Published in final edited form as:

Asia Pac J Public Health. 2012 November ; 24(6): 1013–1022. doi:10.1177/1010539511408712.

Epidemiological associations of hearing impairment and health among a national cohort of 87,134 adults in Thailand

Vasoontara Yiengprugsawan, PhD*, Anthony Hogan, PhD*, David Harley, MD, PhD*, Sam-ang Seubsman, PhD**, Adrian C Sleight, MD*, and Thai Cohort Study Team†

*National Centre for Epidemiology and Population Health, The Australian National University, Canberra, Australia **School of Human Ecology, Sukhothai Thammathirat Open University, Nonthaburi, Thailand

Abstract

Socioeconomic and epidemiological effects of hearing impairment in middle income countries of Southeast Asia is still quite scarce. This study examines the association between hearing impairment and health outcomes in Thailand. Data derived from a cohort of 87,134 Open University adults aged 15–87 years residing throughout Thailand. Approximately 8.5% of cohort members reported trouble hearing, 0.13% reported being deaf. After adjusting for age and sex, poor self-assessed health was strongly associated with some trouble hearing [OR = 2.70, 95% CI 2.48–2.93] and deafness [OR = 3.08, 95% CI 1.73–5.50]. PAFs for hearing impairment were 12.9% for poor self-assessed health, 9.8% for poor psychological health, 3.3% for metabolic disorders, and 4.1% for cardiovascular conditions. There needs to be more attention on hearing impairment with regular check-ups and early detections.

Keywords

hearing impairment; population attributable fractions; cohort study; Thailand

Introduction

The World Health Organization has drawn attention to hearing impairment and its associated social and economic burden on individuals, families, communities and nations.¹ Hearing difficulties in children may delay development of language and cognitive skills, which may hinder progress in school. In adults, hearing deficits make it difficult to obtain secure employment. As well, hearing impaired persons are less likely to have highly skilled jobs and more likely to have low income than those with normal hearing.² Poor hearing imposes social and economic burdens not only on individuals but also on families and communities. Hearing impaired persons can be stigmatised and socially isolated.^{3–7}

Address for correspondence: Dr. Vasoontara Yiengprugsawan, The Australian National University Building 62 – National Centre for Epidemiology and Population Health, Acton 2601, Canberra, Australia. Tel: +61 2 6125 2378; Fax: +61 2 6125 0740.

†**Thai Cohort Study Team**

Thailand: Jaruan Chokhanapitak, Chaibun Churewong, Suttanit Hounthasarn, Suwanee Khamman, Daoruang Pandee, Suttinan Pangsap, Tippawan Prapamontol, Janya Puengson, Yodyiam Sangrattanakul, Sam-ang Seubsman, Boonchai Somboonsook, Nintita Sripaiboonkij, Pathumvadee Somsamai, Duangkhae Vilainerun, Wane Wimonwattanaphan. **Australia:** Chris Bain, Emily Banks, Cathy Banwell, Bruce Caldwell, Gordon Carmichael, Tarie Dellora, Jane Dixon, Sharon Friel, David Harley, Matthew Kelly, Tord Kjellstrom, Lynette Lim, Anthony McMichael, Tanya Mark, Adrian Sleight, Lyndall Strazdins, Vasoontara Yiengprugsawan. vasoontara.yieng@anu.edu.au, vasoontara.yieng@gmail.com, anthony.hogan@anu.edu.au, david.harley@anu.edu.au, sam-ang.seu@stou.ac.th, adrian.sleight@anu.edu.au

In addition to the social and economic effects described above, over the past decade many studies have shown that hearing loss also has adverse effects on many aspects of health. These studies quantify the age-related hearing impairment on quality of life, personal wellbeing and other health outcomes, including certain chronic illnesses and psychosocial states among older persons.⁸⁻¹²

Socioeconomic and epidemiological effects of hearing impairment have been investigated in rich countries. But in most of the developing world, including middle income countries of Southeast Asia, hearing loss does not get much attention due to its invisible nature and the lack of investigative resources in the health sector. Thus information on the causes and consequences of hearing loss is sparse for countries like Thailand. The Thai National Statistical Office has reported that hearing disabilities are indeed common¹³ but little is known of the social or health impacts. Based on available information, the prevalence of sensorineural hearing impairment Thailand in 2000 is between 3.5 and 5%¹⁴ but if milder degrees of hearing loss are included as well the number could be as high as 13.3% among the general population.¹⁵

This study examines the sociodemographic associations and epidemiology of hearing impairments as well as the associated adverse health outcomes among educated Thais based on the unique dataset of the Thai Health-Risk Transition study – a cohort of 87,134 Open University adults residing throughout Thailand. The findings provide important insights into the health and wellbeing of hearing impaired persons in Thailand.

Methods

Study population and data collection

Data were derived from 87,134 distance learning students aged 15 to 87 years from Sukhothai Thammathirat Open University (STOU) who completed a baseline survey in 2005. The baseline characteristics of cohort participants compared to the population of Thailand have been reported.¹⁶⁻¹⁸ Overall the cohort represents well the geo-demographic, ethnic, occupational and socioeconomic status of the adult Thai population. This is because most Open University students already have established jobs and because of their work and family responsibilities and modest economic circumstances are unable to leave their locations to attend an on-campus university fulltime. However, they are better educated than the general Thai population and thus are able to respond to complex health questionnaires.

The baseline questionnaires containing information on individual and household characteristics were sent out to approximately 200,000 STOU students. The response rate was 44% which is above average for mailed questionnaires.¹⁹⁻²¹ Further analysis of responding students showed that they were similar to other STOU students for age, sex, marital status, income, courses of study and geographical location.²² The questionnaire covered a wide range of topics including demographic, socioeconomic and geographic characteristics, health status, health service use, risk behaviours, injuries, dietary intake, and family background. A four-year follow-up was conducted in 2009 (response rate over 70%) and the next one is due in 2013. The main characteristics of the cohort discussed here are age, sex, income per month, and lifecourse urbanization (residence at age 12 and at present).

Data processing and analysis

Data scanning and editing were done using Thai Scandevet, SQL and SPSS.¹⁶⁻¹⁸ For analysis we used Stata version 10. Individuals with missing data for analyses presented here were excluded so totals vary a little according to the information available. Missing data usually involved 1% or less of observations and results were stable given the large size of our dataset.

We assessed the association between outcomes and potential determinants reporting Odds Ratios (ORs) and Confidence Intervals (CI) from multivariate logistic regression. We tested for age-sex confounding by adjusting the crude ORs. We also evaluated other potential confounders (body mass index, smoking, alcohol intakes, income levels, and lifecourse urbanization), assessing whether they varied in prevalence among the compared hearing groups.

Finally, we calculate Population Attributable Fractions (*PAFs*)—the proportion of all cases of a given related disease that occurred in the study population that could have been avoided if no one had the determinant exposure (i.e., ‘trouble hearing’ or ‘deafness’).²³ *PAFs* are calculated from the age-sex adjusted odds ratios and the prevalence of hearing impairment among the ‘controls’ or the general population if known (i.e. those without the outcome of interest, for each association assessed) as follows:

$$PAFs = \frac{\text{Prevalence of exposure (Odds Ratios - 1)}}{[\text{Prevalence of exposure (Odds Ratios - 1)}] + 1}$$

Measures of self-reported hearing levels

Levels of self-reported hearing were obtained as follows: “Which statement best describes your current hearing (without hearing aid)?” Response categories were: ‘good’ ‘some trouble, since childhood (<13 years old)’ ‘some trouble, since teenager or adult (>13 years old)’ ‘deaf, since childhood (<13 years old)’ or ‘deaf, since teenager or adult (>13 years old)’.

Measures of health outcomes

We assessed psychological health using the three anxiety-oriented items of the standard Kessler 6 psychological distress questions. The questions we used were: “In the past 4 weeks, about how often did you feel: 1) nervous; 2) restless or fidgety; 3) everything was an effort”. Answers to each of these questions were on a 5-point scale ranging from ‘all of the time’ to ‘none of the time’. Those answering ‘all the time’ or ‘most of the time’ on all three questions were classified as having ‘poor’ psychological health.

Overall health is based on the first question of the Medical Outcomes Short Form instrument (SF8) - “Overall how would you rate your health during the past four weeks (excellent, very good, good, fair, poor, or very poor). For analysis, we combined the last two categories as ‘poor or very poor’ self-assessed health.

Other measured health covariates included self reported chronic illness. Respondents were asked to indicate if they have ever been diagnosed by a doctor for any one of a list of conditions including certain metabolic disorders (diabetes, high cholesterol), cardiovascular conditions (high blood pressure, stroke), cancers (liver, lung, digestive, breast, others), liver disease, kidney disease, or depression/anxiety.

Ethical considerations

Ethics approval was obtained from Sukhothai Thammathirat Open University Research and Development Institute (protocol 0522/10) and the Australian National University Human Research Ethics Committee (protocol 2004344). Informed written consent was obtained from all participants.

Results

Characteristics of the cohort members

There were 87,314 of cohort members analysed and slightly more than half were females (54.7%). Age groups used in the analysis were 15-19 years (2.9%); 20-29 years (50.8%); 30-39 years (31.3%); 40-49 years (12.6%) and 50 years or older (2.5%). Approximately 40% of cohort members reported income of less than 7000 Baht (about US\$175 in 2005) per month; 22.7% reported between 7000 and 10000 Baht; and 34.0% reported more than 10000 Baht per month. Three groups of lifecourse urbanization groups were reported: rural residents (43.3%); rural moved to urban areas since age 12 years (31.5%); and urban residents (25.2%).

Levels of hearing losses and health outcomes of cohort members

Approximately 8.5% of cohort members reported having some trouble hearing (7.7% after the age of 13 years) and 0.13% reported being deaf (Table 1). The majority of those reporting some troubles were older than 50 years. There were 4.0% of cohort members with no hearing problems who reported poor self-assessed health (Table 2), compared to 10.4% among those who reported some troubles and 14.3% among those reported being deaf (after the age of 13 years). Similarly, 5.4% of cohort members with no hearing problem reported poor psychological health compared to 11.3% who reported some troubles and 10.7% who reported deaf after the age of 13 years. Metabolic disorders (diabetes, high cholesterol) and cardiovascular conditions (high blood pressure, stroke), and depression and anxiety were much more frequent among those reported hearing impairments. Also noteworthy was a modest increase in the prevalence of liver disease and kidney disorders among some of the hearing impaired groups

After adjusting for age and sex (Table 3), poor self-assessed health was strongly associated with trouble hearing [OR = 2.70, 95% CI 2.48-2.93] and being deaf [OR = 3.08, 95% CI 1.73-5.50]. Poor psychological health was also strongly associated with hearing loss [OR = 2.25, 95% CI 2.12-2.39] and being deaf [OR = 2.43, 95% CI 1.56-3.77]. Metabolic disorders, cardiovascular conditions, depression and anxiety were significantly associated with having some trouble hearing; the relationship with these adverse health outcomes was even stronger for those who were deaf but was not statistically significant due to the small number of deaf persons.

We assessed potential confounding for other variables besides age and sex (body mass index, current smoking, regular alcohol intakes, income levels, and lifecourse urbanization) and we noted that each of these variables were of similar prevalence among the two major hearing impairment groups (normal vs some impairment). Accordingly, we did not include them with the age-sex adjusted OR estimates as they were not confounding those analyses.

Analysis of Population Attributable Fractions (see Methods) reveal that hearing impairment was associated with 12.9% of poor self-assessed health, 9.8% of poor psychological health, 3.3% of metabolic disorders, and 4.1% of cardiovascular conditions. Almost all the associated disease related to the group with some trouble hearing which was much more prevalent than deafness among the cohort (8.5% and 0.13%, respectively).

Discussion

Here we reported associations between hearing loss and various health outcomes among a national cohort of distance-learning Thai Open University adults. Our finding of an association of aging and hearing impairment is supported by other Thai studies. For example, the National Statistical Office reports on disability and on older persons found that

the hearing threshold level increased with age in both sexes, at first gradually and then rapidly after the age of 50 years.^{13,24-26} Another recent study was based on elderly Thais in 14 urban communities around Siriraj Hospital in Bangkok with participants ranging from 60 to 96 years of age; the prevalence of ear disease diagnosed by specialists was 16.3% [95% CI 14.0-18.6] and 9.5% of the survey population had a moderate to severe degree of hearing impairment.²⁷ The follow-up study found that early detection and provision of hearing aid improve the quality of life and prevent complications of ear diseases among the Thai elderly population.²⁸

Our national cohort study has also shown strong associations between hearing loss and adverse health and psychosocial outcomes across all age groups. This means that hearing impairment affects Thais in ways similar to those noted in richer countries.^{8,9} For example, in Australia based on a national survey of disability and aging, hearing impairment at all levels was associated with poorer physical and mental health scores on the SF-12 measure, especially for people with severe or profound hearing loss.¹⁰ A Norwegian study of over 50,000 people found hearing loss associated with substantially reduced mental health among older persons, but the effects were much stronger among young (20-44 years) and middle-aged (45-64 years).²⁹ A study based on national health survey in Belgium noted self-reported hearing disability of the population aged 15 years and older; hearing disability was associated with subjective ill health [OR = 1.32], mental ill health [OR = 1.51], and a low social contact [OR = 1.73].³⁰ The strong and highly significant association of hearing impairment with both poor overall health and poor psychological health in our national Thai cohort strongly support the above findings. Indeed, the associations shown for Thai adults in our study were even stronger than those noted for Australia and Europe and due to the large sample size, our results were strongly significant.

Our national Thai cohort also revealed a positive association between chronic illnesses (metabolic disorders, cardiovascular conditions) and hearing impairment. Other reports show association between chronic illnesses and hearing impairment. For example, the national health examination survey in the USA has reported that diabetes was associated with hearing impairment across a wide range of sound frequency.³¹ And a study of 3,000 Dutch persons aged between 55 to 85 years in Amsterdam reported association of hearing impairment with some chronic diseases such as lung and cardiac disease, stroke and cancer.¹¹ The same report also found that hearing impaired elderly persons reported significantly more depressive symptoms and a smaller social network than normally hearing peers. In Australia, the Blue Mountains Hearing Study of close to 3,000 participants reported that hearing loss of older persons increased reliance on the use of community and informal supports (OR 1.49, 95% CI 1.02-2.18).³²

Thailand has already taken many of the steps needed to assist communication and education for the hearing impaired population. Thai Sign Language was acknowledged as “the national language of deaf people in Thailand” in August 1999. As with many sign languages, the means of transmission to children occurs within families with signing deaf parents and in schools for the deaf. There are primary and secondary schools catering for these deaf and hearing disabled students in Thailand. The first of these was opened in Bangkok in 1953. Since then schools for the deaf and hearing disabled have been established in the North, Northeast and the South of Thailand.³³ In 1998, Mahidol University set up higher education for persons with disabilities. The Universal Health Coverage established in 2001 facilitates the use of primary healthcare services and provides access for regular health check-ups.^{34,35}

The strength of this study is its large scale with national population-embedded participation of adults from the socioeconomic mainstream of Thai society. Our study is based on educated Thais and the true magnitude of the trouble hearing might be even greater in the

general population because hearing impairment makes education more difficult. Our cross-sectional analysis reveals a strong statistical association between hearing impairment and a variety of adverse health outcomes after controlling for the effects of age. Some of these health outcomes are themselves capable of causing hearing loss (e.g., diabetes, and hypertension); future longitudinal analysis of this Thai cohort will provide further insights into causal links between hearing impairment and health outcomes. It should be noted that we measured self-reported hearing loss. The stigmatizing nature of hearing loss makes the self misreport quite unlikely. Furthermore, self-reported hearing impairment is the best measure of social and community function and represents the actual lived experiences of respondents.

Our study revealed that hearing loss in Thailand is common and strongly associated with adverse health outcomes as noted in other parts of the world. This study highlights the need for more attention to those with hearing impairment with a focus on raising awareness about prevention, and early detection of hearing impairment through primary healthcare and provision of affordable hearing aids. Many Thai institutions such as schools, universities, formal workplaces and public services are now beginning to adapt to the needs of the hearing impaired population. As well, our data suggest that psychological and medical counseling and supportive social networking would further help to mitigate the impacts of stigma and isolation. Counseling could also help the hearing impaired to adopt preventive and coping strategies for the various diseases to which they are more prone including poor overall health, psychological distress, metabolic disorders, and cardiovascular conditions.

Acknowledgments

This study was supported by the International Collaborative Research Grants Scheme with joint grants from the Wellcome Trust UK (GR071587MA) and the Australian NHMRC (268055), and as a global health grant from the NHMRC (585426). We thank the staff at Sukhothai Thammathirat Open University (STOU) who assisted with student contact and the STOU students who are participating in the cohort study. We also thank Dr Bandit Thinkamrop and his team from Khon Kaen University for guiding us successfully through the complex data processing.

References

1. WHO. Deafness and hearing impairment, fact sheet N°300. World Health Organization; Geneva: 2010.
2. Hogan A, O'Loughlin K, Davis A, Kendig H. Hearing loss and paid employment: Australian population survey findings. *Int J Audiol.* 2009; 48(3):117–22. [PubMed: 19283583]
3. Ritsher JB, Lucksted A, Otilingam PG, Grajales M. Hearing voices: explanations and implications. *Psychiatr Rehabil J.* 2004; 27(3):219–27. [PubMed: 14982328]
4. Andersson G, Willebrand M. What is coping? A critical review of the construct and its application in audiology. *Int J Audiol.* 2003; 42(Suppl 1):S97–103. [PubMed: 12918616]
5. Erler SF, Garstecki DC. Hearing loss- and hearing aid-related stigma: perceptions of women with age-normal hearing. *Am J Audiol.* 2002; 11(2):83–91. [PubMed: 12691218]
6. van den Brink RH, Wit HP, Kempen GI, van Heuvelen MJ. Attitude and help-seeking for hearing impairment. *Br J Audiol.* 1996; 30(5):313–24. [PubMed: 8922696]
7. Hetu R. The stigma attached to hearing impairment. *Scand Audiol Suppl.* 1996; 43:12–24. [PubMed: 8738641]
8. Fischer ME, Cruickshanks KJ, Klein BE, Klein R, Schubert CR, et al. Multiple sensory impairment and quality of life. *Ophthalmic Epidemiol.* 2009; 16(6):346–53. [PubMed: 19995199]
9. Gopinath B, Wang JJ, Schneider J, Burlutsky G, Snowdon J, et al. Depressive symptoms in older adults with hearing impairments: the Blue Mountains Study. *J Am Geriatr Soc.* 2009; 57(7):1306–8. [PubMed: 19570163]

10. Hogan A, O'Loughlin K, Miller P, Kendig H. The health impact of a hearing disability on older people in Australia. *J Aging Health*. 2009; 21(8):1098–111. [PubMed: 19897778]
11. Kramer SE, Kapteyn TS, Kuik DJ, Deeg DJ. The association of hearing impairment and chronic diseases with psychosocial health status in older age. *J Aging Health*. 2002; 14(1):122–37. [PubMed: 11892756]
12. Abas MA, Punpuing S, Jirapramupitak T, Tangchonlatip K, Leese M. Psychological wellbeing, physical impairments and rural aging in a developing country setting. *Health Qual Life Outcomes*. 2009; 7:66. [PubMed: 19607711]
13. NSO. Survey of disability in Thailand Bangkok. National Statistical Office; 2007a.
14. Prasansuk S. Incidence/prevalence of sensorineural hearing impairment in Thailand and Southeast Asia. *Audiology*. 2000; 39(4):207–11. [PubMed: 10963442]
15. WHO. Situation review and update on deafness, hearing loss and intervention programmes. World Health Organization Regional Office for South-East Asia; New Delhi: 2007.
16. Seubsman SA, Kelly MJ, Yiengprugsawan V, Sleight AC. Gender, socioeconomic status, and self-rated health in a transitional middle-income setting: evidence from Thailand. *Asia Pac J Public Health*. 2010 DOI: 10.1177/1010539509356807.
17. Sleight AC, Seubsman SA, Bain C. Cohort profile: The Thai Cohort of 87,134 Open University students. *Int J Epidemiol*. 2008; 37(2):266–72. [PubMed: 17911153]
18. Pachanee CA, Lim L, Bain C, Wibulpolprasert S, Seubsman SA, et al. Smoking behavior among 84 315 Open University students in Thailand. *Asia Pac J Public Health*. 2010 DOI: 10.1177/1010539509349148.
19. Edwards PJ, Roberts I, Clarke MJ, Diguiseppi C, Wentz R, et al. Methods to increase response to postal and electronic questionnaires. *Cochrane Database Syst Rev*. 2009; (3):MR000008. [PubMed: 19588449]
20. Fox R, Crask M, Kim JB. Mail survey response rate: A meta-analysis of selected techniques for inducing response. *Public Opinion Quarterly*. 1988; 52:467–91.
21. Asch DA, Jedrzejewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol*. 1997; 50(10):1129–36. [PubMed: 9368521]
22. Yiengprugsawan V, Seubsman S, Lim L, Sleight A. Use and foregone health services among a cohort of 87,134 adult open university students in Thailand. *Southeast Asian J Trop Med Public Health*. 2009; 40(6):1347–58. [PubMed: 20578471]
23. Webb, P.; Bain, C.; Pirozzo, S. Essential epidemiology: an introduction for students and health professionals. Cambridge University Press; New York, NY: 2005.
24. Kaewboonchoo O, Saleekul S, Jaipukdee S. Age related changes in hearing level among Thai people. *J Med Assoc Thai*. 2007; 90(4):798–804. [PubMed: 17487137]
25. NSO. Survey of older persons in Thailand Bangkok. National Statistical Office; 2007b.
26. Kespichayawattana J, Jitapunkul S. Health and health care system for older persons. *Ageing Int*. 2009; 33(1-4):28–49.
27. Bunnag C, Prasansuk S, Nakorn AN, Jareoncharsri P, Atipas S, et al. Ear diseases and hearing in the Thai elderly population. Part I. A comparative study of the accuracy of diagnosis and treatment by general practitioners vs ENT specialists. *J Med Assoc Thai*. 2002a; 85(5):521–31. [PubMed: 12188380]
28. Bunnag C, Prasansuk S, Nakorn AN, Jareoncharsri P, Atipas S, et al. Ear diseases and hearing in the Thai elderly population. Part II. A one year follow-up study. *J Med Assoc Thai*. 2002b; 85(5): 532–9. [PubMed: 12188381]
29. Tambs K. Moderate effects of hearing loss on mental health and subjective well-being: results from the Nord-Trondelag Hearing Loss Study. *Psychosom Med*. 2004; 66(5):776–82. [PubMed: 15385706]
30. Van Oyen H, Tafforeau J, Demarest S. The impact of hearing disability on well-being and health. *Soz Praventivmed*. 2001; 46(5):335–43. [PubMed: 11759341]
31. Bainbridge KE, Cheng YJ, Cowie CC. Potential mediators of diabetes-related hearing impairment in the U.S. population: National Health and Nutrition Examination Survey 1999-2004. *Diabetes Care*. 2010; 33(4):811–6. [PubMed: 20097782]

32. Schneider J, Gopinath B, Karpa MJ, McMahon CM, Rochtchina E, et al. Hearing loss impacts on the use of community and informal supports. *Age Ageing*. 2010; 39(4):458–64. [PubMed: 20516258]
33. Reilly, CB.; Reilly, N. *The rising of lotus flowers: self-education by deaf children in Thai boarding schools*. Washington Gallaudet University Press; 2005.
34. Somkotra T. Measurement and Explanation of Horizontal (In)Equity in Health Care Utilization Among Thais After Universal Coverage Policy Implementation. *Asia Pac J Public Health*. 2010 DOI: 10.1177/1010539509360674.
35. Yiengprugsawan V, Carmichael GA, Lim LL-Y, Seubsman S, Sleigh AC. Explanation of inequality in utilisation of ambulatory care before and after universal health insurance in Thailand. *Health Policy Plan*. 2010 doi:10.1093/heapol/czq028.

Table 1
Demographic, socioeconomic, and geographic characteristics of cohort members by levels of hearing impairment

Characteristics	Hearing impairment (%)			
	No impairment (n = 79,640)	Some trouble 13 yrs old (n = 6,670)	Some trouble < 13 yrs old (n = 706)	Deaf since 13 yrs old (n = 56)
Overall	91.4	7.7	0.8	0.06
Males	91.7	7.2	0.9	0.09
Females	91.1	8.0	0.7	0.04
Age (years)				
15-19	92.5	6.7	0.8	0.00
20-29	91.0	8.0	0.9	0.05
30-39	92.0	7.1	0.8	0.06
40-49	91.5	7.6	0.8	0.10
50	88.9	10.2	0.6	0.19
Monthly income (Baht)				
< 7000	91.2	7.7	0.9	0.06
7000-10000	91.1	7.9	0.9	0.05
> 10000	91.7	7.5	0.6	0.08
Lifecourse urbanisation				
Rural residents	92.3	6.8	0.8	0.05
Rural-urban residents	91.0	8.0	0.9	0.05
Urban residents	90.4	8.7	0.7	0.10

Table 2
Selected health outcomes among cohort members by levels of hearing impairment

Health outcomes	Percent prevalence of health outcomes by hearing impairment group				
	No impairment (n = 79,640)	Some trouble 13 yrs old (n = 6,670)	Some trouble < 13 yrs old (n = 706)	Deaf since 13 yrs old (n = 56)	Deaf since < 13 yrs old (n = 62)
Poor self-assessed health	4.0 (3,216)	10.4 (691)	9.4 (66)	14.3 (8)	8.1 (5)
Poor psychological health	5.4 (4,295)	11.3 (755)	11.8 (83)	10.7 (6)	9.7 (6)
Depression/anxiety	3.1 (2,491)	6.8 (455)	5.1 (36)	8.9 (5)	3.2 (2)
Metabolic disorders (diabetes, high cholesterol) ¹	8.9 (7,080)	11.8 (788)	8.6 (61)	12.5 (7)	16.1 (10)
Cardiovascular conditions (high blood pressure, stroke) ²	4.8 (3,821)	7.2 (477)	4.8 (34)	11.3 (7)	7.1 (4)
Liver disease	3.4 (2,737)	4.8 (323)	4.4 (31)	3.6 (2)	9.7 (6)
Kidney disease	2.5 (1,990)	4.0 (270)	3.1 (22)	3.6 (2)	1.6 (1)
Cancers (liver, lung, digestive, breast, others)	0.6 (458)	0.8 (54)	0.7 (5)	0.0 (0)	0.0 (0)

Notes:

¹The ratio of high cholesterol to diabetes was approximately 9 to 1.

²The ratio of high blood pressure to stroke were approximately 7 to 1.

Table 3
Crude, age-sex adjusted Odd Ratios (ORs) and Population Attributable Fractions (PAFs)
by levels of hearing impairment and selected health outcomes for cohort members

Levels of hearing impairment	Poor self-assessed health	Poor psychological health	Metabolic disorders	Cardiovascular conditions
Crude ORs				
Good (n = 79,640)	1.00	1.00	1.00	1.00
Some trouble (n = 7,376)	2.71 [2.50-2.95]	2.25 [2.12-2.39]	1.33 [1.23-1.43]	1.47 [1.34-1.62]
Deaf (n = 118)	2.94 [1.65-5.24]	2.26 [1.45-3.48]	1.72 [1.03-2.88]	2.03 [1.09-3.79]
Age-sex adjusted ORs				
Good (n = 79,640)	1.00	1.00	1.00	1.00
Some trouble (n = 7,376)	2.70 [2.48-2.93]	2.25 [2.12-2.39]	1.39 [1.28-1.51]	1.49 [1.35-1.65]
Deaf (n = 118)	3.08 [1.73-5.50]	2.43 [1.56-3.77]	1.43 [0.82-2.50]	1.67 [0.87-3.19]
Population Attributable Fractions (PAFs)% *				
Some trouble (n = 7,376)	12.6	9.6	3.2	4.0
Deaf (n = 118)	0.3	0.2	0.1	0.1
Overall (n = 7,494)	12.9	9.8	3.3	4.1

* Population Attributable Fractions (PAFs) tells us the proportion of the disease or condition that would not occur if no one in the population had the risk factor. For example, 12.9% of poor self-assessed health would not occur if there was no 'trouble hearing' or 'deafness' in the population.