anda menghadiri acara seperti perlumbaan kereta/lori,	Berapa kerapkah anda menghadiri acara seperti perlumbaan kereta/lori, acara	dengan	yang menggunakan

	acara sukan, konsert muzik, atau acara lain dengan sistem pembesar suara?	sukan, konsert muzik, atau acara lain yang menggunakan sistem pembesar suara?		
4a	Berapa kerapkah anda menggunakan kenderaan bermotor seperti motosikal, jet ski, bot laju, atau motor bertayar empat?	Berapa kerapkah anda menggunakan kenderaan bermotor seperti motosikal, jet ski, bot laju, atau kenderaan empat roda?	motor bertayar empat	kenderaan empat roda
8a	Berapa kerapkah anda mendengar muzik, program radio, dan lain-lain menggunakan "headphone" atau "earphone"?	Berapa kerapkah anda mendengar muzik, program radio, dan lain-lain menggunakan fon kepala atau fon telinga?	'headphone' atau 'earphone'	fon kepala atau fon telinga
9a	Selain konsert muzik dan penggunaan "headphone" (seperti yang disebut dalam soalan 3 dan 8), berapa kerapkah anda mendengar muzik, program radio, dan lain-lain melalui pembesar suara di rumah atau dalam kereta?	Selain konsert muzik dan penggunaan fon kepala (seperti yang disebut dalam soalan 3 dan 8), berapa kerapkah anda mendengar muzik, program radio, dan lain-lain melalui pembesar suara di rumah atau dalam kereta?	'headphone'	fon kepala
10a	Adakah anda bekerja dalam keadaan terdedah kepada bunyi yang bising, seperti di tapak pembinaan, pertanian, kilang, perkhidmatan landskap, mencuci kereta, atau pekerjaan lain yang melibatkan peralatan atau mesin yang kuat? (Dengan pekerjaan bising, kami maksudkan bunyi yang begitu kuat sehingga anda perlu menjerit atau bercakap dengan suara kuat untuk didengari pada jarak yang dekat)	Adakah anda bekerja dalam keadaan terdedah kepada bunyi yang bising, seperti di tapak pembinaan, perladangan, kilang, perkhidmatan mesin rumput, mencuci kereta, atau pekerjaan lain yang melibatkan peralatan atau mesin yang kuat? (Dengan pekerjaan bising, kami maksudkan bunyi yang sangat kuat sehingga anda perlu menjerit atau bercakap dengan suara kuat untuk didengari pada jarak yang dekat)	pertanian	perladangan

Content Validation

For this study, the value of I-CVI for each questionnaire components are in the range of 0.87 to 1. Meanwhile, the S-CVI/Ave obtained is 0.98.

Table 4: I-CVI for 31 Items

Items	I-CVI
1a, 1b, 1c, 2a, 2b, 2c, 3a, 3b, 3c, 4a, 4b, 4c, 5a, 5b, 5c, 7a, 7b, 7c, 7d, 8a, 8b, 9a, 9b, 10a, 10b, 10c, 10d, 10e	1
6a, 6b, 6c	0.87

Table 5: Example of changes in semantics following content validators' feedback

Items	Changes	
	From	To
2a	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan perladangan/penjagaan rumput seperti mesin pemotong rumput/pam daun?	Di luar waktu bekerja, berapa kerapkah anda memandu atau menggunakan jentera berat seperti traktor, trak, atau peralatan perladangan/penjagaan rumput seperti mesin pemotong rumput/peniup daun?

Face Validation

For this study, the value of I-FVI for each the questionnaire items are in the range of 0.9 to 1. Meanwhile, the S-FVI/Ave obtained is 0.97.

Table 6: I-FVI for 31 Items

Items	I-FVI
1b, 1c, 2a, 2b, 2c, 3a, 3b, 4a, 4b, 4c, 5a, 5b, 5c, 6a, 6c, 7d, 9a, 9b, 10a, 10b, 10c, 10d, 10e	1
1a, 3c, 6b, 7a, 7b, 7c, 8a, 8b	0.9

DISCUSSION

Adaptation Process

The adaptation process is a critical component of cross-cultural research, ensuring that a questionnaire or instrument remains relevant, understandable, and applicable to the target population (Beaton et al., 2000; Coskun Benlidayi & Gupta, 2024; Epstein et al., 2015). In this study, several changes were made to the original questionnaire to ensure that the items were culturally and contextually appropriate for the Malaysian population. The changes were primarily categorized as omission, rephrasing, and merging items, all of which were intended

to maintain the original intent of the questionnaire while making it more applicable to the local context.

In terms of omission, certain items were removed due to their lack of relevance or common usage in Malaysia. A notable example was the omission of the word "snowmobiles" in Item 4a, as this term is not commonly associated with Malaysian culture or geography. Other terms, such as motorcycles, jet skis, and speed boats, were retained as they are familiar and applicable to the Malaysian population. This adjustment ensured that the questionnaire did not include irrelevant items, which could lead to confusion or misunderstanding among respondents.

The rephrasing category involved altering the phrasing of questions to ensure they were both culturally appropriate and easier to understand. For instance, Items 10a and 11a, which initially distinguished between noisy paid jobs during and outside of summer, were rephrased and merged into a single item. This change was made because Malaysia does not have a seasonal summer break that is common in temperate climates, making the original distinction irrelevant. The revised item now asks about noisy paid jobs conducted in the past year, which includes work done during school holidays or free time, making the question more universally applicable across the year in the Malaysian context.

These changes were made with careful consideration of the cultural context and the goal of preserving the validity and reliability of the questionnaire. Ensuring that questions are both culturally relevant and linguistically clear is essential for maintaining the integrity of the data collected and ensuring that the responses are meaningful and comparable (Han et al., 2022; Olievera et al., 2022). By modifying the items without altering their original meaning, the adaptation process effectively enhanced the cultural sensitivity of the questionnaire while retaining its capacity to assess the intended constructs.

Translation Process

During the translation process, several modifications were made to ensure semantic, idiomatic, and cultural equivalence between the original and translated versions of the questionnaire. These changes were carefully documented in Table 3, following the expert reviews to address inconsistencies and improve clarity.

For instance, in Item 2a and 10a, the term "pertanian" (agriculture) was changed to "perladangan" (farming), as the latter more accurately represents the context of machinery use in the Malaysian cultural and occupational setting. While both terms are closely related, "perladangan" better aligns with local interpretations involving heavy-duty vehicles and land maintenance equipment. This change reflects the importance of selecting culturally appropriate terminology to enhance the relevance and comprehension of the questionnaire (McAllister et al., 2021; Sousa & Rojjanasrirat, 2011).

Similarly, for Item 3a, the phrase "dengan sistem pembesar suara" was restructured to "yang menggunakan sistem pembesar suara" to increase syntactic clarity and ensure the question flows naturally in Malay. Such grammatical realignments, although minor, are vital to preserve the intent of the original item while enhancing user comprehension (Abd Rahim et al., 2023; Gjersing et al., 2010).

Another significant adjustment was seen in Item 4a, where "motor bertayar empat" was replaced with the more precise "kenderaan empat roda" to prevent ambiguity. This change ensures a clearer understanding of the type of vehicle referenced. Thereby, reducing potential misinterpretation by respondents unfamiliar with technical phrasing.

Additionally, more familiar Malay terms like "fon kepala" and "fon telinga" replaced the English loanwords "headphone" and "earphone" (Items 8a and 9a). These adjustments helped preserve the original meaning while enhancing cultural relevance and respondent understanding.

Content Validation

Content validation was carried out by eight audiologists, with I-CVI values ranging from 0.87 to 1.00. Although three items related to firearm exposure (6a, 6b, and 6c) received I-CVI scores of 0.87, they remained above the acceptable threshold of 0.83 as recommended by Lynn (1986) and Yusoff (2019) for studies involving six or more experts. According to Zamanzadeh et al. (2015), items scoring between 0.70 and 0.79 require revision, while those below 0.70 should be eliminated. As all items scored above the threshold, none were removed from the questionnaire. Although no major revisions were required, minor semantic adjustments were made based on content validator feedback to enhance clarity and natural language flow. For example, the phrase "pam daun" was refined to "peniup daun" to better reflect standard Malay usage. The overall S-CVI/Ave score of 0.98 indicated excellent content validity, demonstrating that the items adequately represented the construct of noise exposure (Amy Sie-Yik et al., 2017; Polit & Beck, 2006).

Face Validation

For face validation, ten lay participants with diverse backgrounds assessed the clarity and comprehensibility of each item. The I-FVI scores ranged from 0.90 to 1.00, and the overall S-FVI/Ave was 0.97. Although a few items scored slightly lower, this still falls within acceptable levels as per Rahman et al. (2021). Most participants agreed that the questionnaire items were well-structured and easy to understand, indicating that the final version is suitable for self-administration.

Several limitations should be considered in interpreting the results of this study. First, the validation process focused mainly on content and face validity, without extending to other psychometric properties such as test-retest reliability, which would strengthen the robustness of the tool. Second, although expert and lay feedback were incorporated, the sample size for both groups was relatively small. A broader panel of experts and a larger, more diverse group of respondents would have provided richer insights and potentially different perspectives on item clarity and relevance. Lastly, the study was conducted in a controlled setting, which may not fully reflect how the questionnaire performs in real-world clinical or occupational screening environments.

CONCLUSION

The present study successfully translated, adapted, and validated the Malay version of the Noise Exposure Questionnaire (M-NEQ), demonstrating strong evidence of content and face validity. The translation process ensured both linguistic and cultural appropriateness, while expert and layperson evaluations confirmed the questionnaire's clarity and relevance. High I-CVI and S-CVI/Ave values support the relevance of each item, and similarly high I-FVI and S-FVI/Ave values indicate the tool is comprehensible to the intended population. These findings suggest that the M-NEQ is a valid instrument for assessing noise exposure in a Malaysian context. Further research is recommended to explore additional psychometric properties and assess its effectiveness in clinical and community settings.

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