



Research Article

Targeted Screening in Older Adults: Hearing Loss and Mild Cognitive Impaired

Wai Tsz Chang^{1,2*}, Iris Hoi Yee Ng^{1,2}, Carol Man Kuen Cheung^{1,4}, Marcus Owen Tsang¹, Aurora Ka Yue Tam^{1,4}, Cody Chan¹, Lucas Wai Lok Chan¹, Joshua Tsoh³, Amy Pui Ling Kwok^{3,5}, Michael Chi Fai Tong^{1,2}

¹Department of Otorhinolaryngology, Head and Neck Surgery, the Chinese University of Hong Kong, Hong Kong

²Institute of Human Communicative Research, The Chinese University of Hong Kong, Hong Kong

³Department of Psychiatry, Prince of Wales Hospital, Hospital Authority, Hong Kong

⁴Department of Ear Nose and Throat, New Territory East Cluster, Hospital Authority, Hong Kong

⁵Department of Clinical Psychology, Hong Kong East Cluster, Hospital Authority, Hong Kong

*Corresponding author: Wai Tsz Chang, Department of Otorhinolaryngology, Head and Neck Surgery, the Chinese University of Hong Kong, Hong Kong

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Abstract

Aim: To determine the prevalence of under-diagnosed neurocognitive degeneration and depression in older adults with subjective Hearing Loss (HL) and that of undiagnosed HL in patients with mild cognitive impairment in Hong Kong. **Method:** Patients aged above 60 with subjective HL and those who attended the NTEC ENT clinic from May 2021 to October 2022 were included. Pure tone audiogram was performed to assess the severity of HL. The Hong Kong Montreal Cognitive Assessment and Patient health questionnaire-9 was used to assess the severity of cognitive impairment and depression respectively. Hearing aid amplification was offered to patients with bilateral HL greater than 40dB. Psychogeriatric referral was given to patients with major cognitive impairment or major depression. **Results:** 225 older adults with subjective hearing loss and without known cognitive disorders were included in the general ENT clinic. 62% had bilateral HL greater than 40dB requiring amplification. 98 older adults with diagnosed mild cognitive impairment and without subjective hearing loss were included in the psychiatric out-patient clinic. Overall, significant and positive correlation between hearing loss and dementia as well as between dementia and depression was found. Over 75% of MCI patients were also found to have undetected hearing loss and nearly half requires hearing aid, making them a significantly high-risk group. **Conclusion:** Screening for dementia may be necessary for hearing loss patients. Patients diagnosed with MCI may also require regular hearing loss screening. This can allow for early diagnosis and management of both hearing loss and cognitive decline to prevent the formation of a vicious cycle.

Keywords: Hearing loss; Dementia; MCI; Mild cognitive impairment; Epidemiology; Hearing aids; Hearing screening

Introduction

In Hong Kong (HK), 66.2% of those over the age of 70 years suffer from hearing loss, with the prevalence increasing with age [1]. Meta-analysis also shows that 4.4% of Chinese suffer from dementia, with prevalence doubling with each 5-year increment in age [2]. As the HK and global populations age, the incidence of both hearing loss and dementia will only continue to rise.

To alleviate this situation, our main priority is to reduce the incidence of dementia. Meta-analysis has also shown that hearing loss is independently associated with dementia [3]. Previous studies have suggested that is due to association between sensory deficiencies and differentiation together with atrophy of the auditory system [4]. This in turn, is associated with cortical reorganization and subsequent memory and cognitive processing decline [5]. This indicates that auditory deficiencies have a significant impact on cognitive decline. It has even been suggested that hearing loss is the largest modifiable risk factor against dementia [6]. Therefore, it is important to investigate the correlation between hearing loss and dementia, and if one exists, then it is especially important to investigate the risk of hearing loss on dementia.

As such, another priority is the management and alleviation of hearing loss, which may prevent the formation of a vicious cycle should our study find that hearing loss is a large risk factor against dementia. Unfortunately, Chinese adults have been known to be less concerned with hearing loss compared to those in Western societies [7]. Consequently, hearing loss is often left unnoticed till it becomes more severe, which in turn increases the risk of severe hearing loss. Therefore, it is of utmost importance that patients in high-risk groups are identified and undergo early screening to allow for early diagnosis to slow down their decline in hearing and possibly even in dementia. To identify whether dementia patients belong in the said high-risk group, our study will investigate the incidence of previously undetected hearing loss in patients diagnosed with Mild Cognitive Impairment (MCI).

It is also important to explore the psychological burden of dementia on patients in order to facilitate early diagnosis and efficient management of depression in patients with dementia. Studies have already shown an independent association between depression and hearing loss in older Chinese [8]. Since depression is a severe and prevalent condition, especially in community-dwelling adults over 60 years old in HK [9], it is imperative to explore the correlations and effects of dementia on depression as well. As such, our study will investigate the correlation between dementia and depression. We will then explore the significance and possibility of initiating early diagnosis and subsequent management of depression in patients with dementia or hearing

loss. Through this, we aim to reduce the incidence and alleviate the psychological decline in patients suffering from dementia or hearing loss, and subsequently reduce the psychological impact on these patients.

Methodology

Participants

Participants were recruited between May 2021 and February 2022 from local clustered base university hospital in Hong Kong. All recruited participants were aged 60 years old or above. Patients who refused to be followed up or who had known congenital hearing loss or hearing loss that was surgically correctable were excluded.

Participants in the first group were recruited from ENT clinic. All of them presented with subjective unilateral or bilateral hearing loss. Those with known dementia or other neurological diseases affecting their cognitive functions were excluded. Participants in the second group were recruited from psychiatric psychogeriatric clinics. All of them were diagnosed with MCI or mild dementia by psychiatrist. Those with known unilateral or bilateral hearing loss were excluded. All patients recruited into the study participated on a voluntary basis and written consent was obtained before testing.

Equipment & Materials

Hong Kong Montreal Cognitive Assessment (HK-MoCA) percentile

The HK-MoCA is a standardized neurocognitive assessment featuring a one-page long test. Participants are assessed on a comprehensive range of cognitive domains. The advantage of this assessment tool lies in its ability to accurately evaluate the severity of the cognitive decline without a ceiling effect and in a short duration [10].

Participants are given a score out of 30. Participants are then classified into 4 different percentiles after taking into account their educational backgrounds. Those classified below the 2nd percentile are considered to suffer from Major Neurocognitive Disorder (Major NCD) whereas those scoring between the 2nd and the 16th percentile are considered to suffer from Mild Neurocognitive Disorder (Mild NCD).

Self-cognitive assessment tool (AD8)

The AD8 is a patient self-assessment tool that covers 8 different areas of cognitive functioning, including memory. To assess each area individually, 8 different Yes/ No/ Don't Know questions are used. The assessment is scored out of 8, with only "Yes" answers resulting in a mark. The main purpose of this assessment is to assess the patients' insight into their own cognitive condition. In patients with cognitive decline, patients who are aware of their cognitive decline are usually much more receptive

to treatment and can be expected to show better treatment results. Conversely, those who do not believe they are experiencing cognitive decline often decline relatively faster [11].

Patient-health questionnaire-9 (PHQ-9)

The PHQ-9 assesses the severity of depression in participants through a series of 9 questions, which are based on the 9 criteria for the diagnosis of DSM-IV depression disorders [12]. Participants are asked to rate the frequency of each question on a scale of 0 to 3 (0 for never, 3 for almost every day).

The sum of the score obtained in each question is then used to classify the depression severity of patients into 4 different categories, from Normal to Severe.

Pure tone audiometry (PTA)

The Pure Tone Audiometry assessment is considered one of the most fundamental tests in standardized audiometric assessments and is executed by trained personnel. In this study, PTA is used to measure the degree of air conductive hearing loss in both ears. The average of 1, 2, 4 kHz of the better ear's threshold was subsequently obtained to determine the degree of hearing loss. Participants with 0 to 25db of hearing loss are considered to be normal. Those with 25 to 70 db of hearing loss are considered to have mild to moderate hearing loss. Those with over 70 db of hearing loss are considered to have severe to profound hearing loss.

Procedure

All study procedures were reviewed and approved by The Joint Chinese University of Hong Kong-New Territories East Cluster Clinical Research Ethics Committee (The Joint CUHK-

NTEC CREC), with reference number 2021.414. The purpose and risks of all procedures were clearly explained to participants. All participants provided written and informed consent before participating in each part of the study.

Consented participants were first screened to ensure they met the prerequisites. Participants with subjective hearing loss and no pre-existing dementia were put into the first group to investigate the risk of hearing loss on dementia. Participants diagnosed with MCI and no subjective hearing loss were put into the second group to investigate the incidence of undetected hearing loss for patients with dementia.

Data on participants' severity of hearing loss were first documented via PTA and the average pure tone of 1, 2, 4 kHz of their better ear was calculated. Dementia severity was then assessed using the HK-MoCA percentile and AD8, while depression severity was assessed using the PHQ-9.

All data collected were stored in a password-protected file in a password-protected computer. Data analyses were subsequently carried out using IBM SPSS Statistics Version: 28.0.1.0 (142). For ordinal data, the chi-square test was conducted. For continuous data, bivariate correlational analysis with Pearson's coefficient was conducted.

Results

Subject Demographics

This study included 323 adults, 145 males and 167 females, aged 60 or above (mean = 74.9, standard deviation [SD] = 7.95) 225 of which were recruited into Group 1, whereas the remaining 98 were recruited into Group 2 of the study (Table 1).

	Sample size (n)	Age in years (mean ± SD)	Gender (M: F)	Education (in years)
Group 1	225	73.82 ± 8.31	114: 101	7.83 ± 4.69
Group 2	98	77.5 ± 6.35	31: 66	7.14 ± 4.66
Overall	323	74.9 ± 7.95	145: 167	7.65 ± 4.69

Table 1: Subject Demographics.

Investigation on Group I Participants

Distribution: Amongst Group I participants, 84% (n=189) had hearing loss, of whom 62% (n= 140) had hearing loss of at least 40dB and thus required a hearing aid. Overall, 24% (n=55) and 17.6% (n= 40) found to have mild and major neurocognitive disorder respectively according to the HK-MoCA.

Correlation between hearing loss and dementia

Correlation using HK-MoCA: All participants completed the HK-MoCA assessment, of whom 214 completed the PTA. At least mild cognitive impairment was identified in 11% of normal hearing; 26% with mild- moderate HL; 50% with severe- profound HL i.e. a relative risk of 2.4 and 4.6 respectively. Correlational analysis was conducted between the average of 1, 2, 4 kHz of the better ear’s threshold (in decibels) and the raw HK-MoCA score out of 30, with a higher score indicating better neurocognitive function. One-way ANOVA demonstrated patient with more severe HL had a lower HK-MoCA score [$F(2,183)=4.1, p=0.018$]. (Figure 1).

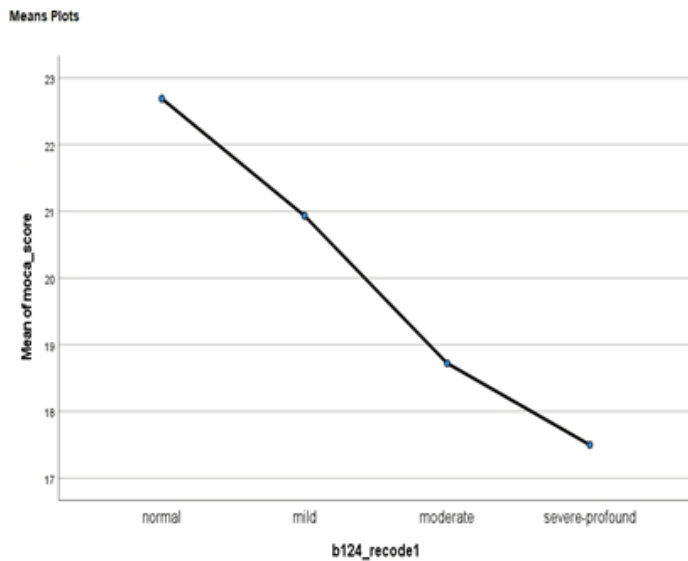


Figure 1: Correlation between hearing loss and dementia.

Association between dementia and depression

Participants were divided into 4 different categories of dementia severity according to their raw HK-MoCA score and educational level. Participants were also categorized according to the severity of their depression, from normal to severe. Chi-square

analysis was carried out between dementia severity and depression severity. Our results indicated a significant association between the two variables, $X^2(12, N = 176) = 21.811, p = .04$ (Table 2).

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	21.811	12	0.040
Likelihood Ratio	17.339	12	0.137
Linear-by-Linear Association	0.547	1	0.459
N of Valid Cases	176		

Table 2: HK-MoCA* Depression Chi-Square Test.

Investigation on Group II Participants

Distribution: Amongst Group II participants, 77% had hearing loss, of whom 47% had hearing loss of at least 40dB and thus required a hearing aid. At the same time, according to the HK-MoCA, 37% had a mild to major neurocognitive disorder.

Incidence of Undetected Hearing Loss in MCI patients

All participants completed the PTA assessment, of whom 75 are showed signs of hearing loss (59 mild cases, 14 moderate cases, and 2 severe cases). Our results indicated that it was much more likely than not for patients diagnosed with MCI to experience undetected hearing loss at the same time, with a negative association between incidence and the severity of hearing loss (Figure 2).

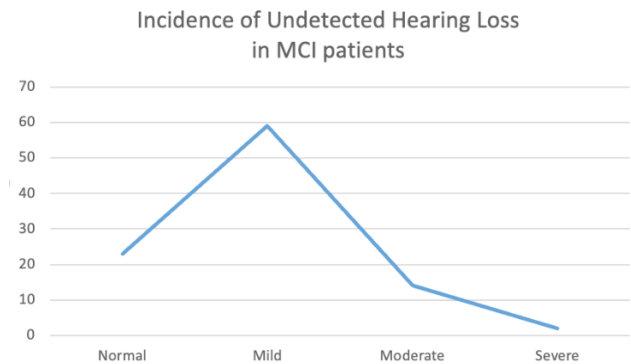


Figure 2: Incidence of Undetected Hearing Loss in MCI patients.

Discussion

In this study, significant and positive correlation between the severity of hearing loss and dementia was found. This concurred with a lot of existing international publication. Again, this addressed the importance of screening the cognitive functions in those older adults presented to ENT clinic with diagnosis of hearing impairment. As such, longer-term monitoring along with regular screening for dementia may be warranted for older adults with hearing loss. To achieve this, the awareness of both general practitioners and geriatricians must be increased regarding this phenomenon. This will allow them to better inform older adults with subjective hearing loss and facilitate regular screening and management throughout patient care. Proactive hearing loss management to prevent decline in hearing and subsequent cognitive decline may also be necessary. This could be achieved by intercepting the pathway of hearing loss to dementia with hearing aids, which can help compensate hearing difficulties and alleviate subsequent cortical reorganization and decline.

Our study also found that over 75% of MCI patients suffered from undiagnosed hearing loss and nearly half required a hearing aid. In fact, results showed that there is only a 7% difference in the proportion of patients with hearing loss in Group I and II. This indicates that MCI is a similarly strong predictor in hearing loss as subjective hearing loss. Hearing loss is known to worsen with age, especially without early intervention and proper management. Coupled with our findings that an increased severity in hearing loss might result in an increased risk of cognitive decline, screening for hearing loss in MCI patients may prove necessary. It may well be possible that early diagnosis and subsequent management of hearing loss in MCI patients can prevent or slow down any further cognitive decline, although a properly performed randomized controlled trial is warrant. To achieve this, the awareness of both general practitioners and psychiatrists must be increased regarding this phenomenon. This will allow them to better inform older adults with MCI and facilitate regular screening and management of any potential hearing loss throughout patient care.

Significant association between the severity of dementia and that of depression has also been found in this study. Thus, the mental burden of dementia and hearing loss in patients with dementia should be addressed. With an escalating population of patients with depression, the socio-economic burden of this will only increase. Therefore, regular screening of dementia and depression should also be implemented. Awareness in general practitioners, geriatricians and psychiatrists should also be raised to ensure that patients with either hearing loss or dementia can be screened and potentially diagnosed in a timely manner, and as such facilitate early management to reduce deterioration [13].

To minimize the problem of a small sample size in this study, a larger scale multi-centered study with longer follow up may be warranted. Patient interviews for cognitive assessments were also conducted in selected cases in the clinic due to limited manpower. Therefore, further investigation on the possibility of intercepting the pathway from hearing loss to dementia with hearing aids is necessary.

Conclusion

The current study provides some preliminary findings on positive association of neurocognitive impairment and the severity of hearing loss. There was significant number of undiagnosed cognitive impairment in older adults with hearing loss, even if it is a major cognitive impairment. As importantly, there was significant number of undiagnosed hearing impairment in those diagnosed MCI or mild demantia, even if it is a severe hearing loss. This indicates that an early screening for dementia is necessary for patients with hearing loss. Similarly, patients suffering from cognitive decline may also need early screening and intervention for hearing loss. Awareness amongst general practitioners, geriatricians, and psychiatrists will also need to be raised to facilitate timely diagnosis and intervention in patients.

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