DOI: 10.7860/JCDR/2017/28144.10756

Original Article

Ear, Nose and Throat Section

Validation of Self-Reported Hearing Loss Among Multi-Ethnic Community Dwelling older Adults in Malaysia

WAN SYAFIRA ISHAK[1], SITI ZAMRATOL-MAI SARAH MUKARI[2], NASHRAH MAAMOR[3], WAN FAZLINA WAN HASHIM[4]

ABSTRACT

Introduction: Little is known about the prevalence of hearing loss and the usefulness of self-reported hearing loss among older adults in Malaysia.

Aim: We conducted a population-based study to investigate the prevalence of self-reported hearing problem and its relationship with audiometric hearing thresholds in older adults in Selangor, Malaysia. We also investigated demographic factors that were associated with the self-reported hearing loss.

Materials and Methods: The participants were recruited from Selangor using multi-stage clustered sampling involving 324 participants aged between 60 to 88 years (68.3±5.9 years). All participants underwent a face-to-face interview and pure tone audiometry. Self-reported hearing loss was obtained using three questions.

Results: The prevalence of self-reported hearing problems was 53.4%. This prevalence did not differ significantly among age group, gender, race and education level ($p>0.05$). Univariate and logistic regression analyses found that tinnitus and Pure Tone Average (PTA) of at least moderate hearing loss at 0.5 kHz to 4 kHz contributed significantly to the likelihood of self-reported hearing problem. Participants with tinnitus and participants with PTA of at least moderate hearing loss at 0.5 kHz to 4 kHz were twice as likely to report hearing problem than their counterparts. The questions yielded poor sensitivity in identifying at least mild loss and moderate sensitivity for at least moderate hearing loss.

Conclusion: The present study highlights the need for a more effective self-report inventory or audiometry instrument that is less sensitive to background noise to better estimate hearing loss prevalence among adults in Malaysia.

Keywords: Self-reported hearing problem, Sensitivity, Specificity, Tinnitus

INTRODUCTION

Hearing loss has been identified as the third most reported chronic health problems affecting individuals aged 60 years and above [1]. The World Health Organization reported the prevalence of hearing loss among this age group to vary between 21% to 85%, with the prevalence being lower in developed nations and higher in less developed countries [2]. This discrepancy is partly due to the lack of awareness on hearing health and limited access to the services in lower income countries than those in developed countries. In Malaysia, a nationwide study found that the prevalence of hearing loss among the 60 years old and above was 69.9% [3].

The advancement of health technology and medical care has contributed to the declining death rates and increasing life expectancy, which in turn increased the older adults population. In Malaysia, over the past three decades, the average life expectancy has increased from 70 years to 75 years in 2016 [4].

Population-based epidemiological data on hearing loss prevalence among older adults is important to serve as a guide in estimating the needs of hearing conservation and rehabilitation programs. Such data, however, is available mostly for more developed nations and still lacking in resource-poor countries where the prevalence of hearing loss is generally higher [5-7]. This lack of prevalence data on hearing loss in less developed nations is partly due to the fact that population-based studies are costly to run. This is because such studies require not only special equipment such as a mobile sound proof room, a sound level meter and conventional pure tone audiometry, but also specially trained personnel to operate. The use of a cheaper instrument than the conventional pure tone audiometry to detect hearing loss can overcome some of these problems.

Questionnaires have been widely used as alternatives to audiometric screening in hearing loss prevalence studies [8,9]. The use of a questionnaire offers several advantages because it is less costly, does not require specially trained personnel and can cover large study population in a short duration. Studies using questionnaires or self-reported hearing problem found the prevalence to range from 17% to 60% [9-12]. Single questions such as “Do you feel that you have hearing loss?” and “Do you have problem with your hearing?” have been found to have acceptable validity between 65% and 78% [9,11], indicating that such questions may be used as a screening tool to estimate the prevalence of hearing loss. However, the sensitivity of these questions was found to vary between studies [7,12]. A study using similar question conducted in Malaysia, for example yielded a low sensitivity to identify significant hearing loss [12].

This study aimed to investigate the prevalence of self-reported hearing problem among older adults aged 60 years and over. Additionally, this study also examined the relationship between self-reported hearing loss and audiometric hearing thresholds in community dwelling older adults. We also investigated demographic factors which were associated with self-reported hearing loss.

MATERIALS AND METHODS

Study Participants

This cross-sectional study was conducted over a period of 1 year between 2013 and 2014. The participants of this study were recruited in conjunction with the Long-term Research Grant Scheme Project (LRGS/BU/2012/UKM-UKM/K/02), a multidisciplinary study investigating medical, nutritional dietary, social and economic factors contributing to aging [13]. The participants were individuals aged 60 years and above who lived in Selangor, one of the states in

Malaysia. A multi-stage cluster sampling technique was conducted to select subjects that would represent the population of Selangor. The sampling technique was as described in Shahar et al., [13].

Family members in the sampled households who were 60-year-old or older, had good understanding of the Malay language, and free from any critical illness which may limit their mobility, were invited to participate by attending the nearby community hall during the data collection day. A total of 392 participants fulfilled the inclusion criteria and participated in the hearing study. This study was approved by the Ethics and Research Committee, Universiti Kebangsaan, Malaysia and was carried out under informed consent of the participants.

Self-Reported Hearing Problem

In the present study three questions were used to screen self-reported hearing problem. Besides the commonly used single question "Do you feel you have hearing problem?" (Q1), two other questions were included; they are Q2: "Do you feel that people mumble?" and Q3: "Has anybody told you that you don't hear well?". The inclusion of Q2 and Q3 was based on the premise that a locally conducted study has found Q1 to have inadequate sensitivity among Malaysian population [12]. Additionally, it is widely accepted that some individuals may be unaware of their hearing loss and blame others for not talking clearly (Q2). Similarly, Q3 was added because hearing loss may be noticed by others. For each of these questions, participants were required to choose either "Yes", "No" or "Unsure". "Unsure" response was treated as a missing value. A self-reported hearing problem was defined as "yes" answer to any of the three questions.

Audiometric Assessment

The audiological examination consisted of an otoscopic examination, a screening tympanometry (Interacoustic Titan), and a pure-tone audiometry. Pure tone audiometry was conducted by a trained personnel in a mobile sound proof booth using Madsen Itera II diagnostic audiometer equipped with TDH-39 headphones. All equipments were calibrated electroacoustically prior to the start of the data collection and were biologically calibrated every morning during the data collection days. Ambient noise levels in the mobile sound-proof booth were measured and were routinely monitored using a sound level meter (Quest Model 2900) to ensure that testing conditions complied with American National Standards Institute (ANSI) ambient noise limits [14].

We measured pure tone air conduction thresholds at 0.5, 1, 2, 4 and 8 kHz. In this study, PTAs were calculated at: 1) better ear across 0.5 to 2.0 kHz (BE0.5–2.0kHz); 2) better ear across 0.5 to 4.0 kHz (BE0.5–4.0kHz); and 3) better ear at high frequencies of 4.0 to 8.0 kHz (BEHF4.0–8.0kHz). Hearing loss was categorized into at least mild loss (PTA>25dBHL) and at least moderate loss (PTA>40dHBL), which was recommended for screening the older population [2,15,16].

Other Variables

Demographic characteristics of the study participants were obtained from face-to-face interviews. Participants were also asked whether they had tinnitus or not through a yes/no question.

STATISTICAL ANALYSIS

In addition to the descriptive statistics, Chi-square tests were used in univariate analysis to assess the possible associated factors for self-reported hearing problem. Subsequently, a multiple logistic regression analysis was done to determine whether the possible associated factors for self-reported hearing problem remained significant after adjusting for other factors. Since the Q1 question "Do you feel you have hearing loss?" is widely used as a screening tool, the performance of the question was also calculated against the pure tone hearing thresholds [12,17,18].

RESULTS

Demographic Data

Of the 392 participants, complete data were available from 324. The age of the participants ranged from 60 to 88 years with mean age of 68.3±5.9 years. In this cohort of older adults, 178 (54.9%) were female and 196 (60.5%) belonged to the 60 to 69-year-old group. The majority of the participants lived in urban areas 201 (62%), were Chinese 190 (58.6%) and had received no formal or primary school education 192 (59.3%). Demographic characteristics of the study participants were shown in [Table/Fig-1].

Variables	Total subjects (n=324)	Self-reported hearing loss (n=173)	$\chi 2$	p
	n (%)	n (%)		
Age group (in years)				
60-69	196 (60.5)	98 (50.0)	2.298	0.13
70+	128 (39.5)	75 (58.6)		
Ethnicity				
Malay	79 (24.4)	40 (50.6)	0.753	0.6686
Chinese	190 (58.6)	101 (53.2)		
Indian	55 (17.0)	32 (58.2)		
Gender				
Male	146 (45.1)	85 (58.2)	2.485	0.115
Female	178 (54.9)	88 (49.4)		
Area of residence				
Urban	201 (62.0)	97 (48.3)	5.613	0.019*
Rural	123 (38.0)	76 (61.8)		
Education level				
No formal education to primary school	192 (59.3)	112 (58.3)	4.618	0.032*
Secondary school and higher	132 (40.7)	61 (46.2)		
Tinnitus				
Yes	63 (19.4)	42 (66.7)	5.336	0.019*
No	261 (80.6)	131 (50.2)		

[Table/Fig-1]: Sociodemographic characteristics of participants, percentages of self-reported hearing loss and $\chi 2$ results.

The participants hearing thresholds were also measured at better ear across 0.5 to 8.0 kHz. The pure tone average (PTA) was categorized into three different frequency ranges which were 0.5 – 2.0 kHz, 0.5 – 4.0 kHz and 4.0 – 8.0 kHz. For each of the frequency range, the PTA was calculated at two cut-off points: 1) at least mild hearing loss (PTA > 25 dBHL); and 2) at least moderate hearing loss (PTA > 40 dBHL). [Table/Fig-2] shows the mean, standard deviation, range and frequency distribution according to these cut of points for each frequency range category.

Hearing Loss categories	Mean (SD) (dBHL)	Min (dBHL)	Max (dBHL)	Degree of hearing loss, n (%)	
				At least mild (PTA >25 dBHL)	At least moderate (PTA > 40 dBHL)
BE0.5–2.0kHz	32.6 (12.49)	10.0	93.0	221 (68.2)	67 (20.7)
BE0.5–4.0kHz	35.79 (12.95)	11.3	86.3	251 (77.5)	90 (27.8)
BEHF4.0–8.0kHz	48.15 (19.93)	12.5	117.5	273 (84.3)	195 (60.2)

[Table/Fig-2]: Mean, standard deviation, range and frequency distribution according to degree of loss for hearing loss categories.

Prevalence of Self-Reported Hearing Loss

Overall, the prevalence of self-reported hearing loss was 173 (53.4%) Chi-square tests were performed to determine whether there were

significant differences in self-reported hearing loss prevalence for each of the demographic characteristics listed in [Table/Fig-1]. The results revealed no significant differences in self-reported hearing loss prevalence between gender, age group and race (p>0.05). Area of residence, education level and history of tinnitus were significantly associated with self-reported hearing loss [Table/Fig-1]. Participants who resided in rural areas were more likely to admit having hearing loss (61.8%) than those who lived in urban areas (48.3%), (χ^2=5.613, p=0.018). Participants who had lower education level (58.3%) were more likely to report hearing loss than those who had higher education level (46.2%), (χ^2=4.618, p=0.032). Likewise, the prevalence of self-reported hearing loss was significantly higher among participants who had history of tinnitus (66.7%) than those who did not (50.2%) (χ^2=5.336, p=0.019).

The self-reported hearing problem was also compared to the better ear Pure Tone Average (PTA) across 0.5 to 4 kHz (BE0.5–4.0kHz). Out of 324 participants, 251(77.5%) participants had at least mild hearing loss (0.25 dBHL) at 0.5 to 4 kHz. Of those who had hearing loss as measured by audiometric test, only 182(56.2%) participants admitted having hearing problem. The PTA of participants who reported hearing problem was significantly higher compared to the group without the complaint (t=4.04, p<0.001, mean difference=5.70, CI 95% =2.92–8.47) with mean threshold of 38.4 dBHL (SD=14.2) and 32.7 dBHL (SD=10.6), respectively. Among those with self-reported hearing loss, the PTA (BE0.5–4.0kHz) was found to be significantly higher in 70+ years old group than the younger age group (t=3.54, p=0.001, mean difference=7.48, CI 95%=3.31–11.64) and in tinnitus group than non-tinnitus group (t=2.89, p=0.004, mean difference=7.12, CI 95%=2.25–11.99). The PTA for the 70+ years group and tinnitus group were 42.7 dBHL (SD=14.6) and 43.8 dBHL (SD=16.8), respectively.

Performance of The Self-Report Questions

Since Q1 has been widely used to determine self-reported hearing loss in many studies, we compared the performance of the self-reported hearing loss based on the multi questions (Q1–Q3) and Q1 alone as screening tools. [Table/Fig-3] shows the performance of these questions in identifying hearing loss against different frequencies pure tone averages and cut-off points. Overall, the sensitivity of self-reported hearing problem based on a "yes" to any of the questions (Q1-Q3) (54.9%–73.3%) was better than that of the Q1 alone (30.8%–58.2%). Using a cut-off point of 25 dBHL, the multi questions were more sensitive in identifying those with hearing loss compared to the use of the single question. The sensitivity increased up to 73% when a cut-off point of 40 dBHL was used. Generally, irrespective of cut-off point used, Q1 alone had a much lower sensitivity to identify hearing loss than the multi questions. The Q1 question had higher specificity (78.6%-89.0%) and PPV (41.5%-89.4) than the multi questions. The Q1 demonstrated poor accuracy (38.6%-49.1%) in identifying at least mild hearing loss and better accuracy for at least moderate loss (57.7%-74.4%). Nonetheless, the self-reported hearing problem based on multi questions showed accuracy between 54.9%-60.5% only.

Factors Associated with Self-Reported Hearing Loss

Binary logistic regression analysis was done to evaluate the association between self-reported hearing problem (Q–Q3) and demographic characteristics, PTAs and self-reported tinnitus. The Chi-square tests were first performed on the possible associated factors for self-reported hearing loss. Based on the findings [Table/Fig-1], the factors that had significant association with self-reported hearing problem were area of residence, education level and self-reported tinnitus. Separate independent t-tests were also done to determine whether the mean of PTAs of participants with self-reported hearing loss based on multi questions differed from those who did not. We found that differences were present only for PTAs of at least moderate hearing loss (>40 dBHL) (p<0.05). Therefore, these factors were added to the logistic regression model. The logistic regression model was statistically significant indicating that the predictors, as a set, reliably distinguish between those who reported and did not report hearing problems [χ^2(6)=35.836, p<0.001]. The model explained 14% (Nagelkerke R2) of the variance in self-reported hearing loss and correctly classified 63.6% of cases.

A multiple binary logistic regression indicated that only PTA BE0.5–4.0kHz was independently associated with self-reported hearing loss (OR=2.16, 95 CI (1.15–4.05), p=0.017). Furthermore, the Wald criterion demonstrated that only history of tinnitus contributed significantly to the prediction (p=0.023), in which those with history of tinnitus were twice more likely to also report a hearing problem than those without. [Table/Fig-4] shows the binary logistic regression analysis for self- report hearing loss among older adults in Malaysia.

Variables	Wald	OR	95% CI	p
Constant	10.51	0.303	-	0.002
Area of residence				
Urban (Ref)				
Rural	3.05	1.62	0.94 – 2.79	0.081
Education Level				
Secondary school and higher (Ref)				
No formal education to primary school	0.216	1.14	0.67 – 1.94	0.642
Hearing loss categories*				
BE0.5 – 2.0kHz > 40	2.60	2.00	0.87 – 4.44	0.674
BE0.5 – 4.0kHz > 40	5.74	2.16	1.15 – 4.05	0.017**
BEHF4.0 – 8.0kHz > 40	0.04	0.92	0.42 – 2.02	0.835
Tinnitus				
No (Ref)				
Yes	5.14	2.02	1.10 – 3.71	0.023**

[Table/Fig-4]: Predictor model for self-reported hearing loss among older adults in Malaysia.
* Reference category: PTA below 40 dBHL **p < 0.05.

Hearing loss categories	Screening performance characteristics (%)									
	Self-reported hearing problem (Q1 – Q3)					Q1: Do you think you have hearing loss?				
	Sensitivity	Specificity	PPV	NPV	Accuracy	Sensitivity	Specificity	PPV	NPV	Accuracy
BE0.5–2.0kHz										
> 25	56.1	52.4	71.7	35.8	54.9	33.9	81.6	79.8	36.5	49.1
> 40	73.1	51.8	28.3	88.1	56.2	58.2	78.6	41.5	87.8	74.4
BE0.5–4.0kHz										
> 25	56.2	56.2	81.5	27.2	56.2	32.7	83.6	87.2	26.5	44.1
> 40	73.3	54.3	38.2	84.1	59.6	51.1	79.5	48.9	80.9	71.6
BEHF4.0–8.0kHz										
> 25	54.9	54.9	86.7	18.5	54.9	30.8	80.4	89.4	17.8	38.6
> 40	61.5	58.9	69.4	50.3	60.5	39.0	89.0	80.9	48.3	57.7

[Table/Fig-3]: Screening performance characteristic for the self-reported hearing problem (Q1 – Q3) and the question 1 'Do you think you have hearing loss?".

DISCUSSION

Our research found that the prevalence of self-reported hearing problem among older adults based on the multi questions was 53.4%. This finding is in line with a similar study which also used a few questions to identify hearing problem [17,18]. Their set of questions that consists of question each on self-report and hearing loss, difficulty hearing in noise, presence of tinnitus and report on intolerance toward everyday sound, yielded a prevalence of 60.8%. The current finding was also similar to studies conducted in other countries such as the United States and Australia. The prevalence of self-reported hearing loss in those countries was between 40.8% and 60.7% [9,11,19].

To our knowledge, there was only one available local study that measured the prevalence of self-reported hearing problem [12]. In their study, they identified only 24.3% older adults who reported hearing loss, which is lower than the current study. This discrepancy is expected since they used a single question "Do you have hearing loss?" to identify self-reported hearing loss. Furthermore, we recruited participants from a community-dwelling older adult population while Rosdina et al., study only concentrated on patients attending a primary care facility.

We found that self-reported hearing loss was not predicted by gender, age, race and education. These results were consistent with a few of the previous studies [9,12]. Nonetheless, there are studies that found significant associations between such demographic characteristics and self-reported hearing problem. For example, Mutsuko et al., found that older participants tend to report hearing loss compared to their younger counterparts [20]. A more dated research found that women tended to perceive themselves to have hearing problem than men [19].

The present study found that tinnitus and PTA of 40 dBHL and over across 0.5 to 4 kHz were significantly associated with self-reported hearing problem. Participants who resided in rural areas and those with self-reported tinnitus were twice more likely to report hearing problem than their urban or non-tinnitus counterparts. The contribution of tinnitus in the likelihood of self-reporting hearing problem is expected. This is because participants with tinnitus as a group had a significantly higher PTA than the non-tinnitus group. Furthermore, many studies have found the contribution of abnormal peripheral auditory system to the generation of tinnitus [21-23]. This finding ties with the significant contribution of at least moderate hearing loss at 0.5 kHz to 4kHz, with twice more likely report of hearing problem. This finding could be partly explained by the fact that having a significant hearing loss at these frequencies may significantly impact conversation; hence those with higher thresholds have more tendencies to report hearing loss than their better hearing counterparts.

A single question such as "Do you have hearing loss?" was recommended as a tool to screen for hearing loss because it showed good screening performance [24]. However, the present study found that the question (Q1) had poor sensitivity, especially, in detecting at least mild hearing loss (PTA > 25 dBHL). The sensitivity improved when the hearing loss was based on > 40 dBHL. Likewise, the self-reporting hearing problem questions (Q1–Q3) also show better sensitivity when using the 40 dBHL cut-off level. This finding is expected because more severe hearing loss is likely to result in worse hearing difficulty. As a typical conversational level is between 60-70 dBSPL, those with more elevated hearing thresholds may find more difficulty during conversation, especially with the presence of competing sounds, as compared to those with better hearing thresholds [25].

Although the multi self-reported hearing problem questions (Q1-Q3) were better able to detect at least mild hearing loss than the single Q1 question, it has a higher probability of falsely identifying a positive result. Nonetheless, based on the overall results of this study, it can be concluded that the multi questions are superior to single question in identifying hearing loss among older adults. The sensitivity, however, is poorer than the recommended value for good screening tools. The finding was comparable with a few previous studies. A study by Rosdina et al., found the sensitivity of the single question to be at 41.4% and 55% for the identification of at least mild and moderate hearing loss, respectively [12]. In Singapore, Wu et al reported the sensitivity of the question as 58% [26].

In contrast to our findings, other large scales studies reported that the question "Do you feel you have hearing loss" to have better sensitivity to identify at least mild hearing loss. For example, the Blue Mountain Hearing Study found the question yielded high sensitivity and specificity of 78% and 67%, respectively [9]. Similarly, Nondahl et al., reported the sensitivity and specificity of the single question in identifying older adults with hearing loss in United States as 71% [11]. The performance of a set of questions or a questionnaire such as Hearing Handicap Inventory for the Elderly-Screening (HHIE) was found to yield better sensitivity and specificity [18]. These differences in results could reflect the different in term of definition used to describe hearing loss, questions for hearing loss identification and population under studies.

LIMITATION

The present study had strengths and limitation. Compared to other local studies, the current study is a large-scale population based study which has higher degree of generalisation. The large sample size and recruitment of participants from the various districts in Selangor enables us to make reasonable presentation of results specific to gender and age groups. However, the proportion of the races in this study did not reflect the proportion of races in Selangor, particularly, and Malaysia generally. Therefore, the prevalence of measured and self-reported hearing loss, and sensitivity and specificity of the questions need to be interpreted with caution as the findings may not be representing the three major races in Malaysia.

CONCLUSION

The prevalence of self-reported hearing loss in the present study was high. The use of multi questions could better reflect true prevalence of measured hearing loss than single questions provided that the questions have higher sensitivity in identifying hearing loss among community dwelling older adults. However, the current study found these questions to be a poor measure of hearing impairment in our local population. Therefore, the use of a more effective self-report inventory or audiometry instrument that is less sensitive to background noise is recommended so that population based hearing screening can be more feasible in order to estimate hearing loss prevalence among adults in Malaysia.

ACKNOWLEDGEMENTS

This study was supported by the by The Ministry of Education (MOE), Malaysia through Long-term Research Grant Scheme (LRGS/BU/2012/UKM-UKM/K/02). We would like to thank all the participants for their participation, BP Healthcare for providing a mobile sound booth during the data acquisition period and audiologists; Steven Lee, Nor Azimah and Ser Reen for their assistance in collecting data.

REFERENCES

[1] Collins JG. Prevalence of selected chronic conditions : United states, 1990-92. Hyattsville, Md.: U.S. Dept. of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 1997.
[2] WHO. Deafness and hearing loss. World Health Organization; 2015. [cited 2016 23rd September]. Available from: http://www.who.int/mediacentre/factsheets/fs300/en/
[3] MOH. Malaysia's health 2007. Putrajaya: Ministry of Health; 2007. [cited 2016 23rd September]. Available from: http://www.moh.gov.my/images/gallery/publications/md/ar/2007-2.pdf
[4] WHO. Global health observatory (gho) data: Life expectancy 2015 [cited 2016 23rd September]. Available from: http://www.who.int/gho/mortality_burden_disease/life_tables/situation_trends/en/.

[5] Gopinath B, Rochtchina E, Wang J, Schneider J, Leeder SR, Mitchell P. Prevalence of age-related hearing loss in older adults: Blue mountains study. Arch Intern Med. 2009;169(4):415-18.
[6] Baraky LR, Bento RF, Raposo NR, Tibirica SH, Ribeiro LC, Barone MM, et al. Disabling hearing loss prevalence in juiz de fora, brazil. Braz J Otorhinolaryngol. 2012;78(4):52-58. PubMed PMID: 22936137. Epub 2012/09/01. eng por.
[7] Agrawal Y, Platz EA, Niparko JK. Prevalence of hearing loss and differences by demographic characteristics among us adults: Data from the national health and nutrition examination survey, 1999-2004. Arch Intern Med. 2008;168(14):1522-30.
[8] Bevilacqua MC, Banhara MR, Oliveira AN, Moret AL, Alvarenga Kde F, Caldana Mde L, et al. Survey of hearing disorders in an urban population in rondonia, northern brazil. Rev Saude Publica. 2013;47(2):309-15. PubMed PMID: 24037358. Epub 2013/09/17. eng.
[9] Sindhusake D, Mitchell P, Smith W, Golding M, Newall P, Hartley D, et al. Validation of self-reported hearing loss. The blue mountains hearing study. International Journal of Epidemiology. 2001;30(6):1371-78.
[10] Cruz MS, Lima MCP, Santos JLF, Lebrao ML, Duarte YAdo, Ramos-Cerqueira ATdA. Self reported hearing loss incidence and risk factors. Cad Saude Publica. 2013;24(4):702-12.
[11] Nondahl DM, Cruickshanks KJ, Wiley TL, Tweed TS, Klein R, Klein BEK. Accuracy of self-reported hearing loss. Int J Audiol. 1998;37(5):295-301.
[12] Rosdina A, Leelavathi M, Zaitun A, Lee V, Azimah M, Majmin S, et al. Self-reported hearing loss among elderly Malaysians. Malaysian Family Physician. 2010;5(2):91-94.
[13] Shahar S, Omar A, Vanoh D, Hamid TA, Mukari SZM, Din NC, et al. Approaches in methodology for population-based longitudinal study on neuroprotective model for healthy longevity (tua) among malaysian older adults. Aging Clinical and Experimental Research. 2015:1-16.
[14] Frank T. Ansi update: Maximum permissible ambient noise levels for audiometric test rooms. Am J Audiol. 2000;9(1):3-8. PubMed PMID: 10943020. Epub 2000/08/16. eng.
[15] Gates GA, Mills JH. Presbycusis. The Lancet. 2005;366(9491):1111-20.
[16] WHO. Guidelines for hearing aids and services for developing countries (2nd ed.). Geneva: World Health Organization; 2004.
[17] Hannula S, Bloigu R, Majamaa K, Sorri M, Mäki-Torkko E. Audiogram configurations among older adults: Prevalence and relation to self-reported hearing problems. Int J Audiol. 2011;50(11):793-801. PubMed PMID: 20839902.
[18] Tomioka K, Ikeda H, Hanaie K, Morikawa M, Iwamoto J, Okamoto N, et al. The hearing handicap inventory for elderly-screening (hhie-s) versus a single question: Reliability, validity, and relations with quality of life measures in the elderly community, japan. Qual Life Res. 2013;22(5):1151-59. PubMed PMID: 22833152. Epub 2012/07/27. eng.
[19] Moscicki EK, Elkins EF, Baurn HM, McNarnara PM. Hearing loss in the elderly: An epidemiologic study of the framingham heart study cohort. Ear Hear. 1985;6(4):184-90.
[20] Mutsuko Y, Yuji N, Takehiro M, Toru T. Self-reported hearing loss in older adults is associated with future decline in instrumental activities of daily living but not in social participation. Journal of American Geriatric Society. 2012;60(7):1304-09.
[21] Ukaegbe O, Ezeanolue B, Orji F. The influence of tinnitus on the audiometric threshold of sufferers. International Archives of Otorhinolaryngology. 2016;20(4):339-43.
[22] Ishak WS, Zhao F, Rajenderkumar D, Arif M. Measurement of subtle auditory deficit in tinnitus patients with normal audiometric thresholds using evoked otoacoustic emissions and threshold equalizing noise tests. International Tinnitus Journal. 2013;18(1):35-44.
[23] Zhao F, Stephens SDG, Ishak WS, Meyer-Bisch C. The characteristics of audioscan and dpoae measures in tinnitus patients with normal hearing thresholds. International Journal of Audiology. 2014;53(5):309-17.
[24] Valete-Rosalino CM, Rozenfeld S. Auditory screening in the elderly: Comparison between self-report and audiometry. Brazilian journal of otorhinolaryngology. 2005;71(2):193-200.
[25] Hornsby BW, Johnson EE, Picou E. Effects of degree and configuration of hearing loss on the contribution of high-and low-frequency speech information to bilateral speech understanding. Ear and hearing. 2011;32(5):543.
[26] Wu HY, Chin JJ, Tong HM. Screening for hearing impairment in a cohort of elderly patients attending a hospital geriatric medicine service. Singapore Med J. 2004;45(2):79-84. PubMed PMID: 14985847. Epub 2004/02/27. eng.

PARTICULARS OF CONTRIBUTORS:
1. Senior Lecturer, Audiology Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.
2. Professor, Institute of Ear, Hearing and Speech, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.
3. Senior Lecturer, Audiology Program, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.
4. Audiologist, Hospital Canselor Tuanku Muhriz, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Wan Syafira Ishak,
Audiology Program, The National University of Malaysia, Jalan Raja Muda Abdul Aziz-50300, Kuala Lumpur, Malaysia.
E-mail: wsyafira@ukm.edu.my

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 14, 2017**
Date of Peer Review: **May 01, 2017**
Date of Acceptance: **Aug 23, 2017**
Date of Publishing: **Oct 01, 2017**