The projected burden of hearing loss in New Zealand (2011-2061) and the implications for the hearing health workforce

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ABSTRACT

BACKGROUND: There is considerable evidence that New Zealand’s population is ageing. For example, the median age increased from 29 years in 1951 to 37 years in 2011–12, and will likely increase to 44 years by 2061. While the implications of an ageing population have been studied, to date there is no study investigating the impacts that population ageing will have on hearing health in New Zealand.

AIM: To explore the changing population structure and estimate the burden of hearing loss in New Zealand between 2011 and 2061.

METHODS: Using three alternative population projections from Statistics New Zealand, we quantify the likely distribution of the population between 2011 and 2061 by age and sex. Published estimates of hearing loss stratified by age and severity of hearing loss were then applied to the population projections to highlight the potential impact that population ageing will have on hearing loss in New Zealand in the next 50 years.

RESULTS: We estimated that there were 330,269 people aged ≥14 years with hearing loss and this would increase to 449,453 in 2061. Overall, males have a higher prevalence of hearing loss than females, and while the prevalence of hearing loss among those aged 14–49 years is expected to decrease, the prevalence among the population aged ≥70 years is expected to double between 2011 and 2061.

CONCLUSION: Age, sex and geographical variations in hearing loss are expected in the next 50 years. Further research into ethnic and variations in hearing loss will be instrumental in targeting the future hearing health workforce required to accommodate these increases.

New Zealand’s population is ageing. Indeed, since 1951 the median age has increased from 29 years to 37 years in 2011–12, and recent projections indicate that this will increase further to 44 years by 2061. A result of the increased proportion of the population living longer is increased pressure on centrally-funded health and social resources. A number of studies have explored the impact of an ageing society on the management of chronic illnesses in New Zealand, however these are typically focused on diseases associated with cardiovascular disease and or diabetes. To our knowledge, no research has investigated the implications of New Zealand’s ageing population on hearing health.

The World Health Organization estimates that hearing loss affects approximately 360 million people, or 5.3% of the world’s population. The most recent estimates of hearing loss in New Zealand were based on 2001 Census data, in which the prevalence of hearing loss among adults not living in residential care facilities aged ≥15 years was 7.5%. A recent Australian study reported the prevalence of hearing loss at 17.4% among the total population. Those authors further stratified their study by severity and estimated 11.4% of the population had mild (≥25 dBHL and <45 dBHL) hearing loss, 4.0% had moderate hearing loss (≥45 dBHL and < 65 dbHL) while severe hearing loss (≥65 dBHL) affected
2.0% of the Australian population. As expected, males had a substantially higher prevalence (21.0%) of hearing loss than females (13.9%), although the prevalence increased dramatically with age among both sexes. Age-related hearing loss (presbyacusis) is the result of a number of genetic and environmental factors that primarily affect the cochlea. There is debate as to the contribution of lifetime noise exposure to presbyacusis and the effect of noise-induced hearing loss prevention programs in reducing or delaying hearing loss. Given that hearing amongst 75 year olds did not change in the three decades between 1976 and 2005, we believe that current population estimates can be used to accurately predict future prevalence of hearing loss.

Hearing loss in New Zealand has been traditionally managed medically by otolaryngologists and through hearing aids by audiologists. To our knowledge, the most recent study that attempted to plan for hearing health services in New Zealand was published in 1984 by the New Zealand Board of Health. At that time, there were 41 otolaryngology specialists and 34.4 full-time equivalent (FTE) audiologists in practice. This equated to a practitioner: population ratio of 1:77,000 for otolaryngologists and 1:92,300 for audiologists.

While new technology and medical treatments for hearing loss will likely be developed during the next 50 years, estimating the required hearing health workforce is vital to ensure that the current level of service is, at the very least, maintained into the future.

This study aims to estimate the future trends of hearing loss in New Zealand, by age, gender and geographical region. In addition, we aim to explore the implications of the changing demography of New Zealand on the provision of hearing health services in the next 50 years. First, we briefly highlight the changing demography of New Zealand, before projecting the age-specific burden of hearing loss in New Zealand between 2011 and 2061. In addition, we demonstrate the geographical variations in hearing loss between 2011 and 2031 before highlighting the required workforce to maintain a status quo level of hearing health services.

Data and Methods

Population projections

We use Statistics New Zealand’s (SNZ) population projections as our denominator. Based on the 2011 mid-year population estimates, the stochastic population projections were created by combining 2,000 simulations of historical fertility, mortality, and migration trends. These simulations can be summarised by percentiles, which indicate the probability that the actual result is lower than the percentile. For example, the 25th percentile indicates an estimated 25% probability that the actual result will be lower, and a 75% probability that the actual result will be higher, than this percentile. In this study, we used the median (i.e., 50th percentile) population projections to represent 95% confidence intervals. The median population projections are based on assumptions that: the total fertility rate decreases to 1.9 births per woman in 2036 and beyond; life expectancy at birth increases to 88.1 years for males and 90.5 years for females in 2061 and; there is a long-run annual net migration gain of 12,000 people from 2015.

Hearing loss prevalence estimates

The most recent prevalence study of hearing loss in New Zealand was published in 2005 (Greville, 2005) and based on results from the 2001 Census in addition to the 2001/2 Health Survey. In that study, the prevalence estimates were only provided for children (aged 0–14 years) and adults (15+) years, and did not take into account the extent to which hearing was impaired. The data used in this analysis came from the Roy Morgan Single Source database. Household surveys were conducted by Roy Morgan Research Limited in New Zealand each year between August 2007 and July 2013. Over this period, 69,976 people aged 14 years and older were interviewed via the telephone. Among those 69,976 respondents, 27,100 (38.73%) were male and 42,876 (61.27%) were female. Most respondents were aged 35 to 49 years (26.64%), while the New Zealand European and Other ethnic groups combined (NZEO) accounted for (72.56%) of participants.
There were 19,734 respondents living in the Auckland region (31.51%), representing the largest share of participants regionally. All results from the survey were weighted by age, gender and region to be representative of the New Zealand population. The weighted population for New Zealand in the Roy Morgan Survey is 3,460,730 people, marginally higher than the 3,376,419 people aged ≥15 years according to the 2013 Census.

Of relevance to this study, survey respondents were asked “Which of the following illnesses or conditions have you had in the last twelve months?” In terms of hearing loss, the response options were “Yes” and “No”. Due to the self-reported nature of the question and the absence of follow-up questions regarding frequency and severity, a response of “yes” is represented as “any hearing loss” in the past twelve months. Table 1 shows the prevalence of hearing loss for males, females and the total population, stratified by age.

We obtained the 2014 membership numbers of audiologists and otolaryngologists in New Zealand and applied those numbers to the projected populations in 2031 and 2061 to estimate the future hearing health workforce to accommodate the projected population growth.

### Results

#### Changes in the population structure

The 2011-based 50th percentile population projections indicate that New Zealand’s total population will increase by 36% from 4,405,200 in 2011 to a projected 5,994,900 in 2061. Figure 1 demonstrates the dramatic...
changes to the country’s population structure over the next 50 years. In 2011, children aged below 15 years accounted for one fifth of the total population, while 13% of the population were aged 65 years and above. While the projected proportion of children aged below 15 years is expected to decrease slightly to 16% of the total population in 2061, Figure 1 suggests that the population aged ≥65 years nearly doubles in the next 50 years and will account for 25% of the population. The increased proportion of the elderly population also impacts on the working age population, which is projected to reduce from 66% of the population in 2011 to 58% by 2061.

Prevalence of hearing loss in New Zealand

We multiplied the age- and gender-specific estimates of any hearing loss (see Table 1) by Statistics New Zealand’s annual median population projections for 2011 to 2061 to estimate the burden of hearing loss in the next 50 years. We repeated this approach, applying the hearing estimates to the 5th and 95th percentile population projections to indicate 95% confidence intervals. Our results suggest that in 2011 there were over 330,000 people aged 14 years and above living in New Zealand with some degree of hearing impairment, increasing to 683,000 people of all ages by 2061. Figure 2 shows that the proportion of males aged ≥14 years is expected to increase from 7.11% in 2011 to 9.81% in 2061, while among females, the proportion of hearing loss will increase from 5.08% to 7.02%.

Variations in projected hearing loss by age and gender

Based on the age and gender variations in the hearing loss prevalence estimates from the Roy Morgan dataset shown in Table 1, the fact that most people with a hearing impairment will be aged above 60 years should not be surprising. However, Figures 3a and 3b highlight more clearly these variations for males and females respectively. Figure 3a shows that the prevalence of hearing loss in males aged 14 to 49 years will decrease steadily, from 1.86% in 2011 to 1.61% in 2061. Among males aged 50 to 59 years the prevalence is projected to be bimodal, peaking first at 1.55% in 2016 before reducing to 1.17% in 2034, with a subsequent peak at 1.51% in 2048, before subsiding again to 1.40% in 2061. A similar bimodal pattern is evident among the males aged 60 to 69 years, increasing from 1.74% in 2011 to 2.13% in 2026, before decreasing to 1.70% in 2043. A second wave among this age group peaks at 2.25% in 2058, falling marginally to 2.23% in 2061. The most dramatic increase is seen among males aged ≥70 years, where the prevalence of hearing loss is expected to double, from 2.04% in 2011 to 4.57% in 2061.

The age-specific trends for females are similar to those described for males, however Figure 3b shows that their hearing loss is less prevalent. For example, while
the bimodal distribution evident for males aged 50 to 59 years is apparent for females, the prevalence estimates range from 0.78% in the 2030s to 0.99% in 2018. For females aged ≥70 years, the prevalence is projected to more than double, from 1.69% in 2011 to 3.71% in 2061. Note that these distributions are a function of the underlying population structure. Therefore, the prevalence of hearing loss will generate peaks and/or troughs as the age groups in the 2011 population pyramid (Figure 1) age.

The prevalence estimates in Figure 3 appear to be particularly small, ranging between 0.78% and 4.57%. In absolute terms however, the number of individuals with hearing loss is more dramatic. Among males, the population aged 14–49 years with hearing loss will increase by 20%, from 40,201 to 48,349, while among females the same age there will be a 10% increase in the number of individuals with hearing loss between 2011 and 2061 from 32,320 to 35,684. For males aged ≥70 years the population with hearing loss will triple from 44,058 in 2011 to 137,394 in 2061. The female population aged ≥70 years will increase by 2.9 times, from 37,878 in 2011 to 111,005 in 2061.

Regional variations in projected hearing loss

We dichotomised Statistics New Zealand’s international standard urban area definition to calculate the proportion of a region’s population living in rural areas (urban area code ≥ 501). Figure 4 and Table 2 use the most recent sub-national population projections (available for 2006 to 2031) and suggest that proportionally, the older population (≥65 years) will increase more in the rural areas, such as Northland, West Coast, Tasman, than in more urban regions, such as Auckland, Wellington, Christchurch and Otago. In 2011, the population ≥65 ranged from 10.6% in the Auckland Region to 18.8% in the Marlborough Region. The projections indicate that by 2031, over 31% of the population in Marlborough Region will be aged ≥65 years. In addition, the elderly population ≥65 will comprise at least 25% of the total population in 10 of the 16 Regional Councils across New Zealand. In other words, there will be a projected 337,800 elderly people living in these regions.

Table 2 shows that the projected number of people aged ≥65 years with hearing loss in New Zealand will increase by 88.5%, from 115,248 to 217,245. The number of elderly people with hearing loss is projected to increase the most in the Auckland Region, doubling from 30,839 in 2011 to 65,348 in 2031, while the Taranaki Region is projected to have the smallest increase, from 7,067 in 2011 to 11,817 in 2061. Those 10 regions with a projected elderly population growth of more than 25% also account for nearly one third of the projected hearing loss events among those aged ≥65 years.
Table 2: The prevalence of hearing loss among the population aged ≥65 years, by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>2011</th>
<th>2021</th>
<th>2031</th>
<th>Change (%) 2011–2031</th>
<th>People living in rural areas 2013 (%)</th>
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<tbody>
<tr>
<td>NZ</td>
<td>115,248</td>
<td>161,673</td>
<td>217,245</td>
<td>88.50</td>
<td>14.03</td>
</tr>
<tr>
<td>Northland</td>
<td>5,084</td>
<td>7,185</td>
<td>9,422</td>
<td>85.33</td>
<td>50.19</td>
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<td>Auckland</td>
<td>30,839</td>
<td>45,326</td>
<td>65,348</td>
<td>111.90</td>
<td>3.98</td>
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<td>Waikato</td>
<td>11,130</td>
<td>15,527</td>
<td>20,435</td>
<td>83.60</td>
<td>22.88</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>8,794</td>
<td>12,033</td>
<td>15,841</td>
<td>80.13</td>
<td>18.33</td>
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<tr>
<td>Gisborne</td>
<td>1,158</td>
<td>1,610</td>
<td>2,140</td>
<td>84.80</td>
<td>25.19</td>
</tr>
<tr>
<td>Hawke's Bay</td>
<td>4,652</td>
<td>6,340</td>
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<td>12.69</td>
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<tr>
<td>Taranaki</td>
<td>3,455</td>
<td>4,554</td>
<td>5,732</td>
<td>65.90</td>
<td>22.98</td>
</tr>
<tr>
<td>Manawatu-Wanganui</td>
<td>7,067</td>
<td>9,364</td>
<td>11,817</td>
<td>67.21</td>
<td>19.29</td>
</tr>
<tr>
<td>Wellington</td>
<td>11,974</td>
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<td>3.84</td>
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<tr>
<td>Tasman</td>
<td>1,512</td>
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<td>3,082</td>
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<td>41.21</td>
</tr>
<tr>
<td>Nelson</td>
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<td>1,983</td>
<td>2,650</td>
<td>87.54</td>
<td>1.90</td>
</tr>
<tr>
<td>Marlborough</td>
<td>1,688</td>
<td>2,414</td>
<td>3,082</td>
<td>82.58</td>
<td>23.07</td>
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<td>West Coast</td>
<td>1,021</td>
<td>1,453</td>
<td>1,884</td>
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<td>43.42</td>
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<tr>
<td>Canterbury</td>
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<td>23,360</td>
<td>31,231</td>
<td>87.83</td>
<td>16.61</td>
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<tr>
<td>Otago</td>
<td>5,987</td>
<td>8,068</td>
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<tr>
<td>Southland</td>
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<td>3,749</td>
<td>4,711</td>
<td>66.64</td>
<td>30.57</td>
</tr>
</tbody>
</table>

Figure 4: The geographical distribution of the population aged ≥65 years
Workforce planning: meeting demands of the population with hearing loss

So far, we have outlined the projected trends in hearing loss in New Zealand between 2011 and 2061. Our final objective is to estimate the size of the hearing health workforce that will be required to serve the surge in the population with hearing loss. We obtained the 2014 membership lists of audiologists registered with the New Zealand Audiological Society (NZAS) and otolaryngologists from the New Zealand Society of Otolaryngology, Head and Neck Surgery (NZSOHNS) to calculate the distribution of population to clinicians. Of the 377 audiologists registered with the NZAS in 2014, 246 were full members, while there were 90 otolaryngologists registered with the NZSOHNS. Based on the median population estimation in 2011 of 4,405,200 there are currently 17,907 people per fully registered audiologist and 48,947 people per otolaryngologist. By 2061, the population is projected to increase to 5,994,900 and assuming that the NZAS and NZSOHNS memberships remained at the 2014 levels, we estimate that there will be 24,370 people per audiologist and 66,610 people per otolaryngologist. In order to remain at the 2011 population to clinician levels, the hearing health workforce will need a further 89 audiologists and 32 more otolaryngologists by 2061.

Discussion

To our knowledge this is the first study in New Zealand using population projections to estimate the burden of hearing loss over the next 50 years. Our findings demonstrate the dramatic increase in hearing loss among the population aged ≥60 years, compared to a relatively small and decreasing prevalence of hearing loss prevalence among adults aged 14–49 years. These patterns reflect trends in New Zealand’s rapidly changing projected population structure and assume that the current hearing loss prevalence estimates remain constant. We have shown that the projected growth of the population aged ≥65 years will be higher in the more rural regions than in the main metropolitan regions. In fact, the population aged ≥65 is likely to represent at least 25% of the population in 10 of the 16 regions across the country by 2031. These 10 regions will also be home to approximately 31% of the hearing loss burden by 2061.

Our results suggest that in 2011 there were 330,269 people living in New Zealand aged ≥14 years with hearing loss, increasing to 334,685 in 2013. This is approximately 45,000 people fewer than the 380,000 adults aged ≥15 years estimated to have hearing loss in the 2013 Disability Survey. While the 2013 Disability Survey estimated that hearing loss affected 9% of the population, with the prevalence for men (12%) higher than for women (9%), our estimates were lower at 7.50% for all persons, 8.95% for males and 6.13% for females. The differences between results in this study and the 2013 Disability Survey may result from different sampling frames, the definitions of ‘hearing loss’ and/or the denominator populations used. Nevertheless, previous New Zealand research which used 2001 Census data and reported the prevalence of hearing loss among those aged ≥15 years at 7.5% and at 22.1% for the population aged ≥65 years, is broadly similar to our estimates of 7.5% and 19.63% from the Roy Morgan data. The hearing prevalence estimates used in this study are also considerably less than those reported in a recent Australian study, which reported the population across all ages with some degree of hearing loss at 17.4% for all persons, 13.9% among females and 21% for males (Access Hearing 2005).

We have shown that proportionally, the population aged ≥65 is going to increase significantly over the next 15 years in regions that are particularly rural. Given that 10 of the 16 regions are expected to have more than 25% of their population aged ≥65 years and that these regions will account for approximately one third of the elderly population with hearing loss, there is a strong possibility that the hearing health workforce may face a situation similar to general practitioners, practice nurses and pharmacists in rural areas. A more recent report found that there were 49 vacancies for GPs in 47 rural practices and in 14 of those practices the GP is at retirement age. We estimated that there were 17,907 people per audiologist and 52,443 people per otolaryngologist in 2011 using current membership information.
These numbers were broadly consistent with those published in 2008 by Goulios and Patuzzi, who reported 22,399 people per audiologist and 59,615 people per otolaryngologist in New Zealand. This is a significant improvement in the hearing health service levels from 30 years ago. A 1984 report from the then Department of Health found there to be 34.4 full-time equivalent audiologists, giving a ratio of 92,300 people per audiologist—nearly double the suggested ratio of 50,000 people per audiologist and 2.6 times higher than the more liberal service level of 35,000 people per audiologist. Unofficial data estimated there to be 41 otolaryngologists in 1984, representing a ratio of 77,000 people per specialist. Our current estimate of 52,443 people per otolaryngologist is remarkably close to that conservative target of 50,000 people per otolaryngologist reported in 1984. A total of 126 otolaryngologists would currently be needed to meet the more liberal service provision of 1:35,000 people. Assuming that the existing population per clinician ratios are adequate, we estimated that a further 89 audiologists and 30 otolaryngologists will be required in 2061.

In 2008, New Zealand’s population per clinician ratios were about 48% higher than in Australia for audiologists and 2.21 times greater than those reported for otolaryngological services in the UK. Therefore, the extent to which the current hearing health service provision according to patients per clinician measures is appropriate is also cause for debate. Since 2008, the number of audiologists has increased by 73 from 173 to 246. During this time the number of audiology graduates in New Zealand has increased from 20 per annum to approximately 30. The projected growth in the population with hearing loss will place an increased burden and cost on society especially in terms of funding for hearing aid subsidies, however the recent increases in numbers of audiologists graduating from New Zealand universities would appear to meet this predicted demand for future hearing health services.

This research is not without its limitations. First, we have not explored variations in the burden of hearing loss by ethnicity or by deprivation. Ethnic-specific population projections based on the 2013 Census and extending to 2038 were released in May 2015, but we have not yet estimated the burden of hearing loss among these ethnic groups. Similarly, the use of deprivation indices for large geographical areas such as the regions used in this study is not recommended as pockets of deprivation are masked. Updated population projections for Census Area Units were released recently, allowing us to investigate variations in the prevalence of hearing loss through to 2043 by deprivation in the future. In addition, while there is evidence that hearing health among Māori and Pacific patients is substantially worse than for other ethnic groups, particularly among younger populations, no ethnic-specific estimates of hearing loss are currently available.

Second, the population projections used in this analysis predict future trends based on historical patterns of fertility, mortality and migration and therefore may not represent the true demographic structure of the population in 50 years. We have attempted to overcome this by using the 5th and 95th percentile population projections. We used three different projections to provide confidence limits, but acknowledge that current demographic patterns are subject to change.

Third, while the estimates of hearing loss obtained from the Roy Morgan Surveys are comparable to previous estimates in New Zealand (Greville 2005), we acknowledge the bias inherent in telephone surveys. Socio-economic status, including employment status and economic activity, may influence the respondent’s perception of health, leading to a result that reflects the surveyed population’s perception of poor health, rather than the actual morbidity experienced by that population. In addition, there is a long latency period (10-years) between the first signs of hearing loss, to the time of audiometric or clinical intervention. As a result, there is a degree of likelihood that mild cases of hearing loss are under-reported in the Roy Morgan Surveys.

This paper provides a first glance at the projected burden of hearing health in the next 50 years. Further work is required...
to estimate the likely patterns of hearing loss by level of severity, and a subsequent study will investigate the ethnic variations in hearing loss following the release of new ethnic population projections in early 2015.

**Competing interests:** Nil

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