

ORIGINAL ARTICLE

Correlation between Hearing Handicap Inventory for the Elderly Screening (HHIE-S) and Pure Tone Audiometry (PTA) Test among Malaysian Elderly

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ABSTRACT

Introduction: The study aims to determine the correlation of the Hearing Handicap Inventory for Elderly Screening (HHIE-S) questionnaire with the pure tone audiometry (PTA) in the Malaysian older adult population. **Methods:** This cross-sectional study took a random sample of adults ≥ 60 years in a tertiary hospital. A total of 202 participants completed both the HHIE-S questionnaire and the PTA test. The total HHIE-S score and the PTA result were explored for the correlation using a Kruskal–Wallis and the validity using the receiver operating characteristic curve. **Results:** A Kruskal–Wallis analysis indicated a significant correlation for the level of hearing impairment ($r = .704$, $p < 0.001$) between the HHIE-S score and the PTA result. Comparison between HHIE-S score of 8 and the PTA >25 db results gave sensitivity: 87.9%, specificity: 78.4%, positive predictive value: 80.3%, and negative predictive value: 86.6%. **Conclusion:** This study suggests that the HHIE-S questionnaire is a good and valid screening instrument for hearing impairment detection in the Malaysian older adult population.

Keywords: Older adults, Hearing impairment, Hearing handicap, HHIE-S, PTA

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INTRODUCTION

Because of increased longevity and general population growth, the proportion of people aged 60 and above in the world's population is growing rapidly (1, 2). The Malaysian older adult population is also increasing, which means health care needs would also increase (3). Common health problems reported among the older adults in Malaysia are visual problems (68%), difficulty in chewing food (48%), and hearing impairment (16%) (3, 4). Hearing impairment is the most prevalent chronic condition affecting one-third of older adults (5, 6) and remains an essential issue (7). A previous study showed that the prevalence of self-reported hearing loss among older adults in Malaysia was 53.4% (5). Hearing impairment is a public health problem as it has affected the quality of life for older adults (8, 9).

Less communication with others due to hearing

impairment will lead to negative well-being (10), poor quality of life (11), and increased mortality risk among older adults (12). Not all older adults who have hearing impairment are aware of their condition until they undergo hearing tests (13). Pure tone audiometry (PTA) is a gold standard procedure to assess hearing impairment (14) at different frequencies (15). On the other hand, the HHIE-S questionnaire is a commonly used screening tool to identify the level of hearing impairment among older adults (16, 17). The original HHIE-S was designed to determine hearing impairment's social and emotional aspects; it can also be used to screen an individual for a hearing handicap (18).

Lack of awareness of hearing impairment and limited services to trace the prevalence of this disorder related to the prevention and treatment of hearing health could be one reason for the higher prevalence of hearing impairment seen in the less developed countries (19). The limited services for the hearing screening tools in primary health care would lead to under detection of hearing impairment in older adults (20). Despite the importance of early identification of hearing impairment among older adults in Malaysia, it was not

widely investigated. In primary health care, a sensitive, valid, basic, and inexpensive hearing screening tool is required. Audiometric test services are limited to detecting hearing impairment on a large scale among older adult subjects in primary settings or hospitals where audiology services are unavailable. The HHIE-S is a screening/detection tool for hearing impairment in other countries (16, 17). This study investigates the HHIE-S as an alternative hearing impairment assessment tool in Malaysia that can be used when an audiology service is unavailable.

MATERIALS AND METHODS

This study was performed in 2018, using the simple random sample method among adults aged 60 and above. Older adults who fulfilled the inclusion criteria and provided informed consent participated in the study. The participants completed the structured questionnaire and completed the PTA assessment in the Audiology Unit, Tuanku Ja'afar Hospital, Negeri Sembilan, Malaysia. They were then tested using the HHIE-S questionnaire and compared with the PTA result. Inclusion criteria for this study were age 60 years and above with previous underlying hearing impairment due to excessive noise exposure, Malaysian citizens undergoing PTA assessment with or without hearing impairment, and understanding and communicating in Malay and English. The exclusion criteria were other acute or chronic conditions, including mental illness, that might interfere with their decision to answer the questionnaire.

A questionnaire consists of socio-demographic questions and a Malaysian version of the MMHIE-S (20) was completed by the consenting participants. The HHIE-S, as a self-assessment hearing handicap tool, was introduced by Ventry and Weinstein (1982) with a simplified version in 1983 in the United States (21).

The HHIE-S instrument consists of 10 questions about hearing impairment. This questionnaire categorized and measured the level of hearing impairment among older adults. The total points were 40; for each question, there are three possibilities to be answered. It is "yes (worth 4 points), sometimes (worth 2 points), and no (worth 0 points)". Zero points indicate no report of social and emotional detriment from the individual's hearing impairment, and a total score of 40 implied high social and emotional impacts of hearing impairment. Based on the final score, the older adults with hearing impairment were categorized thus: score 0–8 is no handicap, score 10–24 is mild to moderate handicap, and score 26–40 is a significant handicap.

The participants underwent the PTA procedure with an audiologist after undergoing an otoscope examination for any impacted wax in the Audiology Unit. Hearing impairment was measured at frequencies of 500–4000

Hz using the PTA because this range represented most of the speech spectrum. The WHO grades of hearing impairment proposed a limit of hearing impairment to 25 dB or better (Grade 0) (22). The following grading shows the hearing impairment levels: Grade 1 - mild (26–40 dB); Grade 2 - moderate (41–60 dB); Grade 3 - severe (61–80 dB); and Grade 4 - profound (≥ 81 dB).

All data were analyzed using IBM statistical packages for social sciences (SPSS) version 25. The HHIE-S questionnaire validity was determined by calculating the sensitivity and specificity using PTA results from the receivers operating characteristic (ROC). The cut-off measurement to determine Pass/Fail result in the PTA test is ≥ 26 dB and HHIE-S score > 8 . A value of $p < 0.05$ was considered statistically significant. The validity of the HHIE-S and the PTA result was validated by calculating sensitivity and specificity based on two diagnostic test evaluations with the optimal cut-off threshold on ROC.

The ethics approval was given by the Medical Research and Ethics Committee, Ministry of Health Malaysia (NMRR-18-1150-41395). All participants were volunteered to be part of the study by giving their written consent before participating in this study.

RESULTS

The socio-demographic data in this study were summarized and presented in Table I. A total of 202 subjects had completed both the HHIE-S questionnaire and formal audiometric assessment. The respondents consist of 120 (59.4%) males and 82 (40.6%) females with ages ranging between 60 years old and 95 years old. The mean age of the sample was 69.2 ± 7.13 , median 68, and IQR (64–74) years old. The internal consistency coefficient based on Cronbach's alpha was 0.85.

Respondent with HHIE-S score more than 8 or PTA > 25 dB is having hearing impairment. The result from the instrument has shown the prevalence of hearing handicaps is 75.7%. On the other hand, hearing impairment detected from the PTA procedure among the elderly was 81.7%, a 6% differentiation. The hearing handicap based on HHIE-S result was classified into three categories to study the percentage of respondents in each class. 24.3% of respondents are no handicap, most (55.4%) of respondents are mild to moderate handicap, and 20.3% of respondents are a significant handicap.

A non-parametric test was used for analyzing the correlation between HHIE-S and PTA due to the test assumption for normality, Shapiro–Wilks, was violated. The boxplots show a correlation between total HHIE-S and the level of hearing impairment (Figure 1). Based on Table II, a Kruskal–Wallis test shows that significant hearing handicap has a higher mean HHIE-S rank of 162.09 followed by mild to moderate with a mean rank

Table I: Demographic characteristic of the study elderly population

Socio-demographic characteristics	No. of respondent (s)	Percentage (%)
Age		
60–69 years old	115	56.9
70–79 years old	69	34.2
80–89 years old and above	18	8.9
Gender		
Male	120	59.4
Female	82	40.6
Race		
Malay	81	40.1
Chinese	79	39.1
India	38	18.8
Other	4	2.0
Educational Level		
No formal education to primary school	44	21.8
Secondary school	84	41.6
Tertiary school	74	36.6
Hearing Aids Usage		
Yes	35	17.3
No	167	82.7

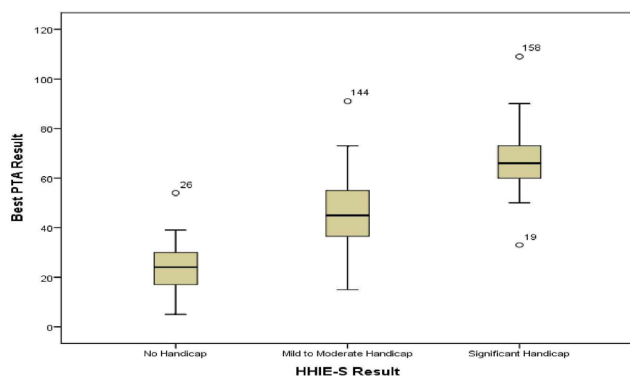


Figure 1: The correlation between hearing handicap among elderly subject and hearing level

of 107.02 and no hearing handicap with a mean rank of 38.18. A Kruskal–Wallis ANOVA indicated a statistically significant difference between the level of hearing impairment and the HHIE-S value, H (corrected for ties) = 110.295, $df = 2$, $N = 202$, $p = 0.001$. Subsequent Dunnet’s C post hoc test (Table III) found a significant mean difference of hearing handicap among the elderly and a correlation significant (p -value is significant at level 0.0083) between the level of the hearing disorder among the elderly.

Validity refers to the interpretation of scores and is directly tied to the usefulness of the interpretations of the HHIE-S as a screening tool. For this study, validity was assessed by comparing the HHIE-S scores and level of hearing for the PTA result, calculating the sensitivity,

TABLE II: The correlation between the level of hearing handicap and the level of hearing impairment was measured by PTA

Variables	n (%)	PTA Scores Mean rank	Median (IQR)	Kruskal-Wallis H (df)	p-value
Level of handicap					
No handicap	49 (24.5)	38.18	24 (14)	110.295 (2)	0.001*
Mild to Moderate	112 (55.4)	107.02	45 (18.75)		
Significant	41 (20.3)	162.09	66 (15.5)		

*Significant at level 0.05

Table III: Post hoc test for level of hearing handicap and PTA result

Level of hearing handicap	Mean (SD)	F-statistic (df)*	p-value
No handicap	24.69 (9.68)	122.99 (2,199)	0.001
Mild to Moderate	45.98 (13.80)		
Significant	66.83 (12.85)		

*Oneway ANOVA
 No handicap vs. Mild to Moderate, $p = 0.001$
 No handicap vs. Significant, $p = 0.001$
 Mild to Moderate vs. Significant, $p = 0.001$ (Dunnet’s C)

the specificity, the positive predictive value (PPV), the negative predictive value (NPV), the positive and the negative likelihood ratio, and the accuracy (Table IV). The sensitivity (true positive rate) was 87.9%, the specificity (true negative rate) was 78.4%, PPV (the probability that subjects with a positive screening test truly have), the hearing handicap was 80.3%, the NPV (the probability that subjects with a negative screening test truly do not have) the hearing handicap was 86.6%, the positive likelihood ratio was 4.07, the negative likelihood ratio was 0.15, and the accuracy was 83.2%.

Table IV: Validation assessment between HHIE-S and PTA test

Parameters	HHIE-S Score >8	
	PTA ≥26dB	95% CI
Sensitivity	87.9%	85.7-89.9
Specificity	78.4%	75.7-80.9
PPV	80.3%	78.3-82.1
NPV	86.6%	84.5-88.48
Positive likelihood ratio	4.07	3.61-4.59
Negative likelihood ratio	0.15	0.13-0.18
Accuracy	83.2%	81.4-84.8

DISCUSSION

By comparing the gender, most respondents were male, and they have a higher risk of hearing impairment than females. This finding was comparable to the study of Rosdina et al. (2011); the prevalence of hearing handicap using HHIE-S is about 1.8 times lower than the prevalence measured by PTA (13). This shows that although the elderly had hearing impairment, they failed to report it (23). The study claimed that the elderly underreported their hearing status probably due to the perception that it is a normal part of the aging process (8, 24).

There were 24.3% of respondents considered a non-hearing handicap, 55.4% are considered mild to moderate hearing handicap, and 20.3% are considered

a significant hearing handicap. This shows that more than half the patients who have visited the Audiology Clinic had a hearing handicap level mild to moderate hearing handicap based on the HHIE-S questionnaire. This could be due to hearing impairment, a chronic condition that developed slowly after exposure to the risk factors. As a condition worsens, it happens slowly and gradually, causing patients to be used to hearing impairment, or sometimes without even realizing that they are already suffering from this condition until they seek a physician and hearing assessment was done.

The result was comparable with the previous studies that reported the internal consistency coefficients based on Cronbach's alpha was 0.85 (9). The reliability of HHIE-S and the internal consistency were acceptable, although Cronbach's alpha in the present study was lower than obtained in other studies; 0.87 (21, 25) and 0.91 (9). This study shows that HHIE-S is a reliable instrument (20), easy to self-administer, and helpful in detecting hearing handicaps among the elderly. Using the HHIE-S scores as categorical data, the prevalence of HHIE-S > 8 scores significantly increases the severity of hearing impairment based on PTA, consistent with the previous study published (9).

Continuous awareness of the well-being of hearing health is essential. Therefore, it is necessary to emphasize to older adults the importance of regular hearing assessment (13). The health care providers also can play an essential role in the awareness programmed and early detection of hearing impairment among these groups. By these findings, the proper intervention can be the plan to help the older adults who are suffering from hearing impairment to reduce the effect of the hearing handicap, thus improving the quality of life. A good screening tool should be sensitive to identify the elderly who have a hearing impairment (5, 23). The study by Servidoni and Conterno (2018) found out a high value in the HHIE-S sensitivity (89.1%), specificity (75%), PPV (93.3%), NPV (63.6%), Positive likelihood ratio (3.56), Negative likelihood ratio (0.15), and accuracy (86.2%) (26).

The HHIE-S questionnaire shows good performance in identifying older persons with hearing impairment and can be recommended as an alternative hearing screening tool for an epidemiology study if PTA is unavailable (27). Therefore, if the score is 10 points and above, further PTA tests will be conducted to confirm the hearing impairment for early intervention or rehabilitation is done. Identifying prevalence and trends of hearing impairment in the large geographical area and subgroups of the risk population may be useful (14).

CONCLUSION

The HHIE-S questionnaire has appeared to be a good screening instrument with good parameters resulting in

our subjects compared with the PTA. This instrument can be implemented as a reasonably sensitive instrument deployed in epidemiological and population-based studies to assess hearing handicaps among elderly subjects. The HHIE-S questionnaire was a reasonably valid screening instrument recommended for use at the primary health care levels and hospitals to detect hearing impairment among the elderly in Malaysia. The HHIE-S questionnaire is easy self-administered in primary health care, especially in the Health Clinic or community.

In summary, the HHIE-S performed reasonably for identifying subjects with a moderate hearing handicap. No tool could entirely replace the PTA result. However, this HHIE-S questionnaire is a sufficient reliable instrument for the initial and is helpful to detect the hearing handicap. This instrument is highly recommended as one of the hearing screening impairment tools at the community level to the Malaysian population.

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