

Hearing Loss and Risk Factors among Community Dwelling Older Adults in Selangor

(Hilang Pendengaran dan Faktor Risiko dalam Kalangan Warga Tua dalam Komuniti di Selangor)

SITI ZAMRATOL-MAI SARAH MUKARI*, NASHRAH MAAMOR, WAN SYAFIRA ISHAK & WAN FAZLINA WAN HASHIM

ABSTRACT

There is a lack of population-based data on prevalence of hearing loss in Malaysia. The purpose of this population-based study was to determine the prevalence of hearing loss and its risk factors among 382 older adults aged 60 years and above, recruited through multistage random sampling in Selangor. Hearing level was measured using pure tone audiometry. Hearing loss was classified into at least mild hearing loss and significant hearing loss based on the pure tone average (PTA) of 0.5, 1, 2 and 4 kHz. The examination also included face-to-face interview on hearing related medical history, noise exposure and hearing aid use. Overall, the prevalence of at least mild hearing loss and significant hearing loss were 73.6% (95% CI: 69.4 - 77.4) and 24.6% (95% CI: 20.8 - 28.7), respectively. The odds for at least 'mild hearing loss' were male gender, Chinese ethnicity, residing in urban areas, had no formal education or primary school education and history of hypertension. The risk for 'significant hearing loss' was significantly higher in males, those who lived in urban areas and elderly with cognitive impairment. Chinese and Indian ethnicities had significantly lower risks than Malay ethnic to have significant hearing loss. Despite the high prevalence of hearing loss, only 4.4% who might benefit from hearing aids wore them. In conclusion, findings from this study show high prevalence of hearing loss among the elderly population. Given the significant association between hearing loss and cognitive impairment, future studies should explore the role of hearing amplification in alleviating or slowing the progress of cognitive decline.

Keywords: Community dwelling elderly; hearing loss; prevalence; risk factors

ABSTRAK

Data prevalen hilang pendengaran di Malaysia adalah terhad. Kajian berasaskan populasi ini bertujuan menentukan prevalen hilang pendengaran dan faktor risikonya dalam kalangan 382 orang penduduk Selangor yang berumur 60 tahun dan ke atas yang dipilih melalui persampelan rawak pelbagai tahap. Tahap pendengaran diukur menggunakan audiometri nada tulen. Hilang pendengaran dibahagikan kepada dua tahap, iaitu hilang pendengaran ringan dan hilang pendengaran ketara berdasarkan purata nada tulen (PTA) pada frekuensi 0.5, 1, 2 dan 4 kHz. Temu bual bersemuka juga dilakukan untuk mendapatkan maklumat mengenai sejarah perubatan yang berkaitan dengan pendengaran, pendedahan kepada hingar, serta pemakaian alat bantu pendengaran. Prevalen hilang pendengaran ringan atau lebih adalah 73.6% (95% CI: 69.4 - 77.4), manakala hilang pendengaran ketara pula ialah 24.6% (95% CI: 20.8 - 28.7). Faktor risiko yang berkaitan dengan hilang pendengaran ringan atau lebih ialah lelaki, berbangsa Cina, tinggal di kawasan bandar dan tidak mendapat pendidikan formal atau pendidikan sekolah rendah dan mengidap hipertensi. Risiko untuk hilang pendengaran ketara pula ialah lelaki, tinggal di bandar dan kemerosotan kognitif. Bangsa Cina dan India didapati mempunyai risiko yang lebih rendah daripada bangsa Melayu bagi hilang pendengaran ketara. Walaupun prevalen hilang pendengaran adalah tinggi, hanya 4.4% daripada mereka yang boleh mendapat manfaat daripada alat bantu pendengaran memakainya. Kesimpulannya, kajian ini menunjukkan prevalen hilang pendengaran dalam kalangan warga tua adalah tinggi. Memandangkan hubungan yang signifikan antara hilang pendengaran dan keceleaan kognitif, kajian akan datang perlu meneroka peranan amplifikasi pendengaran dalam mengurang atau melambatkan kadar penurunan fungsi kognitif.

Kata kunci: Faktor risiko; hilang pendengaran; prevalen; warga tua dalam komuniti

INTRODUCTION

Hearing loss is one of the most prevalent chronic conditions affecting older adults. The World Health Organization (2013) estimates that about 33% of adults older than 65 years old suffer from disabling hearing loss. This prevalence is unevenly distributed, being higher in low income countries than in developed nations. Low health

status, lack of awareness on hearing health and limited services related to prevention and treatment of health conditions in regards to hearing loss may be some of the reasons for the higher prevalence of hearing loss seen in the less developed countries.

Although hearing loss in the older age group is often viewed as a noncritical health condition and considered as

normal, its impact can be significant. Hearing loss can lead to physical, social (Kramer et al. 2002; Strawbridge et al. 2000), psychosocial (Lotfi et al. 2009) and cognitive consequences (Tun et al. 2009; Uhlmann et al. 1989). Difficulty to hear clearly can lead to physical and emotional exhaustion as more attention and energy are required to decode auditory information. Communication problem may also lead to social isolation, feeling of loneliness, stigmatization, depression and increase dependency on others (Shield 2006). Additionally, more recent studies have also associated hearing loss with faster rate of cognitive decline (Lin et al. 2013; Tay et al. 2006; Valentijn et al. 2005).

Despite the negative impact of hearing loss on the overall quality of life, published prevalence data of hearing loss in Malaysia is limited. The best population based data on hearing loss was obtained from the National Ear and Hearing Disorders Survey conducted in 2005 (Ministry of Health 2007). Although the study reported on demographic patterns of hearing loss, detailed analysis on modifiable risk factors and association of hearing loss with cognitive impairment were not included. In this study we reported the prevalence of hearing loss in adults aged 60 years and above. Besides examining the associations between demographic characteristics and hearing loss, we also determine the relationship between hearing loss with cognition and modifiable known risk factors such as noise exposure, diabetes mellitus and hypertension. Finally, in light of prior studies that report low hearing aid adoption rate (Zhao et al. 2015), particularly in the developing countries, we examined the prevalence of hearing aid use among participants with hearing loss in this study.

METHODS

STUDY COHORT

This research was part of a prospective population-based study on ageing (LRGS-TUA). The LRGS-TUA focused on a wide range of neuroprotective factors of Malaysian elderly. Participants were recruited through random sampling of enumeration blocks from four zones in Malaysia, namely the east, north, central and south zones. The details of sampling technique were as described in Shahar et al. (2015).

For this part of the study we collected hearing data from the central zone, which was represented by the state of Selangor. From 728 recruited, 613 participants fulfilled the study LRGS-TUA inclusion criteria (84.2%) and agreed to participate. However, only 382 (62.3%) attended the hearing interview and testing. Audiometric data was available from 378 participants (61.7%). As a result of high attrition rate, the demographic distribution of our sample differed from that of the Selangor population. Therefore, we applied post-stratification weighting to the data to provide the state representativeness in terms of gender, ethnic and area of residence (urban/rural) according to the

2010 National census. The report of this study is based on the weighted data.

AUDIOMETRIC ASSESSMENT

The hearing assessment included an otoscopic examination, screening tympanometry, and measurement of air and bone conduction hearing thresholds. Pure tone hearing thresholds were conducted by trained personnel in a sound-treated mobile booth using a calibrated Madsen Itera II diagnostic audiometer that was equipped with TDH 39 headphones. We measured pure tone air conduction thresholds at 0.5, 1, 2, 4 and 8 kHz. Pure tone average (PTA) was calculated for the octave frequencies from 0.5 to 4 kHz, considered important for speech perception. In this report we divide hearing loss into 2 categories: at least mild hearing loss (PTA \geq 25 dBHL); and significant or moderate hearing loss (PTA \geq 40 dBHL) at least mild HL in the better ear. Reporting the prevalence of at least mild hearing loss is important for comparative purposes because most of previous studies used this criterion in their reports. Additionally, we also described the prevalence of significant hearing loss to better reflect the occurrence of hearing loss which requires clinical intervention in our elderly population.

OTHER VARIABLES

Data of demographic characteristics, medical history and history of noise exposure were obtained from the face-to-face interviews. Cognitive function was measured using the Malay version of Mini Mental State Examination (MMSE) (Zarina & Che Wan 2010). Age was grouped as 60 to 64 years, 65 to 69 years, 70 to 74 years and 75 or more years. Race was categorized as Malay, Chinese and Indian. Although the initial study samples also comprised of 'other races', they were omitted from the analyses because there were only four of them. Education level was collapsed into three levels, which were: no formal education and primary school; secondary school (up to form five); and post-secondary school. Participants were asked whether they have been diagnosed as having hypertension and diabetes mellitus through yes/no question. Similarly, history of exposure to excessive noise was also obtained. Information on hearing aid use was also obtained during the interview. Cognitive status was classified into normal (MMSE > 21) and impaired cognition (MMSE \leq 21) (Ibrahim et al. 2009). Information about hearing aid use was elicited by asking the participants on whether or not they wear hearing aid, through a yes/no response option.

STATISTICAL ANALYSIS

We determine the prevalence of at least mild hearing loss and significant hearing loss. Hearing loss was treated as a dichotomous variable. Binary logistic regression analyses were used to determine the odds of having hearing loss associated with demographic characteristics, adjusting for MMSE, hypertension, diabetes mellitus and noise exposure.

RESULTS

COHORT

Out of 476 participants (weighted data), 41.3% were males and 64.2% lived in urban areas. Malay ethnicity formed 45.2% of this cohort, while the compositions of Chinese and Indian were 43.1 and 11.7%, respectively. Majority of the participants (57.3%) either received no formal education or only attended primary school. Only 11.3% had post-secondary education and 31.4% attended secondary schools. The participants aged from 60 to 85 years (Mean = 68.5, SD: 5.6 years).

PREVALENCE OF AT LEAST MILD AND SIGNIFICANT HEARING LOSS

The overall prevalence of at least mild hearing loss was 73.6% (95% CI: 69.4 - 77.4) while the prevalence of

significant hearing loss was 24.6% (95% CI: 20.8 - 28.7). Tables 1 and 2 summarize the prevalence of different levels of hearing by demographic characteristics, MMSE, hypertension and noise exposure.

PREVALENCE AND CORRELATES OF HEARING LOSS

We evaluated the associations between hearing loss and demographic characteristics, MMSE, hypertension, diabetes mellitus and history of noise exposure using logistic regression analyses. In logistic regression models, adjusting for all confounders (Table 1), the odds of having at least mild hearing loss was significantly associated with age, gender, race, education status, area of residence and history of hypertension. Across 5-year age groupings, hearing loss was found most prevalent in the 65 - 69 years age group (OR = 2.23 (95% CI: 1.08 - 4.62)) compared to 60 - 64 years old group. Males were almost thrice more

TABLE 1. Prevalence and correlates of mild hearing loss or more in adults aged 60 years and above

	Prevalence (95% CI)	‡Univariate OR (95% CI)	‡Multivariate OR (95% CI)
Age (year)			
60 – 64	69.9 (62.3 – 76.5)	Reference	Reference
65 – 69	84.1 (75.1 – 90.3)	2.30* (1.18 – 4.49)	2.23* (1.08 – 4.62)
70 – 74	70.2 (62.7 – 76.7)	1.02 (0.63 – 1.65)	0.62 (0.34 – 1.13)
≥75	75.8 (63.9 – 84.8)	1.34 (0.68 – 2.63)	1.19 (0.49 – 2.90)
Gender			
Male	80.6 (74.5 – 85.5)	1.93** (1.25 – 3.00)	2.93*** (1.72 – 4.98)
Female	68.5 (62.8 – 73.8)	Reference	Reference
Race			
Malay	66.4 (59.7 – 72.4)	Reference	Reference
Chinese	80.5 (74.5 – 85.4)	2.11** (1.34 – 3.33)	2.59** (1.41 – 4.77)
Indian	75.0 (62.3 – 84.5)	1.53 (0.78 – 3.01)	1.30 (0.58 – 2.90)
Education			
None and primary	77.0 (71.6 – 81.6)	2.60** (1.40 – 4.83)	2.57* (1.14 – 5.79)
Secondary	73.3 (65.7 – 79.8)	2.15* (1.11 – 4.15)	1.63 (0.77 – 3.46)
Post-secondary	55.8 (42.3 – 68.4)	Reference	Reference
Area of residence			
Rural	65.5 (73.2 – 82.6)	Reference	Reference
Urban	78.3 (58.0 – 72.3)	1.91** (1.25 – 2.90)	2.79*** (1.57 – 4.97)
MMSE			
≤21	78.4 (67.8 – 76.6)	1.41 (0.77–2.57)	0.5 (0.24 – 1.04)
>21	72.4 (67.7 – 86.2)	Reference	Reference
Hypertension			
No	64.0 (57.1 – 70.3)	Reference	Reference
Yes	80.7 (75.6 – 85.0)	2.39*** (1.57 – 3.64)	2.11* (1.23 – 3.62)
Diabetes mellitus			
No	68.6 (63.4 – 73.4)	Reference	Reference
Yes	85.2 (78.5 – 90.1)	2.59*** (1.54 – 4.35)	1.83 (0.98 – 3.42)
History of noise exposure			
No	72.6 (67.8 – 76.9)	Reference	Reference
Yes	76.2 (67.2 – 83.3)	1.23 (0.74 – 2.04)	1.02 (0.51 – 2.02)

Asterisks signify level of statistical significance: * $p < .05$; ** $p < .01$; *** $p < .001$.

‡ Univariate odds ratios indicate the odds of hearing loss relative to the designated reference group.

‡ Multivariate odds ratios indicate the odds of hearing loss relative to the designated reference group after adjusting for other covariates listed in Table 1

TABLE 2. Prevalence and correlates of moderate hearing loss or more in adults aged 60 years and above

	Prevalence (95% CI)	‡Univariate OR (95% CI)	‡Multivariate OR (95% CI)
Age (year)			
60 – 64	22.3 (16.3 – 29.7)	Reference	Reference
65 – 69	28.7 (20.3 – 39.0)	1.44 (0.79 – 2.62)	1.37 (0.70 – 2.68)
70 – 74	24.5 (18.4 – 31.9)	1.16 (0.68 – 1.97)	1.04 (0.55 – 1.97)
≥75	23.8 (15.0 – 35.6)	1.08 (0.54 – 2.14)	1.08 (0.47 – 2.49)
Gender			
Male	33.7 (27.4 – 40.7)	2.37*** (1.53– 3.67)	4.60*** (2.67 – 7.91)
Female	17.9 (13.7 – 23.0)	Reference	Reference
Race			
Malay	26.7 (20.8 – 32.7)	Reference	Reference
Chinese	22.6 (17.3 – 28.9)	0.81 (0.51 – 1.27)	0.56* (0.32 – 0.98)
Indian	23.1 (13.7 – 36.1)	0.82 (0.40 – 1.68)	0.29** (0.12 – 0.70)
Education			
None and primary	26.6 (21.6 – 32.3)	0.79 (0.49 – 1.28)	1.89(0.75 – 4.77)
Secondary	22.4 (16.3 – 30.0)	0.66 (0.31 – 1.41)	1.27 (0.52 – 3.12)
Post-secondary	18.4 (10.0 – 31.4)	Reference	Reference
Area of residence			
Rural	23.9 (19.6 – 32.7)	Reference	Reference
Urban	25.6 (19.3 – 29.1)	0.90 (0.58 – 1.40)	2.15* (1.18 – 3.90)
MMSE			
≤21	49.3 (15.3 – 23.3)	4.10*** (2.42 – 6.43)	7.28*** (3.69 – 14.38)
>21	19.0 (38.2 – 60.5)	Reference	Reference
Hypertension			
No	22.0 (16.7 – 28.4)	Reference	Reference
Yes	26.1 (21.1 – 31.7)	1.25 (0.81 – 1.94)	1.06 (0.61 – 1.84)
Diabetes mellitus			
No	23.2 (18.9 – 28.2)	Reference	Reference
Yes	27.3 (20.6 – 35.3)	1.24 (0.79 – 1.96)	1.23 (0.69 – 2.19)
History of noise exposure			
No	25.9 (21.5 – 30.7)	Reference	Reference
Yes	20.4 (13.7 – 29.2)	0.72 (0.42 – 1.24)	0.65 (0.34 – 1.23)

Asterisks signify level of statistical significance: * $p < .05$; ** $p < .01$; *** $p < .001$.

‡Univariate odds ratios indicate the odds of hearing loss relative to the designated reference group.

‡ Multivariate odds ratios indicate the odds of hearing loss relative to the designated reference group after adjusting for other covariates listed in Table 2

likely than females to have hearing impairment (OR = 2.93 (95% CI: 1.72 - 4.98)) and Chinese were more likely to have at least mild hearing loss than Malay (OR = 2.59 (95% CI: 1.41 - 4.77)). The prevalence of hearing loss was more than twice higher in participants who received no formal education or primary school education (OR = 2.57, (95% CI: 1.14 - 5.79)), compared to those who attended post-secondary school education. Living in urban areas was also significantly associated with higher prevalence of mild hearing loss or more (OR = 2.79, (95% CI: 1.57 - 4.97)). Hypertension doubled the likelihood of at least mild hearing loss, (OR = 2.11, (95% CI: 1.23 - 3.62)). We found no association between cognitive status, diabetes mellitus and history of noise exposure with hearing loss.

We also performed a logistic regression analysis to explore the association between moderate hearing loss or more (significant hearing loss) and all the above variables (Table 2). After controlling for other variables, gender, race, area of residence and cognitive level were

significantly associated with significant hearing loss. Males were four times more likely to have significant hearing loss than females, (OR = 4.60, (95% CI: 2.67 - 7.91)). Hearing loss was less likely among Chinese (OR = 0.56, (95% CI: 0.32 - 0.98)) and Indian (OR = 0.29, (95% CI: 0.12 - 0.70)) than Malay. Those residing in urban areas were about twice more likely to have hearing loss (OR = 2.15, (95% CI: 1.18 - 3.90)). The prevalence of significant hearing loss increased more than seven times in participants with mild cognitive impairment (OR = 7.28, (95% CI: 3.69 - 14.38)), compared to those with normal cognition.

HEARING AID USE

The overall prevalence of hearing aid use among participants with hearing loss was 4.4%. The prevalence of hearing aid use among those with mild and moderate hearing loss was 3.3 and 6.5%, respectively.

DISCUSSION

Using the hearing loss definition proposed by the World Health Organization (2013), we found that 73.6% of adults aged 60 years and above had at least mild hearing loss in the better ear. The prevalence of significant hearing loss was 24.6% and yet less than 5% of those who could benefit from hearing amplification wore hearing aids. The prevalence estimate of at least mild hearing loss is somewhat similar to that of population-based study carried out in Malaysia in the year 2005, in which it was estimated that the prevalence of hearing loss among adults aged 60 years and above was estimated to be about 70%. However, it is important to note that the aforementioned study defined hearing loss based on the average hearing thresholds of 1, 2, 3 and 4 kHz. Considering that hearing loss in older adults tends to affect higher frequencies more than low frequencies the prevalence of hearing loss in the present study is likely to be higher if we were to exclude 0.5 kHz in defining hearing loss.

Consistent with previous studies, we found that the prevalence of at least mild hearing loss was significantly associated with demographic characteristics such as age, gender, race, education level and area of residence. For significant hearing loss or at least moderate hearing loss, however, significant factors include gender, race and area of residence. While hypertension was not associated with significant hearing loss, it doubled the likelihood of at least mild hearing loss. In contrast, cognitive impairment increased the prevalence of significant hearing loss by more than seven folds and yet did not increase the probability of at least mild hearing loss.

We did not find significant associations between either at least mild or significant hearing loss with diabetes mellitus and noise exposure. Unlike many studies which found the prevalence of hearing loss increasing with age, we observed that hearing loss was significantly more prevalent among the age group of 65 - 69 years old group as compared to 60 - 64 years old. Surprisingly, in this study, increase in age is not associated with higher probability of having significant hearing loss.

Similar to many previous studies, we found that hearing loss is more prevalent in males than in females. For at least mild hearing loss males are nearly three times more likely to have hearing loss than females. Male dominance over female is even greater for significant hearing loss, where males are about four and a half times more likely than females to suffer from hearing loss. This male preponderance has been frequently linked to differences in occupational and recreational preferences and associated level of noise exposure (Pratt et al. 2009). More recent studies suggest that gender differences may be attributed to hormonal differences. For examples, females were found to have elevated hearing thresholds three months after hysterectomy (Reron et al. 2002) and postmenopausal females who received oestrogen therapy showed slowing of hearing loss progression (Kilicdag et al. 2004).

The prevalence of at least mild hearing loss is significantly associated with race. Chinese are two and a half time more likely to have hearing loss compared to Malay, while the prevalence of hearing loss in Indian did not differ significantly from Malay. However, different pattern was observed for significant hearing loss where Chinese were about 50% and Indian 70% less likely to have significant hearing loss than the Malay group. Possible reasons for differences across racial groups include cultural attitudes towards health, dietary intake and access to health care. In addition, an intrinsic factor known as melanin has been cited to have otoprotective role (Barrenas 1997). However, to the best of our knowledge, there has not been any study examining the otoprotective effects of melanin between different Asian racial groups.

This study showed differences in the prevalence of at least mild and significant hearing loss among urban and rural population. The urban population has almost three times higher prevalence of at least mild hearing loss and twice more frequent to have significant hearing loss than the rural population. This disparity could be due to environmental factors such as noise exposure. It must be noted, however, that the sample of this study was biased towards urban population, which comprised of about two-thirds of the study participants. Although the data of the present study has been weighted according to the distribution of racial, gender, age groups and area of residents of Selangor population, it was still possible that the prevalence of hearing loss among the rural population was underestimated.

Previous studies have yielded conflicting results with regards to the association between hypertension and hearing loss in older adults. For instance, Agrawal et al. (2008) in their epidemiological study on the prevalence of hearing loss in adults found that hypertension accentuated the onset of hearing loss. In contrast, Lin et al. (2011) did not find a significant correlation between hypertension and hearing loss. It is possible that hypertension is only weakly associated with hearing loss and its effect was masked by stronger risk factors (Lin et al. 2011). In our study, hypertension was only significantly associated with at least mild hearing loss but not significant hearing loss.

We did not find positive associations between hearing loss with diabetes mellitus. Other population-based studies also produced equivocal results with regards to diabetes mellitus. For example, diabetes mellitus was found to increase the risk of hearing loss in Agrawal et al. (2008) study but not in Cruickshank et al. (1998) and Lin et al. (2011).

Noise exposure has been significantly correlated with hearing loss in many population-based studies (Agrawal et al. 2008; Cruickshanks et al. 1998), but our results did not support this finding. This discrepancy could be due to the way we obtained information about noise exposure. In this study, the information about noise exposure was obtained using a general question on whether or not participants have been exposed to loud sounds either at work or during leisure time, without specifying the noise source and

duration of exposure. This type of question was likely to result in inaccurate data on noise exposure and affects the estimates of odds ratio between the two variables.

Our study also showed that cognitive impairment was greatly associated with significant hearing loss, with participants having cognitive impairment found to be about seven times more likely to display significant hearing loss. The significant association between cognitive impairment and hearing loss was consistent with prior studies which demonstrate similar findings (Lin et al. 2011; Tay et al. 2006; Valentijn et al. 2005). Because of these associations, recent studies have examined the possibility of hearing aid usage in alleviating or slowing the rate of cognitive decline (Lin et al. 2013). However, the results so far have not been encouraging (Lin et al. 2013; Wong et al. 2014).

Despite the high prevalence of hearing loss in this cohort, only 4.4% of those with at least mild hearing loss wore hearing aids. The prevalence of hearing aid use increased to 6.5% among those with significant hearing loss. These hearing aid take-up rates were lower compared to results obtained from other countries. A population-based study by Chien and Lin (2012) in the United States of America, for example, found that 7.3% of individuals with at least mild hearing loss aged between 60 - 69 years old wore hearing aids. This prevalence rose to 17.0% among the 70 - 79 years old. Similarly, a study in Brazil found a higher rate of hearing aid use (10%) than in this study (Cruz et al. 2013).

In conclusion, the prevalence of hearing loss among elderly in Selangor is high. Despite that, the hearing aid take-up rate is very low, indicating that in most cases, hearing loss remains untreated. In view of the significant association between cognitive impairment and hearing loss, future studies should explore the possibility of hearing aid use in slowing the progress of cognitive decline. Additionally, because prior studies have confirmed the adverse effects of hearing loss on various aspects of life there is a need to emphasize the importance of hearing aid use among individuals with hearing loss.

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- Siti Zamratol-Mai Sarah Mukari*
Institute of Ear, Hearing and Speech (I-HEARS)
Universiti Kebangsaan Malaysia
Jalan Raja Muda Abdul Aziz
50300 Kuala Lumpur, Federal Territory
Malaysia
- Nashrah Maamor & Wan Syafira Ishak
Audiology Program, School of Rehabilitation Sciences
Faculty of Health Sciences
Universiti Kebangsaan Malaysia
Jalan Raja Muda Abdul Aziz
50300 Kuala Lumpur, Federal Territory
Malaysia
- Wan Fazlina Wan Hashim
Hospital Canselor Tuanku Muhriz
Jalan Yaacob Latif, Bandar Tun Razak
56000 Cheras, Kuala Lumpur, Federal Territory
Malaysia

*Corresponding author; email: zamratol@ukm.edu.my

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