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Hearing loss impacts on the use of community and informal supports

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Abstract

Objective: the aim of this study is to estimate the cross-sectional and longitudinal impact of hearing loss on use of community support services and reliance on non-spouse family/friends among older people.
Methods: Blue Mountains Hearing Study participants (n=2,956) were assessed for hearing impairment by audiologists in sound-treated booths. Participants were classified as hearing impaired if $PTA_{0.5-4kHz}$ >25 dB HL. Use of services and non-spouse family/friend support was assessed cross-sectionally. Incident use was assessed among survivors at the 5-year follow-up (n=1,457).
Results: a significant cross-sectional association between hearing loss (>25 dB HL) and use of community support services was observed after adjusting for age, sex, living status, self-rated poor health, self-reported hospital admissions, disability in walking and best-corrected visual impairment [odds ratio (OR) 2.12, 95% confidence interval (CI) 1.15–3.90]. Participants with hearing loss who never used a hearing aid were twice as likely to use formal supports as participants without hearing loss (multivariate-adjusted OR 2.25, 95% CI 1.19–4.24). Hearing loss increased the incident need for non-spouse family/friend support or community services (multivariate-adjusted OR 1.49, 95% CI 1.02–2.18).
Conclusions: after adjusting for confounding factors, hearing impairment negatively impacted on the independence of older persons by increasing reliance on community or family support.

Keywords: *hearing loss, community services, informal support, Blue Mountains Eye Study, Blue Mountains Hearing Study, elderly*

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Introduction

Caring for the growing number of disabled older adults is an issue of increasing importance with the ageing population. Understanding the factors that could determine the type and amount of home care services, both formal (community support services) and informal (non-spouse family/friend), needed may assist in long-term planning of health services and policies [1, 2]. Previously, we have shown that many health-related factors including walking disability, vision loss and a history of stroke are significantly associated with the use of support services in older Australians [1]. In this study, walking disability was the factor with the strongest impact on use of community support services.

Age-related hearing loss is a common and under-recognised health problem in the older population. According to epidemiological studies in the USA, UK and Australia, it affects between 31 and 45% of persons aged ≥50 years [3–7]. Due to the strong age-related increase in hearing loss prevalence [6], this condition is a major health problem worldwide, related to population ageing. Diminished ability to hear and communicate is frustrating, and impacts on the affected individual as well as other people in their environment [8]. Hearing loss may produce social isolation, distorted communication and can lead to stigmatisation. Hearing loss has been associated with adverse psychosocial effects, including poor quality of life, well-being [5, 9, 10] and with depressive symptoms [11–13].

Despite its high prevalence and known negative impacts, few studies have assessed the contribution of hearing impairment to the use of community support services or need for regular help from non-spouse family or friends. In a study utilising data from the 2 years (1971 and 1977) of the US Health Interview Survey, increased utilisation of services was found among hearing-impaired patients, although they did not control for potential confounders such as chronic illness that may be associated with higher rates of service utilisation [14]. Similarly, in a US study of 1,436 randomly selected 65-year-old health maintenance organisation members (for the years 1967–91), the authors noted that hearing impairment was associated with an increased likelihood of making at least one visit to a health care provider [odds ratio (OR) 3.31, 95% confidence interval (CI) 1.55–7.06], but did not lead to use of additional services [15]. In contrast, in a study using data from the 1983–85 US National Health Interview Survey of adults aged 18+years, hearing loss as a principal complaint led to less utilisation of health services compared to other chronic conditions such as arthritis and visual impairment [16]. Likewise, in the Blue Mountains Eye Study, 3,654 people aged ≥49 years were examined west of Sydney, Australia, during 1992–94. In this population-based study, self-reported hearing loss was not significantly associated with reliance on community support services, after adjusting for age and sex (OR 1.3, 95% CI 0.9–1.9) [1]. However, this analysis was conducted before an objective hearing assessment was introduced to the study design. Further, to date there have been no longitudinal studies that have been conducted to assess the association between hearing loss and use of community support services. The primary advantage of this type of analyses being that it will help determine the causality and directionality of the association.

We used the Blue Mountains Hearing Study (BMHS) cohort, a representative population of older Australians to answer the following questions: (i) Does having a hearing impairment increase the likelihood of receiving support from community services and/or non-spouse family/friends, cross-sectionally?; (ii) Does having a hearing loss at baseline increase the incidence of using community support services and/or receiving support from non-spouse family/friend after adjusting for potential confounders?; (iii) Is the association between hearing loss and the use of community support services modified by walking disability, vision loss and hospital admissions?; and (iv) Does hearing aid use influence the likelihood or risk of using support services among hearing-impaired adults?

Methods

Study population

The BMHS is a population-based survey of hearing loss conducted during 1997–99 and 2002–04 among participants of the Blue Mountains Eye Study (BMES-1). Methods to identify the BMES-1 population were described previously [17]. During 1992–94, 3,654 participants aged ≥49 years were examined (82.4% participation; BMES-1). Surviving baseline participants were invited to attend 5-year follow-up examinations (1997–99, BMES-2), at which 2,334 (75.1% of survivors) and an additional 1,174 newly eligible residents were examined, i.e. those who had moved into the study area or study age group. At the 10-year follow-up (2002–04, BMES-3), 1,952 participants (75.6% of survivors) were re-examined, respectively. Hearing was measured at BMES-2 and BMES-3, i.e. in BMES-2, 2,956 participants aged 50+ years had audiometric testing done.

Measures

Pure-tone audiometry at both visits was performed by audiologists in sound-treated booths, using TDH-39 earphones and Madsen OB822 audiometers (Madsen Electronics, Denmark). Bilateral hearing impairment was determined as the pure-tone average of audiometric hearing thresholds at 500, 1,000, 2,000 and 4,000 Hz ($PTA_{0.5–4kHz}$) in the better ear, defining any hearing loss as $PTA_{0.5–4kHz}$ >25 dB HL, and moderate to severe hearing loss as $PTA_{0.5–4kHz}$ >40 dB HL.

At face-to-face interviews with trained interviewers, a comprehensive medical history that included information about hearing, demographic factors, socio-economic characteristics and lifestyle factors was obtained from all participants. Self-rated health was assessed by asking the question 'for somebody your age, would you say your health

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Table 1. Baseline characteristics of Blue Mountains Study participants (n=2,803)

Characteristics	No hearing loss (n=1,881)	Hearing loss (n=922)	Unadjusted P-values
Age (years), mean±SD	64.3±7.9	73.7±8.4	<0.0001
Male, n (%)	748 (39.8)	464 (50.3)	<0.0001
Higher qualification, n (%)	1,198 (68.2)	498 (57.0)	<0.0001
Home ownership, n (%)	1,722 (91.6)	830 (90.0)	0.18
Receiving pension, n (%)	935 (50.0)	687 (74.8)	<0.0001
Living alone, n (%)	482 (25.6)	311 (33.7)	<0.0001
Self-reported poor health, n (%)	318 (17.0)	215 (23.5)	<0.0001
Number of falls reported, n (%)	514 (27.3)	306 (33.2)	0.001
Hospital admissions, n (%)	104 (5.5)	73 (7.9)	0.01
Cognitive impairment, n (%)	19 (1.0)	55 (6.2)	<0.0001
Walking disability, n (%)	56 (3.0)	134 (14.6)	<0.0001
Best-corrected visual impairment, n (%)	20 (1.1)	43 (4.7)	<0.0001

is excellent, very good, good, fair, or poor?' Low self-rated health was defined as fair or poor. Walking difficulty or use of a cane, walker or wheelchair was observed by a trained examiner and categorised as 'disability in walking'. Visual acuity was measured wearing current glasses, using a Log-Mar chart, and was followed by subjective refraction [17]. For each eye, visual acuity was recorded as the number of letters read correctly from 0 (<6/60) to 70 (6/3). Visual impairment was defined as visual acuity of <39 letters (<6/12) in the better eye after subjective refraction. Cognitive function was assessed using the mini-mental state exam (MMSE) administered at both the baseline and follow-up visits. MMSE scores range from 0 to 30 [18], with scores <24 indicating cognitive impairment.

To assess use of community support services and dependence on informal supports, participants were asked the following questions:

- Do you get regular help from meals on wheels (MOW)?
- Do you get regular home visits from a community nurse?
- Do you get regular visits from Homecare?
- Who usually cleans your house? (you, spouse, daughter, son, other relatives, home help, others)
- Who usually does your shopping? (same choices as above)
- Are you able to go out alone?

Dependence on community support services was defined as regular use of MOW, Homecare or community nursing. Reliance on informal support was defined as receiving assistance from someone other than a spouse (family member/friend) for cleaning or shopping. In addition, participants' ability to go out alone was also assessed.

Statistical analysis

SAS software (v9.1; SAS Institute, Cary, NC, USA) was used for analysis, including t-tests, chi-square tests and logistic regression. Multivariable logistic regression analysis was used to calculate adjusted OR and 95% CI to demonstrate the impact of hearing loss on use of community support services or reliance on support from non-spouse family or friends while adjusting for other factors. Multivariate models were adjusted for age, gender and the following potential confounding factors: living status, self-rated poor health, self-reported hospital admissions in the past year, disability in walking and best-corrected visual impairment. We also tested for statistically significant interactions between hearing loss and other risk factors (i.e. walking disability, vision loss and hospital admissions) by adding a product term in the final multivariate model. We defined an interaction if the influence from the joint variable of hearing loss and another confounder departed from the multiplicative scale of the influence of each factor alone, confirmed by a statistically significant interaction term. Significance was taken as P<0.05.

Results

Of the 2,956 hearing study participants, 2,940 had complete audiological data. Any level of hearing loss (>25 dB HL) was present in 33% of participants. Of the 2,956 hearing study participants, 2,818 had complete data on community support services and family support. Of these, 15 participants were excluded as they had incomplete audiological data, leaving 2,803 participants. Participants with hearing loss were significantly older and more likely to be male, living alone and receiving a government social security pension (Table 1). They were also more likely to have low self-rated health, to have reported at least one fall in the previous year and to have a disability in walking, visual impairment or cognitive impairment (Table 1).

At baseline, use of any community support service was reported by 3.0% of the study cohort. This included 1.6% of participants (n=45) reporting use of MOW, 0.82% (n=23) reporting use of a community nurse, 1.7% (n=47) reporting use of regular home help or 0.8% (n=23) who reported use of two or more community support services. Furthermore, 3.6% reported relying on help for cleaning or shopping from non-spouse family or friends and 3.5% reported being unable to go out alone. Although there were no significant differences in the frequency of use of community support services or reliance on informal support from non-spouse

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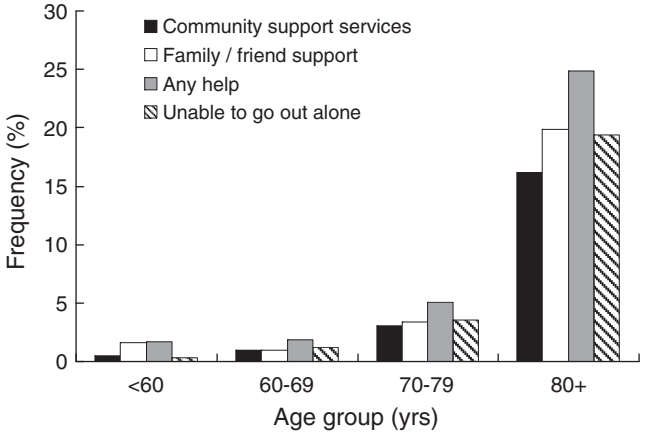

Figure 1. Prevalent use of community services, family support and inability to go out alone by age group in the Blue Mountains Hearing Study population. $P_{trend} \leq 0.0001$

family or friends between men and women, women were more likely to report an inability to go out alone compared to men (OR 2.58, 95% CI 1.57–4.21).

A significantly higher proportion of participants living alone used community support services compared with those not living alone (5.8 vs 1.9%, $P<0.0001$). The use of community support services and non-spouse family or friend support increased with age, markedly in those aged >80 years (Figure 1). Similarly, reported inability to go out alone increased significantly with age ($P<0.0001$).

Among those with measured hearing loss (>25 dB HL, both ears), use of at least one community support service was reported by 66 persons (7.2%) while reliance on non-spouse family or friend support was reported by 67 (7.8%) and 72 (7.8%) reported being unable to go out alone.

After adjusting for age and sex, any hearing loss was significantly associated with the prevalence of use of community support services (Table 2). This association remained statistically significant after multivariate adjustment (OR 2.12, 95% CI 1.15–3.90). After stratifying by the severity of hearing loss, significant associations were found for persons with mildly impaired hearing but not separately for persons with moderate to severe hearing loss. The likelihood of using community or family support increased with increasing severity of hearing loss (Table 2).

The results showed strong evidence for an interaction effect between hearing loss and walking disability ($P_{interaction}=0.02$). We stratified our analysis by walking disability and observed that, in older adults without a walking disability, hearing loss was significantly associated with the use of any support services (OR 2.54, 95% CI 1.47–4.38). This significant association was not observed among people with a walking disability ($P=0.73$). There was no evidence for a similar effect between hearing loss and visual impairment ($P_{interaction}=0.20$), and hearing loss and hospital admissions ($P_{interaction}=0.47$).

Participants who frequently (>1 h/day) and infrequently (≤1 h/day) used a hearing aid were not more likely than those without hearing loss to use community support services at baseline (multivariate-adjusted OR 1.55, 95% CI 0.66–3.68 and OR 2.60, 95% CI 0.98–6.87, respectively). However, participants with hearing loss who never used a hearing aid were twice as likely to use community support services than those without hearing loss (OR 2.25, 95% CI 1.19–4.24 after multivariate adjustment). The frequency of hearing aid use was not associated with the use of non-spouse family or friend support or reported inability to go out alone.

At baseline, a total of 1,457 participants had complete demographic and audiological data and did not report use of community support services, use of non-spouse family or friend support, or inability to go out alone. These participants were included in the 5-year incidence analysis. Incident use of community support services and non-spouse family or friend support increased with age, as did reported inability to go out alone (Figure 2). The incidence of regular help from non-spouse family or friend support was signifi-

Table 2. Hearing loss and the prevalence of use of community services, family/friend support and inability to go out alone

Hearing loss	Support			
	Community support services	Non-spouse family member/friend	Community or family support	Unable to go out alone
No hearing loss	19 (1.0)	28 (1.6)	40 (2.1)	29 (1.5)
Age- and sex-adjusted OR (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Multivariate-adjusted OR (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Any (>25 dB HL), *n* (%)	66 (7.2)	67 (7.8)	103 (11.2)	72 (7.8)
Age- and sex-adjusted OR (95% CI)	**2.47 (1.39–4.39)**	**1.92 (1.15–3.20)**	**2.19 (1.43–3.34)**	1.62 (0.98–2.69)
Multivariate-adjusted OR (95% CI)[a]	**2.12 (1.15–3.90)**	1.59 (0.91–2.77)	**1.83 (1.16–2.88)**	0.96 (0.50–1.81)
Mild to moderate (25–40 dB HL), *n* (%)	37 (5.9)	37 (6.3)	57 (9.0)	33 (5.2)
Age- and sex-adjusted OR (95% CI)	**2.33 (1.28–4.27)**	**1.74 (1.01–3.00)**	**1.97 (1.25–3.10)**	1.23 (0.70–2.16)
Multivariate-adjusted OR (95% CI)[a]	**2.21 (1.17–4.18)**	1.60 (0.89–2.87)	**1.81 (1.12–2.94)**	0.84 (0.42–1.68)
Moderate to severe (>40 dB HL), *n* (%)	29 (10.0)	30 (11.3)	46 (15.9)	39 (13.5)
Age- and sex-adjusted OR (95% CI)	**2.78 (1.41–5.46)**	**2.35 (1.27–4.35)**	**2.71 (1.62–4.52)**	**2.54 (1.41–4.59)**
Multivariate-adjusted OR (95% CI)[a]	1.93 (0.93–4.02)	1.58 (0.79–3.13)	**1.86 (1.06–3.27)**	1.18 (0.55–2.51)

OR, odds ratio; 95% CI, 95% confidence interval.

[a]Adjusted for age, sex, living status, self-rated poor health, hospital admissions in the past year, walking disability and best-corrected visual impairment.

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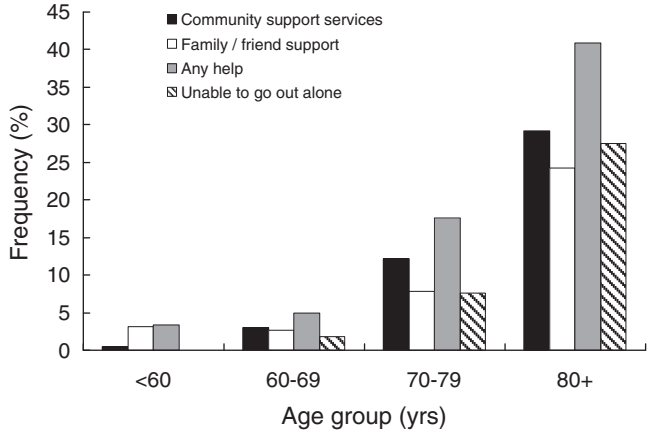

Figure 2. Incident use of community services, family/friend support and inability to go out alone by age group in the Blue Mountains Hearing Study population. $P_{trend} \leq 0.0001$

cantly higher in women than in men (7.4 vs 3.2%, $P=0.002$), as was the reported inability to go out alone (6.9 vs 3.3%, $P=0.003$).

At the 5-year follow-up, 62 participants (13.2%) with hearing loss reported taking up use of community support services, 39 (10%) reported developing reliance on non-spouse family or friend support and 51 (10.5%) reported an inability to go out alone (Table 3). Participants with moderate to severe hearing loss (>40 dB HL) at the baseline survey had a 2.7-fold higher risk of developing a reliance on non-spouse family or friend support compared to those with normal hearing (Table 3). Those with any hearing loss (>25 dB HL) at baseline were also more likely to require support from either non-spouse family or friends, or community services, at the 5-year follow-up (multivariate-adjusted OR 1.49, 95% CI 1.02–2.18). There were no significant associations found between hearing loss and the 5-year incidence of reported inability to go out alone.

We also assessed the association between hearing aid use and the incidence of support service usage. The constructed model included people without hearing loss compared to three groups of hearing aid use among people with hearing loss: (i) did not use a hearing aid at all, (ii) used a hearing aid infrequently and (iii) used a hearing aid frequently. The following additional covariates were also adjusted for: age, sex, living status, self-rated poor health, self-reported hospital admissions in the past year, disability in walking and best-corrected visual impairment. At follow-up, hearing aid use frequency at baseline was not associated with the incident uptake of community support services and reported inability to go out alone. However, compared to participants without hearing loss, older adults who reported frequent use of their hearing aid at baseline were three times more likely to use informal support from non-spouse family or friends after the 5-year follow-up (multivariate-adjusted OR 3.33, 95% CI 1.46–7.63). Significant associations were not observed between use of informal supports and infrequent hearing aid use and non-usage of a hearing aid (OR 2.07, 95% CI 0.64–6.70 and OR 1.40, 95% CI 0.76–2.59, respectively).

Discussion

The projected increase in age-related hearing loss prevalence over the next several decades warrants a better understanding of how hearing-impaired adults use formal and informal services. This is one of the very few studies on the association between hearing loss and use of community support services and reliance on non-spouse family/friends among older people.

Cross-sectional analysis showed that hearing loss was associated with a 2-fold increased use of community services, with mild to moderate and moderate to severe loss associated with an 80% increased reliance on either formal or informal support. Hence, our findings contribute to evidence suggesting that hearing impairment may increase

Table 3. Hearing loss and incident use of community services, family/friend support and inability to go out alone

Hearing loss	Support			
	Community support services	Non-spouse family member/friend	Community or family support	Unable to go out alone
No hearing loss	46 (4.9)	31 (3.6)	72 (7.7)	27 (2.9)
Age- and sex-adjusted OR (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Multivariate-adjusted OR (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
Any (>25 dB HL), *n* (%)	62 (13.2)	39 (10.0)	90 (19.4)	51 (10.5)
Age- and sex-adjusted OR (95% CI)	1.43 (0.92–2.23)	**1.81 (1.05–3.10)**	**1.58 (1.09–2.29)**	1.69 (0.99–2.87)
Multivariate-adjusted OR (95% CI)[a]	1.32 (0.84–2.08)	1.72 (0.99–2.99)	**1.49 (1.02–2.18)**	1.48 (0.85–2.55)
Mild to moderate (25–40 dB HL), *n* (%)	44 (12.8)	22 (7.7)	60 (17.7)	32 (9.0)
Age- and sex-adjusted OR (95% CI)	1.50 (0.94–2.39)	1.46 (0.80–2.67)	1.47 (0.99–2.20)	1.55 (0.88–2.75)
Multivariate-adjusted OR (95% CI)[a]	1.37 (0.85–2.22)	1.42 (0.77–2.62)	1.38 (0.91–2.08)	1.38 (0.77–2.49)
Moderate to severe (>40 dB HL), *n* (%)	18 (14.1)	17 (16.0)	30 (24.2)	19 (14.2)
Age- and sex-adjusted OR (95% CI)	1.26 (0.66–2.41)	**2.97 (1.45–6.06)**	**1.91 (1.12–3.25)**	**2.06 (1.03–4.14)**
Multivariate-adjusted OR (95% CI)[a]	1.17 (0.60–2.28)	**2.71 (1.29–5.67)**	**1.84 (1.06–3.19)**	1.73 (0.84–3.57)

OR, odds ratio; 95% CI, 95% confidence interval.

[a]Adjusted for age, sex, living status, self-rated poor health, hospital admissions in the past year, walking disability and best-corrected visual impairment.

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reliance on use of both formal and informal support. This is contrary to findings from a relatively small study conducted among 284 frail older adults presenting for aged care assessment, where moderate to severe hearing loss was not significantly associated with increased community services use [19]. Factors such as the age–sex distribution and level of frailty between the two study samples may explain the discrepancy in the findings.

Cross-sectional analysis also showed that those with hearing loss who had never used hearing aids were twice as likely to rely on community support services as those without hearing loss. This is in agreement with data from a relatively small Australian study (n=496) [20] in which the authors noted that those who did not use hearing aids had increased use of community support services. This may be because persons with greater need of community support services may be less able to seek out treatment for hearing loss. In contrast to the above findings, the Randwick study noted those who had not received assistance for their hearing loss reported more difficulty shopping and greater reliance on family members [20].

Temporal data demonstrated that hearing loss was a significant predictor of uptake of support, particularly from non-spouse family/friends, suggesting a causal relationship between hearing loss and need for support. The association between hearing loss and use of non-spouse family or friend support was significantly greater than the use of community support services. This could be due to hearing loss altering the nature of, and level of dependency within, relationship networks due to its impact on communication, interactions and self-sufficiency [21–24]. It may also reflect difficulty in obtaining, or lack of information about, community support services. More surprising, perhaps, is the finding that even those who reported frequent use of hearing aids were significantly more likely to rely on informal support from non-spouse family or friends over time compared to those without hearing loss. Previous research has shown uncorrected hearing loss is associated with isolation and reduced social activity [8, 21], whereas the use of hearing aids improves social and emotional function, communication and reduces depression [25]. Thus, a positive interpretation of this finding may be that the use of hearing aids enabled participants to maintain social relationships and expand their use of informal supports over time. Alternatively, it is acknowledged that even those who wear hearing aids can experience socially disabling levels of hearing loss [26] due to a lack of post-fitting rehabilitation, lack of support to adapt to hearing aids with resultant dissatisfaction or a failure to achieve significant improvements because of slowed central processing of acoustic information [27–29].

Strengths of this study include its population-based sample, relatively high participation and standardised, audiometric testing to measure hearing function. The ability to classify subjects as mildly and moderately to severely impaired also added value to this study. One of the limitations of this study is our inability to adequately adjust for all confounders, as there are many unstated factors that are likely to have influenced the uptake of formal and informal supports. Second, our incidence findings need to be interpreted with caution as the relatively small numbers of incident cases of use of support services at follow-up may have limited our study power. Another limitation is the possibility of survival bias; selective survival would bias our findings towards null if individuals who died early were more likely to have walking disability or have been frequently admitted to hospital. Finally, we need to highlight that the duration of follow-up is short and that the average age of the cohort is relatively old. Therefore, the influence from hearing loss on usage of support services may have already been exerted before the cohort was followed. Hence, the temporal findings presented may be an underestimation.

In conclusion, we provide previously lacking data on the cross-sectional and longitudinal impact of hearing loss on the use of community support services and informal support from family and friends. Hearing loss was a significant and independent predictor of reliance on non-spouse family or friend support. These findings emphasise that individuals with a hearing loss encounter practical and social problems beyond those experienced by older persons without hearing loss. Given the ageing population of most developed countries, we should be conscious in planning future social and health services to note that older persons will experience hearing loss that may predispose them to reduced independence and increased need for support.

Key points

- Hearing loss impacts negatively on independence of older persons by increasing reliance on community/family support.
- Hearing aid use was inversely associated with the use of community support services.
- Early diagnosis of hearing loss may allow for treatments or interventions to assist people to retain independent living.

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Conflicts of interest

None declared.

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Ethics approval

The University of Sydney Human Research Ethics Committee. Written informed consent was obtained from all participants.

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