

Original Research



Prevalence and determinants of hearing impairment among elders in Colombo, Sri Lanka

Gayani Dissanayake^{1*}, Nalika Gunawardana², Yasoma Weerasekara¹, Chandra Jayasuriya³

¹Nutrition Division, Ministry of Health, Sri Lanka; ²World Health Organization Regional Office for Southeast Asia, India; ³National Hospital of Sri Lanka

*Correspondence: gayanisandeepika26@gmail.com

 <https://orcid.org/0000-0002-0738-9149>

DOI: <https://doi.org/10.4038/jccpsl.v31i2.8821>

Received on 17 Jan 2025

Accepted on 3 Jun 2025

Abstract

Introduction: Hearing impairment, the fourth leading cause of disability worldwide, impacts communication and quality of life especially in the elderly. It is defined as inability to hear sound levels above 25dB in pure tone audiometry.

Objectives: To determine the prevalence of hearing impairment and its demographic and socioeconomic determinants among elderly persons living in the district of Colombo, Sri Lanka

Methods: A community-based cross-sectional study enrolled 900 elders aged 65 years and above from 36 *grama niladhari* (GN) divisions. Hearing impairment was assessed using the portable screening audiometry (PSA) test, with positive cases defined as hearing impairment in one or both ears. Other data were collected using an interviewer-administered-questionnaire. Apparent and true prevalences (adjusted for sensitivity & specificity of PSA) were calculated with 95% confidence interval. Bivariate analysis identified the associated factors and multi-variate analysis was utilized to control the effects of confounding factors.

Results: The apparent prevalence was 52.7% (95% CI: 51.8, 53.5), while true prevalence was 32.8% (95% CI: 27.8, 37.1). Of the affected individuals (n=454), 26.9% (95% CI: 25.1, 27.8) had unilateral impairment and 25.7% (95% CI: 24.8, 26.5) had bilateral impairment. Employment (OR: 1.4; 95% CI: 1.1, 1.9) and education level (OR: 1.6; 95% CI: 1.1, 2.5) were significant predictors in the bivariate analysis. Being male (adjusted OR: 1.4; 95% CI: 1.1, 2.0) and being employed (adjusted OR: 1.4; 95% CI: 1.1, 1.9) showed a higher risk for hearing impairment when controlled for the effect of other factors.

Conclusions & Recommendations: Hearing impairment is highly prevalent among elders in Sri Lanka, with being employed and being male as key determinants. Community-based screening programmes should focus on groups identified as being at a higher risk of having hearing impairment.

Key words: Prevalence, Hearing impairment, Elders

Introduction

Hearing is one of the basic senses essential for human survival and effective communication. The World Health Organization (WHO) has recognized hearing impairment as the fourth leading cause of disability globally (1). A hearing threshold of -10dB to 25dB is considered normal hearing while a threshold level above 25 dB is considered as impaired hearing. Hence, the inability to hear the sound level beyond 25 dB in one or both ears is defined as impaired hearing.

In the global context, the prevalence estimates of hearing impairment among elders show a wide inter-regional and inter-country disparity (2). This is partly due to differences in the age categories included in the assessment and the methods used to assess hearing status. Pure tone assessment (PTA) is regarded as the gold standard test to assess hearing impairment. However, its application in low resource community settings poses practical challenges owing to cost of the device, immobility of the device and the prerequisite for a sound treated booth and a qualified audiology technician to perform the test. There are different tools/tests that could be applied to screen for hearing impairment such as self-administered questionnaires, mobile apps and simple tests such as whispered voice test (WVT), click test, Rinner's test and portable screening audiometry test (PSA). Of these, the PSA has been validated against the gold standard PTA in a community-based study in Sri Lanka (3). It has demonstrated high sensitivity (88.3%; 95% CI: 82.2, 93.0) and specificity (64.7%; 95% CI: 50.1, 77.6) and is identified as suitable for community-based screening programmes owing to its validity as well as portability and simplicity, requiring minimal training in its administration.

According to two recent studies, the prevalence of hearing impairment among Sri Lankan elders over 60 years has been reported as 41% (4) and 30.5% (5). The study conducted by Balasuriya & Gnanissara in 2001 utilized a self-reported method to evaluate

hearing status (4), while De Silva et al. (2016) conducted a community-based study using the WVT (5). In another study, Fonseka (2019) applied the WVT and reported a prevalence of 17.4% among elders over 60 years in community (6). However, the WVT is not validated for Sri Lankan settings, thus leading to an underestimation of the prevalence of hearing impairment. Particularly, there are no community-based studies in Sri Lanka to estimate the prevalence of hearing impairment among the elderly using validated, objective hearing assessment techniques.

Hearing impairment is a multifactorial condition. Its association with age (7), sex, ethnicity, level of education (8) and level of income (9) has been widely studied. Advancing age has been found to be a strong predictor of hearing impairment (10). Those in the 75-80 years age group have shown to be nearly 2.5 times at risk for hearing impairment compared to the 70-74 years age group (OR: 2.4; 95% CI: 1.79, 3.46) in a study conducted in USA (11). The prevalence estimated in this study was 52.6% utilizing PTA test. Another study conducted in England in 2019 has found that the proportion of men and women with hearing impairment to be 52.8% and 47.2%, respectively (9). The study in USA in 2011 demonstrated that non-Hispanic white people have a higher prevalence of hearing impairment than Mexican and other Hispanic population (OR: 1.03; 95% CI: 0.51, 2.07) (7). Demographic and socioeconomic factors associated with hearing impairment among elders have not been studied in Sri Lanka. In this backdrop, the present study was conducted to estimate the prevalence of hearing impairment among the elders in community settings in Colombo District and to determine the factors associated with their impairment.

Methods

A descriptive cross-sectional study was conducted from August to October 2022 in 36 *grama niladari*

(GN) divisions of six randomly selected divisional secretariat (DS) divisions in Colombo District among elderly persons aged 65 years and above. Those who were cognitively impaired were excluded from the study as cognition concentration and attention were required to respond to the test. Furthermore, those with presence of upper respiratory tract infection and cerumen impaction which can result in temporary hearing impairment were screened and excluded. The older individuals who were bed-bound, immobile and not able to visit community places to undertake the PSA test were also excluded.

The sample size for estimation of the prevalence of hearing impairment was calculated using the standard formula (12). The expected prevalence of hearing impairment was taken as 0.631 (13) at the significance level of 5%. A margin of error of 0.05 and design effect of 2, considering a non-response rate of 15%, the calculated sample size was 841. Hence, the final sample size was 900. A two-stage cluster sampling was employed. In the first stage, six DS divisions were selected randomly. A GN division was considered as a geographical cluster, and the cluster size was taken as 25. Hence, the number of clusters to be included in the study was 36. At the second stage, the number of clusters to be selected from each DS division was determined based on probability proportionate-to-the-size of the elderly population aged 65 years and above in each DS division. Within each selected GN division, one road was randomly selected, and there onwards, 36 households to the right side of the selected road were visited consecutively to identify the sample. This process continued until 25 eligible participants were enrolled. If there was more than one elderly person in the selected household, one person was chosen randomly.

The validated PSA test including an interviewer-administered-questionnaire consisting of basic demographic and socioeconomic information were used for data collection. The PSA test was

administered before the questionnaire and a pre-prepared checklist was employed to ensure its adherence to procedure. It was administered in a designated place in the community setting, which was in line with the environmental conditions required in the validation of the PSA test. The selected locations included healthy lifestyle clinics, temples or other religious places located within an average distance of 1 km radius from the households of the elders. Prior to conducting the formal test, a practice test was conducted for each ear to detect whether the study unit would erroneously respond to the sound of bell. Only the participants who exhibited accurate responses for both sounds in each ear preceded to the test proper. Participants who were unable to hear sound level above 60 dB in the PSA test were identified as hearing impaired, on par with the cut-off values used in the validation test (3). Three trained pre-intern medical graduates collected data. Their training consisted of screening participants on eligibility criteria and administration of the instruments. Several measures were taken to minimize the subject and interviewer variation including an environmental assessment using a checklist prior to PSA test, inclusion of a practice test and training of data.

Data analysis

Prevalence was calculated as given below:

$$\text{Apparent prevalence} = \frac{\text{Total number of hearing impaired}}{\text{Total number of respondents}}$$

$$\text{True prevalence} = \frac{\{(\text{Apparent prevalence} + \text{specificity}) - 1\}}{(\text{Sensitivity} + \text{specificity}) - 1} \quad (14)$$

Sensitivity and specificity values of PSA test were taken as 88.3% (95% CI: 82.2, 93.0) and 64.7% (95% CI: 50.1, 77.6), respectively (3). Chi-squared test was used to assess the significance of factors associated with hearing impairment in the bivariate analysis; and multi-variate analysis to control the confounding factors. The significance level was determined at $p < 0.05$ for the bivariate analysis, while $p < 0.1$ was the cut-off point for the inclusion of factors in multi-variate analysis.

Results

Of the 900 participants recruited, 862 completed the study (95.77% response rate). The true and apparent prevalences of hearing impairment were 32.8% (95%

CI: 27.8, 37.1) and 52.7% (95% CI: 51.8, 53.5). Prevalence of hearing impairment only in one ear (26.9%; 95% CI: 25.1, 27.8) was similar to that of in both ears (25.7%; 95% CI: 24.8, 26.5) (Figure 1).

Table 1: Prevalence of hearing impairment by demographic and socioeconomic characteristics (N=862)

Characteristic	No. (%)	Crude OR (95% CI)	<i>p-value</i>	Adjusted OR (95% CI)	<i>p-value</i>
Age					
< 75 years	324 (71.4)	1.0 (0.7, 1.5)	0.81		
≥ 75 years	130 (28.6)	1.0			
Sex					
Male	189 (41.6)	1.4 (1.1, 1.8)	0.06	1.4 (1.1, 2.0)	0.04
Female	265 (58.4)	1.0			
Ethnicity					
Sinhala	424 (93.4)	1.5 (0.9, 2.7)	0.14		
Other	30 (6.6)	1.0			
Marital Status					
Other	21 (4.6)	1.0			
Ever married	433 (95.4)	1.2 (0.6, 2.3)	0.07		
Living Status					
Alone	53 (11.7)	1.0			
With family	401 (88.3)	1.8 (1.1, 2.9)	0.04	1.7 (1.0, 2.9)	0.08
Highest education					
Up to Grade 10	418 (92.1)	1.6 (1.1, 2.5)	0.006	1.5 (1.0, 2.0)	0.03
Passed Grade 10+	36 (7.9)	1.0			
Employment status					
Employed	328 (72.3)	1.4 (1.1, 1.9)	0.005	1.3 (1.1, 1.7)	0.02
Not employed	126 (27.8)	1.0			
Monthly income					
≤LKR 20,000	352 (77.5)	1.3 (0.9, 1.8)	0.15		
>LKR 20,000	102 (22.5)	1.0			

Factors associated with higher prevalence were age category of below 75 years, male, Sinhala ethnic group, ever married and those living with family ($p < 0.05$). Being male (adjusted OR: 1.4; 95% CI: 1.1,

1.8) and being employed (adjusted OR: 1.3; 95% CI: 1.1, 1.7); showed a higher risk of having hearing impairment when controlled for the effect of other factors (Table 1).

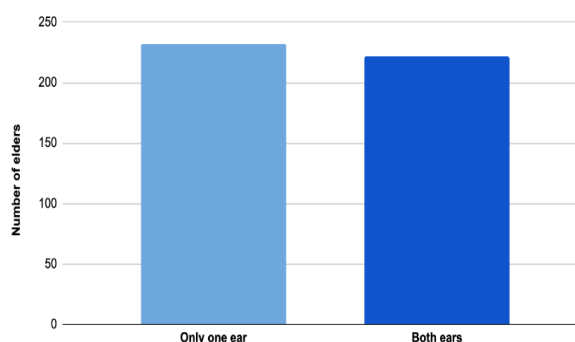


Figure 1: Type of impairment among hearing impaired elderly aged 65 years and above (N=454)

Discussion

The study identified an apparent prevalence of hearing impairment among the elderly aged above 65 years as high as 52.6%. A similar prevalence of 63.1% (95% CI: 57.4, 68.8) has been reported in the study from USA (8). Other studies in the same population showed that the prevalence was 44.8% among individuals aged 70 years and above (11) and also among those aged 60 years (15). Considering the regional studies, an Indian study reported that the prevalence was 63.1% in individuals of the same age group (16). Although conducted in a community setting, self-reporting was used to determine hearing impairment in this study. In contrast, another study from East Delhi, India revealed the prevalence of hearing impairment to be 3.3% (17). In this study, hearing impairment has been defined as impairment of hearing of both ears and Rinner's test used for hearing assessment. Findings have implications on the methodologies and definitions adapted in hearing assessment studies.

Comparison of the findings to determine periodic change in the prevalence of hearing impairment is mainly limited due to methodological differences across studies as well as regions involved in the research. The study in Kalutara District among individuals aged 60-74 years and over reported 30.4% in 2016 (5), while the study in Colombo in 2019 among those aged above 60 years reported 12.6% (6). The definition adapted to determine a person as hearing impaired in these two studies is

similar to the present study. Both these studies evaluated hearing impairment using the WVT.

A study conducted by Lisan et al. confirmed that the prevalence of hearing impairment rises with advancing age (OR: 2.49; 95% CI: 1.79, 3.46). 10). Another study conducted by Cruickshanks et al. identified age as a strongly associated factor among people aged 65 years or older (18). In contrast, a non-significant higher prevalence of hearing impairment was found in the current study among elderly individuals aged 75 years and above compared to those below 75 years (OR: 1.0; 95% CI: 0.7, 1.5). However, being male was a significant risk factor (adjusted OR: 1.4; 95% CI: 1.1, 2.0) in the current study after controlling for confounding factors. The study by Lin et al. also showed that hearing impairment was higher among males (68.1%; 95% CI: 67.2, 69.1) compared to females (58.6%; 95% CI: 57.6, 60.0) of the same age group (10).

The present study showed a high risk of hearing impairment among those with lower level of education (adjusted OR: 1.5; 95% CI: 1.0, 2.0). This is comparable with a Korean study among individuals with no qualifications compared to those with a degree or higher education level (9). Further, hearing impairment was higher among elderly with lower level of income (OR: 1.3; 95% CI: 0.9, 1.8). It was in concurrence with another study by Lin et al., where elderly with higher income showed a lower

risk (OR: 0.38; 95% CI: 0.15, 0.98). The current study as well as another study by Tsimpida et al. demonstrated that those engaged in routine/manual occupations are more likely to have hearing impairment compared to those in managerial/professional occupations. In contrast, Cruickshanks et al. showed that the type of occupation has no association with the progression of hearing loss (10).

This study highlights the burden of hearing impairment in the elderly population in Colombo District, supporting the global and regional trends. It was also shown to increase with advancing age, emphasizing the inevitable effects of aging on auditory function. Hearing impairment is also closely associated with diminution of overall quality of life (19).

Conclusions & Recommendations

The prevalence of hearing impairment among elders aged over 65 years was notably high, at 52.7% (95% CI: 51.8, 53.5) in one or both ears. The proportions of individuals with hearing impairment in only one ear (26.9%; 95% CI: 25.1, 26.8) and those with impairment in both ears (25.7%; 95% CI: 24.8, 26.5) were similar. The true prevalence of hearing impairment was estimated to be 32.8% (95% CI: 27.8, 37.1). Among the socio-demographic factors, living alone, male sex, and being employed were significant in the bivariate analysis. After controlled for confounders, being male (adjusted OR: 1.4; 95% CI: 1.1, 2.0) and being employed (adjusted OR: 1.3; 95% CI: 1.1, 1.7) showed a higher risk for hearing impairment.

Public Health Implications

- The prevalence of hearing impairment among elderly is high, and it could be an arena of newly emerging public health concern.
- As the prevalence is expected to increase with an aging population, there is a pressing need to implement early screenings. Further, enhance accessibility of hearing aids is essential to improve the quality of life for elderly individuals.

Author Declarations

Competing interests: The authors declare that there is no competing interest regarding the publication of this paper.

Ethics approval and consent to participate: Ethics approval for this study was granted by the Ethics Review Committee of the Faculty of Medicine, University of Colombo (Reference number: EC-22-032). Prior to conduct the study, permission was obtained from the Deputy Director General of Health Services at the National Hospital of Sri Lanka, Provincial Director of Health Service Western Province and Regional Director of Health, Colombo. Informed written consent was obtained from all participants.

Funding: Self-funded

Acknowledgements: The principal investigator extends sincere thanks to the research supervisors, the Consultant ENT surgeon at the National Hospital of Sri Lanka and to all the study participants and data collectors for their valuable contributions.

Author contributions: GSD served as the principal investigator for the research; NG and YKW provided invaluable contributions as the technical supervisors of the whole process of the project, reviewed and finalized the manuscripts; CJ contributed for study by providing expert opinion at the planning and implementation stage of the study.

References

1. World Health Organization. *Addressing the rising prevalence of hearing loss*. Geneva: WHO, 2018. Available from: <https://apps.who.int/iris/handle/10665/260336>.
2. World Health Organization. *WHO global estimates on prevalence of hearing loss: mortality and burden of diseases and prevention of blindness and deafness*. Geneva: WHO, 2012. Available from: http://www.who.int/pbd/deafness/WHO_GE_HL.pdf.
3. Dissanayake GS, Gunawardana N, Weerasekara Y. Validation of Portable Screening Audiometry (PSA) test for screening of hearing impairment among elders in an urban setting, Sri Lanka. *J Coll Community Physicians Sri Lanka* 2023; 28(1): 45-50. <https://doi.org/10.4038/jccpsl.v31i1.8799>.
4. Balasuriya A & Gnanissara SAP. Utilization of health services by the elderly and their health status in a health division in Sri Lanka. *J Coll Community Physicians Sri Lanka* 2001; 6(1): 30-33. <https://doi.org/10.4038/jccpsl.v6i1.8293>.
5. De Silva SH, Jayasuriya AR, Rajapaksa LC, De Silva AP, Barraclough S. Development and validation of a measure of quality of life for the young elderly in Sri Lanka. *Asia Pac J Public Health* 2016; 28(1 Suppl): 115S-25S. <https://doi.org/10.1177/1010539515625113>.
6. Fonseka HNA. *Community healthcare service needs of the elders and effectiveness of a community healthcare package for the elders in Colombo district*. MD Thesis (Community Medicine). Colombo: University of Colombo, Postgraduate Institute of Medicine; 2019.
7. Uchida Y, Sugiura S, Nishita Y, Saji N, Sone M, Ueda H. Age-related hearing loss and cognitive decline- The potential mechanisms linking the two. *Auris Nasus Larynx* 2019; 46(1): 1-9. <https://doi.org/10.1016/j.anl.2018.08.010>.
8. Lin FR, Thorpe R, Gordon-Salant S, Ferrucci L. Hearing loss prevalence and risk factors among older adults in the United States. *J Gerontol A Biol Sci Med Sci* 2011; 66(5): 582-590. <https://doi.org/10.1093/gerona/glr002>.
9. Tsimplida D, Kontopantelis E, Ashcroft D, Panagioti M. Socioeconomic and lifestyle factors associated with hearing loss in older adults: A cross-sectional study of the English Longitudinal Study of Aging (ELSA). *BMJ Open* 2019; 9(9): e031030. <https://doi.org/10.1136/bmjopen-2019-031030>.
10. Lisan Q, Goldberg M, Lahlou G, et al. Prevalence of hearing loss and hearing aid use among adults in France in the CONSTANCES Study. *JAMA Network Open* 2022; 5(6): e2217633. <https://doi.org/10.1001/jamanetworkopen.2022.17633>.
11. Lwanga SK & Lemeshow S. Sample size determination in health studies: a practical manual. Geneva: World Health Organization, 1991. Available from: http://www.tbrieder.org/publications/books_english/lemeshow_samplesize.pdf.
12. Thakur R, Banerjee A, Nikumb V. Health problems among the elderly: a cross-sectional study. *Ann Med Health Sci Res* 2013; 3(1): 19-25. <https://doi.org/10.4103/2141-9248.109466>.
13. Department of Census & Statistics Sri Lanka. *Census of Population and Housing Sri Lanka 2012*. Colombo: DCS, 2012. Available from: <http://203.94.94.83:8041/index.php?fileName=P1&gp=Activities&tpl=3>.
14. Speybroeck N, Devleeschauwer B, Joseph L, Berkvens D. Misclassification errors in prevalence estimation: Bayesian handling with care. *Int J Public Health* 2013; 58(5): 791-795. <https://doi.org/10.1007/s00038-012-0439-9>.
15. Lin FR, Yaffe K, Xia J, et al. Hearing loss and cognitive decline in older adults. *JAMA Intern Med* 2013; 173(4): 293-299. <https://doi.org/10.1001/jamainternmed.2013.1868>.
16. Goman AM & Lin FR. Prevalence of hearing loss by severity in the United States. *Am J Public Health* 2016; 106(10): 1820-1822. <https://doi.org/10.2105/AJPH.2016.303299>.

17. Vaish K, Patra S, Chhabra P. Functional disability among elderly: A community-based cross-sectional study. *J Family Med Prim Care* 2020; 9(1): 253-258.
https://doi.org/10.4103/jfmpe.jfmpe_861_19.
18. Cruickshanks KJ, Nondahl DM, Tweed TS, et al. Education, occupation, noise exposure history and the 10-yr cumulative incidence of hearing impairment in older adults. *Hear Res* 2010; 264(1-2): 3-9.
<https://doi.org/10.1016/j.heares.2009.10.008>.
19. Ciorba A, Bianchini C, Pelucchi S, Pastore A. The impact of hearing loss on the quality of life of elderly adults. *Clin Interv Aging* 2012; 7: 159-163.
<https://doi.org/10.2147/CIA.S26059>.