A 16-year longitudinal study of hearing in very old Australians

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Introduction

Hearing impairment is recognised for its prominence among the chronic conditions of ageing, being more prevalent in Australia than all other national health priorities except musculo-skeletal conditions (Australian Institute of Health and Welfare, 2004). However despite its prevalence, there have been fewer epidemiological studies of hearing impairment than for other chronic diseases and disorders. Epidemiological data based on audiological evaluations are scant and a rigorously defined burden of illness for hearing impairment at a population or community level using both audiological and self-report types of estimate is still only available from a few studies world-wide (Gates *et al*., 1990; Davis, 1995; Wilson *et al*., 1998; Cruikshanks *et al*., 1998). Longitudinal studies are particularly valuable in providing information about patterns of ageing, about cohort differences in age-related physical, sensory and psychological functioning and for the services which an ageing population might require. The separate and pooled results of longitudinal studies are expected over time to provide more coherent and better integrated findings which will be a stronger evidence base for public health policies. The aims of such policies should promote healthy ageing and reduce the risk and impact of dependence and disability in old age. The Australian longitudinal study of ageing (ALSA) is a unique multidisciplinary study of older people in Australia. Its strengths lie in its sample size and high retention rate of initial participants, its focus on people 65 years and older at commencement and its longitudinal nature. Even with an international perspective, only a handful of other studies of older people provide the breadth and quality of data which ALSA does, particularly in the areas of hearing and vision. In this paper we will (i) introduce ALSA; (ii) describe the results from the most recent data collection (Wave 9); (iii) draw some comparisons between results obtained from participants in Waves 1 and 9, 16 years apart; (iv) compare hearing aid use among the oldest participants in Waves 1 and 9; (v) draw some conclusions.

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The Australian longitudinal study of ageing

ALSA is the largest and most comprehensive study of persons over 65 years of age ever undertaken in Australia, comprising 11 waves of data collection to date (2010). It began in 1992 and has used epidemiological methods to examine how social, biomedical, behavioural, economic and environmental factors are associated with age-related changes in the health and well-being of older persons. The study has two broad primary purposes: i) the examination of multiple health and health services measures and requirements, including morbidity, disability, acute and long term care service use and mortality; ii) the identification of factors contributing to positive health outcomes and the examination of models of health and successful ageing by individuals.

The data described in this paper were collected as part of ALSA's first phase, Wave 1, in 1992 and Wave 9 in 2008. The original Wave 1 participants (N=2087), aged 65 to 103 years, were recruited from the database of the South Australian Electoral Roll and postal invitations were sent to prospective participants. The urban (metropolitan Adelaide) sample was stratified to provide estimated equal numbers in 7, 5 year age and sex groups from 70 up to 100 years of age and over. Males were deliberately over represented to compensate for their predicted higher mortality over the period of the study.

Wave 9 in 2008 was the most recent complete assessment by interview and clinical measures. (Wave 11 commenced in 2010.) The surviving participants numbered 74 men and 139 women (mean age: 87.4y). The attrition in this sample of older people is almost entirely due to natural causes and not loss through failure to respond. Table 1 shows the demographics of the participants who were present in both Waves 1 and 9. There was a small but statistically significant difference in ages between males and females in Wave 9 (P=0.007) with males being slightly older on average (88.59 y) compared to females (87.07). This reflects an aspect of the sampling in Wave 1 in which spouses aged 65 to 69 years were recruited in order to have a sample of couples for the longitudinal study. There were only 17 male spouses of the 140 spouse participants in this age range.

ALSA is a bio-psychosocial study with data gathered by personal, in-residence contact (called the Full waves) and by telephone interview (T) in alternate years. There are two components to the full waves: i) a comprehensive personal interview with a trained interviewer and ii) a broad home-based clinical assessment of neuropsychological and physiological functions carried out on a separate visit.

The hearing data comprise clinical audiometric data and self-report data. Standard audiometric procedures under earphones were used to generate 7 pure tone air conduction thresholds for octave frequencies from 0.5 to 8 kHz, and half octave frequencies 3 and 6 kHz in each ear. A 4-frequency pure tone average (0.5, 1, 2 and 4 kHz) was calculated for each ear and used to determine a better hearing ear (BE) and worse hearing ear (WE) for each participant. This protocol for collecting audiometric data has been unchanging across all the 5 full waves of data collection. The 16 self-report questions of Wave 1 were reduced to 8 questions for all subsequent full waves, covering hearing, tinnitus, hearing aid use and perceived auditory abilities.

Results of Wave 9

Audiometric results

Figure 1 shows the groups' pure tone threshold average values for the better ear (BEPTA) and worse ear (WEPTA) at Waves 1 and 9 for the 142 Wave 9 participants who completed the audiometric testing (divided into 4 age groups at Wave 1). At Wave 1 the youngest group showed a borderline normal level of hearing ability with successive age groups showing a mild degree of HI. By Wave 9 the BEPTA worsened for all four age groups to a mild degree of HI in the youngest and a moderate degree of HI in the three successive age groups. There was a commensurate deterioration in WEPTA over the 16 years to a moderate degree of HI for all but the oldest age group; there appears to be a greater increase for the WEPTA in average HI in the oldest age group however this comprised only 3 participants.

Figure 2 shows the pattern of the mean change in hearing (for the right ear only) measured at 4 audiometric test frequencies (0.5, 1, 2 and 4kHz) for ALSA Wave 9 participants between Waves 1 and 9. These data show the greater increase with increasing age of mean thresholds for the mid to high speech frequencies, ie. 1 kHz and above, compared to the smaller mean change with time at 0.5 kHz.

Self report results

We report responses from 190 Wave 9 participants (125 females and 65 males) to 6 self-report questions about perceived hearing difficulties (1), hearing aid use (1), tinnitus (1) and self perceived situational difficulties related to self-reported hearing status (3).

Question 1. Do you wear a hearing aid? Sixty three per cent of the respondents reported that they did not wear a hearing aid (HA). Although there was a gender difference with 48% of male participants reporting HA use *Some* or *Most of the time* compared to 31% of females, this difference was not statistically significant (χ^2 test). Among the Wave 9 participants there was increasing use of a HA *Some* or *Most* of the time by age group. For the age groups ≤ 84 y (N=34), 85-89 y (N=111), 90-94 y ((N=40) and those ≥95y (N=7) the proportions of participants reporting HA were 23.5%, 37.8%, 35% and 71% respectively, however these increases by age were not statistically significant (χ^2 test).

Question 2. How much, if any, difficulty do you have with your hearing even when wearing your hearing aid? From the responses in Table 2 it is clear that the majority of the participants report at least some difficulty with their hearing. The pattern that emerges here shows a significant gender difference ($X^2(3, N=188)=8.32$, P=.040, phi=.210) with women tending to report less hearing difficulty than men.

Question 3. Do you have noises in the head or ears that last longer than 5 minutes? The majority of the participants, 80%, reported *No, never*. There was no significant gender difference among the 25% of males and the 19% of females who reported prolonged spontaneous tinnitus, *Some of the time* or *Most of the time*, as implied by the question's temporal element.

Question 4. Do you have difficulty following TV programs at a volume others find acceptable? Two thirds of the participants (67%) reported *No* or *Slight* difficulty, however 40% of male participants reported "Moderate" or "Great" difficulty compared to 25% of female respondents. Again this gender difference did not achieve statistical significance (χ^2). With increasing age the Wave 9 participants reported increasing difficulty in their responses to Question 4. For the age groups ≤84 y (N=34), 85-89 y (N= 111), 90-94 y ((N=40) and those ≥95y (N=7) the proportions of participants reporting "Moderate" or "Great" difficulty were 20.5%, 27.9%, 37.5% and 57.1% respectively, however these increases by age did not reach statistical significance (χ^2 test).

Question 5. Some people find it difficult to hear someone talking in a quiet room. Do you find this? Very few of the respondents found this a situational difficulty with 93.5% of them reporting *No* or *Slight* difficulty. Ninety four percent of female participants' responses fell in either of these two categories compared to 92% of male participants' responses.

Table 1. Demographics of participants in both Wave 1 and Wave 9 (N=213).

	Mean age (y)	Age range (y)	Females	Males
Wave 1	72	65-91	65.8%	34.2%
Wave 9	88	80-106	N=139 (mean 87.1 y)	N=74 (mean 88.6 y)

Table 2. Q. 2: How much, if any difficulty, do you have with your hearing even when wearing your hearing aid?

	Degree of difficulty with hearing			
	None	Slight	Moderate	Great
Sex				
Male N=64	21.9%	48.4%	18.8%	10.9%
Female N=124	40.3%	40.3%	15.3%	4.0%
Total	34.0%	43.1%	16.5%	6.4%

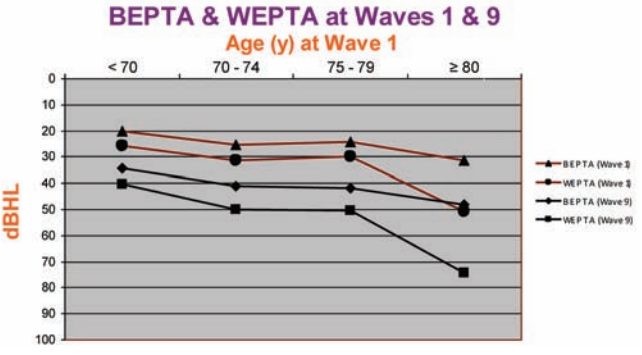

Figure 1. Mean changes in BEPTA and WEPTA by age group for Wave 9 participants between Wave 1 and Wave 9.

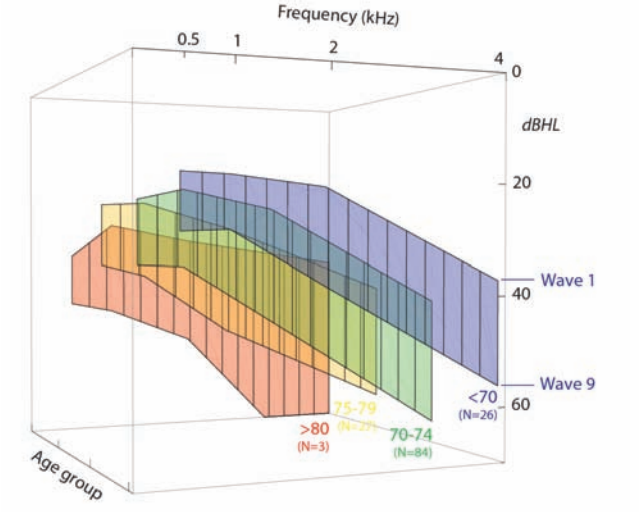

Figure 2. The mean change in hearing (right ear only) measured at 4 audiometric test frequencies (0.5, 1.0, 2.0 and 4.0 kHz) for ALSA Wave 9 participants in the period between Wave 1 and Wave 9 displayed by their age grouping at Wave 1.

Question 6. Do you find your personal and social life is affected by hearing problems? We have analysed the responses to this question only for the Wave 9 respondents who reported hearing problems in answer to Question 2. The overall majority, 67.5%, reported *Never* or *Seldom* experiencing effects of their own hearing loss on their social life. However, men were significantly more likely to find their social life affected by their hearing problems ($X^2(3, N=126)=12.85$, P=.005, phi =.312). There was no significant relationship by age.

Hearing aid use among the oldest participants in Wave 1 and Wave 9

Table 3 shows the use of a HA in those participants at Wave 1 who were 85 years old or older and the different sample of participants 85 years old or older in Wave 9. The table also distributes these two subsamples of ALSA participants who wore HAs by gender and by degree of average HI. The latter was derived from each participant's BEPTA and categorised according to the hearing ranges shown, that is, an average mild hearing loss or an average moderate or greater degree of hearing impairment. The results clearly demonstrate that ALSA participants 85 years or older in Wave 9 in 2008 were much more likely to be wearing a HA irrespective of gender or degree of hearing impairment than the earlier cohort of participants of the same age in 1992.

Table 3. Use of hearing aids in participants ≥ 85y in Waves 1 and 9.

	mild HL (20 -34 dBHL)		≥ mod HL (≥35 dBHL)	
	Wave 1	Wave 9	Wave 1	Wave 9
Female	23.4% (N=47)	44.8% (N=29)	16.3% (N=49)	47.6% (N=42)
Male	41.2% (N=34)	63.3% (N=11)	23.2% (N=112)	55.8% (N=43)

Conclusions

At Wave 9 ALSA participants, whose mean age was 87.4 years, were likely to report no or slight hearing difficulty; that they did not wear a HA; that they did not have tinnitus and did not find their social lives affected by hearing loss, even if they reported one, when asked about each of these areas. In general male participants were significantly more likely than female participants to report considerable difficulty in relation to hearing, despite a higher rate of HA use. These difficulties with respect to the effect of their hearing loss on their social life also reached a statistically significant level of difference for male participants. The results of the self-report data showed no statistically significant effect of increasing age on self-reported hearing problems or situational difficulties related to hearing loss although there appear to be age-related trends. However, there is evidence for increased use of HAs by Wave 9 participants 85 years and older compared to their age peers 16 years earlier. This is an encouraging result which may reflect a number of different interrelated issues. For example, the increase may reflect: i) a change during this period to greater Australian Government supported access to HAs at lower cost for older Australians; ii) the strong commercial thrust of the hearing aid industry in Australia targeting old people as potential users of HAs; iii) a possible cohort effect due to the repeated audiometric assessments and related questioning that this specific group of old people has undergone. Further comparative analyses of changes across the 5 full ALSA waves are likely to elucidate these and other interesting questions.

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