Hearing impaired and

deaf people in New Zealand;

population numbers

and characteristics

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Summary

Information concerning the population of hearing impaired and deaf people in New Zealand has not been widely available in the past, with the first population survey of any size being carried out in 1991. The current report updates the population estimates and includes extra information available from projects associated with the 1996 and 2001 censuses, the latter to a limited extent, as well as data available from databases kept by the National Audiology Centre.

Results show that the prevalence of hearing loss varies from 10.3%, or just under 400,000 people (for people reporting hearing loss) to 0.24%, or 2,800 children with permanent hearing loss accessing funding for hearing aids.

Men are much more likely to suffer from hearing loss than are women. This difference is similar to that found in other developed countries and appears to be attributable to occupational noise-induced hearing loss. Age has a major effect on hearing loss, and there is a clear interaction between gender and age.

These estimates are of a similar order of magnitude with those available from the USA, the United Kingdom, and parts of Europe. In New Zealand, however, there seems to be a somewhat higher prevalence of hearing loss, particularly among children, and the ethnic effect – with higher prevalence of hearing loss among Maori and Pacific Island children, in particular – is quite different from other countries.

The census study of 1991/92 has proved the most useful, and limitations have been identified with the identification of hearing loss *following* a response to a disability question in the 1996 census. It is recommended that future census studies ask about hearing loss directly, in line with the approach taken by the US National Center for Health Statistics.

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Introduction

There have been various attempts in the past to calculate the numbers of people suffering from hearing loss or deafness in New Zealand. Review reports (Deafness, the invisible handicap, 1979; the Hearing Report, 1984; Thorne, 1993) have been published with estimates based on overseas models.

In an early report from the National Health Survey held in 1960-62 in the USA, 4.2% of people 18-79 years of age were found to have hearing loss exceeding 25 dB HL averaged over three frequencies from 500-2000 Hz (Roberts and Cohrssen, 1968).

Schein & Delk (1974) described the results of a 1971 survey in the USA. 6.6% were found to suffer from hearing impairment, 3.2% from significant bilateral hearing loss, and 0.87% from deafness. 28.6% of 25-74 year-olds could not understand recorded speech in sentences at normal levels of 30 dB HL.

Jauhianien (1968) in Finland developed a model to predict prevalence and severity of hearing loss. This model was used to predict numbers suffering from hearing loss in New Zealand for the Hearing Report (1984).

Davis (1995) described the results of several related studies making up the British National Study on Hearing, in which hearing was either measured audiometrically, or inferred using self-report questionnaires. In the questionnaire part of the study (n=35,330), 8.8% reported some degree of difficulty hearing in quiet in the better ear, increasing to 18% for the worse ear. 0.3% said they could not hear at all in the better ear, with 1.2% reporting this for the worse ear.

When pure tone audiometry is used, the difficulty is in knowing what the failure criterion should be. Sixteen percent of respondents, adults 18-80 years old (n=2,679), in the British study were found to have bilateral hearing loss where the better ear 4-frequency average

exceeded 25 dB HL. If the criterion was lifted to 30 dB, the prevalence was 11.2%. If a three frequency average was used (i.e. without taking hearing at 4 kHz into account) the prevalence rates were 11.3% for a 25 dB cut-off and 7.9% for a 30 dB cut-off.

In Canada it has been estimated that between 3 and 4% of the population have difficulty hearing conversations (Canada Health Survey, 1991), and in Australia, 4% was found to be affected by complete or partial deafness (Castles, 1991).

More recently, census sampling information from the US has become available (Adams et al, 1999). This involved repeated questioning of people residing in 24,371 households during 1996 – representing a total of 63,402 people. A range of health and disability information was collected, including for hearing impairment. The overall prevalence of self-reported hearing impairment was found to be 8.34%.

While there has thus far been no one project aimed solely at defining the hearing impaired and deaf populations of New Zealand, three censuses (1991, 1996, 2001) have included spin-off projects carried out by Statistics New Zealand to define numbers suffering from disability and/or health problems. Hearing loss, in the 1991/92 study, or disability attributed to hearing communication difficulty (1996; 2001) has been one of many disability and/or health issues addressed.

Details from the 1991/92 survey were collated earlier and summarized by the present author as a National Audiology Centre report (The deaf and hearing impaired population of New Zealand, 1997).

The aim of this project is to extract information from various sources, including data collected by Statistics NZ and analysed by or for the Ministry of Health, concerning the:

- numbers of hearing impaired and deaf people in New Zealand
- incidence of hearing loss as a factor of age, gender, and where possible, race
- relationships between hearing loss and social factors (eg income, employment)
- relationships between hearing loss and other disabilities
- distribution of hearing impaired and deaf people in the various regions of the country

Methods

The different population projects have used different sample sizes, and have asked respondents different questions.

Table I: Survey sample sizes and descriptions

Survey	Numbers questioned	Sample description
1991/92	7, 065	People in households
1996/97	20,848 (4,100 with some disability; 16,750 without any disability)	a) Sample of non-institutionalised population
	1,016 people from 130 facilities	b) people 15+ years of age living in health-related long-stay residential facilities

Details of the 2001/2 census study were not available at the time of writing.

The 1991/92 survey was limited to just over 7,000 households, selected on a nationally statistically representative random basis. This means that estimates are subject to fairly large sampling errors, with all estimates below 45,000 being subject to sampling errors of 30% or more. Reliable estimates are not available for small geographical areas nor for small population groups. In addition, there is an under-estimation of numbers with hearing loss because only non-institutionalised people were included. Fuller descriptions of the methodology are given in A Picture of Health (1993) and Triggs et al (1994).

The 1991/2 study asked respondents directly:

- Do you (or does *Johnny*) have any of the following:
  a) Hearing loss?
  b) Sight loss?
  c) …..

The 1996/7 study was less direct, asking adult respondents firstly whether they considered themselves to be disabled:

- Do you have any condition or health problem that makes it impossible (or difficult) for you to do everyday things that people of your age can usually do?

This question is fairly loaded as far as hearing impairment is concerned, particularly since hearing loss is popularly associated with advancing age. The design of this question ensures conservative estimates of prevalence for hearing loss.

In the follow-up study, more specific questions followed:

- Can you hear what is said in a conversation with one other person?
- Can you hear what is said in a group conversation with three other people?
- Use of special equipment for deaf/hard of hearing

People who answered No to the first sub-question (ie they could not hear what was said in a conversation with one person) were considered to be deaf. Those who answered Yes to the first sub-question, but No to the second were considered to be hearing impaired.

Children's guardians were asked more directly:

- Is the child deaf or having trouble hearing which is not currently corrected?

The reference to correction here is inappropriate for hearing loss, since a hearing aid cannot correct hearing loss in an analogous way to lenses and sight, and may have introduced its own bias. In any event, it would be more useful to be counting the children who use hearing aids, rather than excluding them. With this question, some will be excluded and others included depending on how respondents interpret the question.

Full details of the methodology are available from the Statistics NZ report, Disability in New Zealand (1998).

Data were also obtained from the National Audiology Centre, who collect and analyse information on children's hearing screening, identification of hearing-impaired and deaf children, and the children's hearing aid fund.

Results & Discussion

Overall prevalence

The different studies have asked different questions, and not surprisingly, have come up with different estimates of prevalence (see Table II).

The overall prevalence rate of 9.8% for the non-institutionalised population is slightly higher than the 8.3% found in a study with similar methodology in the US (Adams et al, 1999), and the 8.8% reported by the questionnaire section of the British National Study on Hearing. The latter study was, however, restricted to people between 18-80 years of age.

The census data do not in general provide information regarding degree of hearing loss, apart from the 1996/97 survey which asked two questions in an attempt to differentiate those with severe losses from the total hearing impaired population.

Data from the National Audiology Centre's databases have been used to provide complementary information to estimate population size of the deaf community.

The prevalence data presented indicate that people with acquired hearing losses form the bulk of the hearing-impaired/deaf population by a factor exceeding 100 (>10% for acquired hearing loss c.f. <0.1% for congenital/prelingual losses).

From the National Audiology Centre's data on children wearing hearing aids, an estimate of 6,400 prelingually hearing-impaired or deaf adults can be calculated. About 1/3 of these would be expected to have severe or profound hearing loss, which produces an estimate of about 2,100. This figure fits well with the 2,600 estimated from the 1996/97 census survey, which would be expected to also include people with acquired severe or profound hearing loss.

Of the 2,800 children wearing hearing aids, about 1/6, or under 500, would be expected to have severe or profound hearing loss (from the hearing severity data available in the National Audiology Centre's deafness identification database).

Table II: Overall prevalence estimates for various definitions of hearing loss among New Zealand population

Definition	Prevalence (%)	Numbers (2001 population)	Source of data
Hearing loss (including estimate of institutionalised)	10.3	390,600	1991/92 census
Hearing loss (non-institutionalised)	9.8	368,600	1991/92 census
Hearing loss causing disability	6.6	250,300	1996/97 census
Hearing loss causing disability (non-institutionalised)	5.7	214,400	1996/97 census
Hearing loss causing disability requiring assistance	4.17	156,900	1996/97 census
Deafness† causing disability (15 years+ only)*	0.07	2,600	1996/97 census
Deafness † causing disability requiring assistance (15 years+ only)*	0.07	2,400	1996/97 census
5 year old children with chronic hearing loss	7.7	4,500	National Audiology Centre hearing screening data
Permanently hearing impaired & deaf children (up to school leaving age)	0.24	2,800	National Audiology Centre children's hearing aid fund

† Inability to hear one other person talking *1996 population numbers

Age

It is well known that hearing loss is associated with increasing age. The population studies (see Table III) indicate that prevalence of hearing loss (regardless of definition) amongst people over 65 years of age is about 3.5 times of those of younger adults (15-64 years). More detailed analysis shows ever-increasing rates of hearing loss starting from age range 25-44 years.

Table III: Prevalence estimates for age groups and various definitions of hearing loss among New Zealand population

Age group	Hearing loss (non-institutionalised) 1991/92	Hearing loss causing disability 1996/97	Hearing loss causing disability (non-institutionalised) 1996/97	Hearing loss causing disability requiring assistance 1996/97
0-14	48,800 5.6	23,100 2.7	20,800 2.6	12,000 1.4
15-24	18,400 3.3	9,200 1.8		
25-44	87,800 7.8	35,200 3.4		
45-64	101,900 13.7	71,100 10.4		
15-64	208,100 8.4	128,900 5.3	115,500 5.2	63,000 2.6
65-74	53,800 22.7	35,600 15.3		
75+	57,500 34.0	42,400 25.5		
65+	111,300 27.0	98,100 22.4	78,000 19.5	82,000 18.8

The prevalence of hearing loss in children 0-14 years of 5.6% compares with the point prevalence of 7.7% for new school entrants (i.e. 5 years of age) over the last 3 years for which data are available, found by the NZ hearing screening programme. Studies of childhood hearing loss, the vast bulk of which is due to otitis media, have reported a peak in the age group 2-7 years, with decreasing prevalence among children 8 years and over. For example, in the Dunedin study, Chalmers et al (1989) found that 8.8% of 5-year-olds had evidence of otitis media, but that the level decreased with age: 6.1% of 7-year-olds, 1.8% of 9-year-olds and 1.3% of 11-year-olds were found to have otitis media. In addition to the large numbers with conductive hearing loss associated with otitis media, there is a small core group with permanent hearing loss – the average prevalence over childhood is 0.24% (see Tables II and XXI), but there will be a slight increase in prevalence with increasing age, as acquired hearing losses from diseases such as meningitis and events such as head trauma add to the base of those with congenital hearing loss.

The recent US study (Adams et al, 1999) found a much lower overall prevalence of 1.3% for children up to 18 years. The prevalence for adults 18-64 years was similar to the New Zealand data (7.2%), and that for older people was higher (30.3% for those 65 and over).

The overall results of the British study are given in Table IV. Prevalence of measured hearing loss is slightly lower than the New Zealand data, with the exception of the oldest age group, where it is considerably higher. This probably reflects the frequently commented-on phenomenon that older people seem to have a different audiometric criterion for describing themselves as having a hearing loss. The much lower prevalence of reported difficulty hearing in quiet also presented in Table IV for people 61-80 years supports this interpretation. It is more difficult to interpret the reported difficulty hearing in noise data. The study's authors suggest that the 14% of 18-30 year-olds who have difficulty in noise should be treated as a baseline, and an argument could be made for deducting 14% from those reporting difficulties in noise from other age groups.

The age effect on self-reported and measured hearing loss is probably due to a general expectation and acceptance of hearing loss with advancing age, the very difficulty introduced

into the New Zealand studies in 1996/97 and 2000/01 by limiting those included in the disability study to those reporting" a condition … that makes it impossible (or difficult) for you to do everyday things that people of your age can usually do".

Table IV: Prevalence of a) measured hearing loss with age in all 3 sectors of the British National Study on Hearing and b) difficulty hearing in quiet in better ear (Davis, 1995)

Age group	Hearing loss (4-frequency average >30 dB HL)	Reported hearing difficulty in quiet	Reported hearing difficulty in noise
18-30	0.6	2.7	14.1
31-40	2.3	3.6	20.0
41-50	6.4	8.2	26.5
51-60	11.1	11.0	31.2
61-70	24.3	14.6	35.2
71-80	46.1	25.0	43.9

Gender

Both the studies completed thus far show a significantly greater number of males than females with hearing loss (see Table V).

The 1991/92 study showed percentage differences which overall show that over 90,000 more males than females suffer from hearing loss. This finding is all the more dramatic because of the lower life expectancy for males, and the strong association of hearing loss with age.

Table V: Prevalence estimates for each gender and various definitions of hearing loss among New Zealand population

	Hearing loss (non-institutionalised) 1991/92 study	Hearing loss (non-institutionalised) causing disability - 1996/97 study
Male	229,500 12.3	127,900 6.8
Female	139,100 7.3	86,400 4.5
Male-female difference	90,400 5.0	31,500 2.3

These results are not dissimilar to the 1996 US data which show a gender gap of 3.3%, equivalent to 3.8 million people (male: 10.0%, female: 6.7%).

The gender gap in the audiometric part of the British National Study on Hearing varied within study sectors from 0.3% (in the household study) to 3.1% (in the domiciliary study of people who did not attend clinic appointments). Of those who did attend clinic appointments, there was a gender gap of 1.9%. Division of respondents into those employed in non-manual or manual occupations revealed that there was a gender difference of 2.7% among the manual group, compared with none in the non-manual group.

Gender & age

There are unequivocal interactions between gender and age with both definitions of hearing loss (see Figures 1-4 and Tables V-VI).

The slight difference between males and females in the 0-14 and 15-24 year age groups (see Tables VI and VII) can be attributed to the higher vulnerability of male children to hearing loss and deafness, along with all other disabilities.

Table VI: Prevalence estimates for various age groups and gender for non-institutionalised people with hearing loss (1991/92 study).

Age group	Male	Female	Male-female difference
0-14	28,300 6.3	20,400 4.8	7,900 1.5
15-24	11,000 3.7	7,400 3.0	3,600 0.7
25-44	66,000 12.0	21,800 3.8	44,200 8.2
45-64	64,400 16.6	37,500 10.7	26, 900 5.9
65-74	34,300 31.6	19,500 15.1	14,800 16.5
75+	25,000 40.2	32,500 30.0	-7,500 10.2

Figure 1. Prevalence of hearing loss (non-institutionalised) with age & gender
1991/92 study

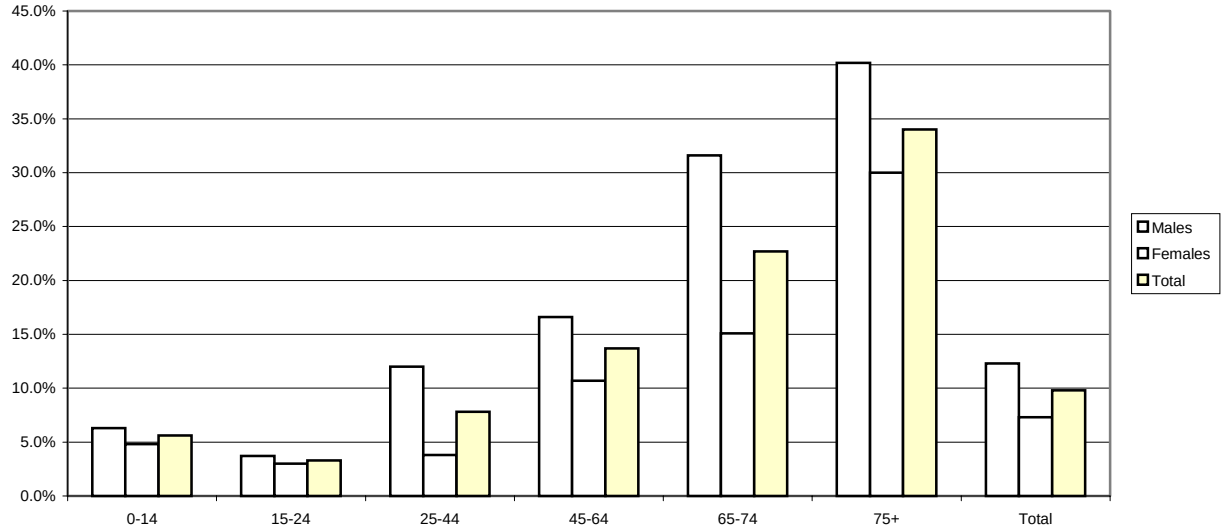


Figure 2. Numbers of people with hearing loss
1991/92 study

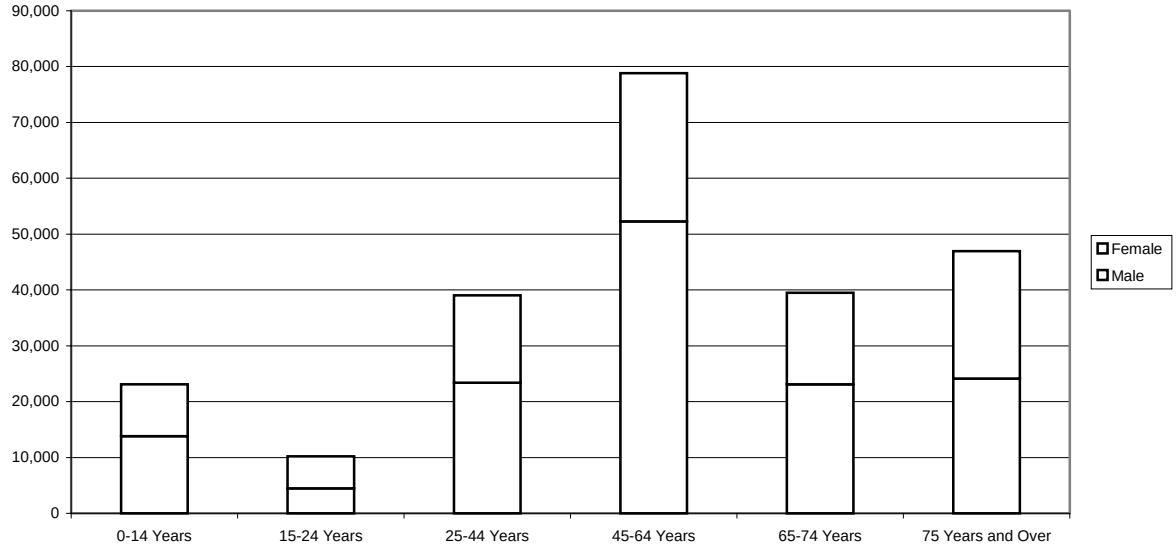


Table VII: Prevalence estimates for various age groups and gender for people with disability caused by hearing loss (non-institutionalised) (1996/97 study, adjusted for 2001 population).

Age group	Male	Female	Male-female difference
0-14	12,500 3.1	8,30 2.2	4,20 0.9
15-24	4,00 1.6	5,20 2.1	-1,200 -0.5
25-44	21,000 4.1	14,200 2.6	6,800 1.5
45-64	47,200 13.9	23,900 7.0	23,300 6.9
65-74	20,800 18.8	14,800 12.1	6,000 6.7
75+	21,800 35.4	20,600 19.6	1,200 15.8

Figure 3. Prevalence of hearing loss causing disability (non-institutionalised) with age & gender 1996/97 study

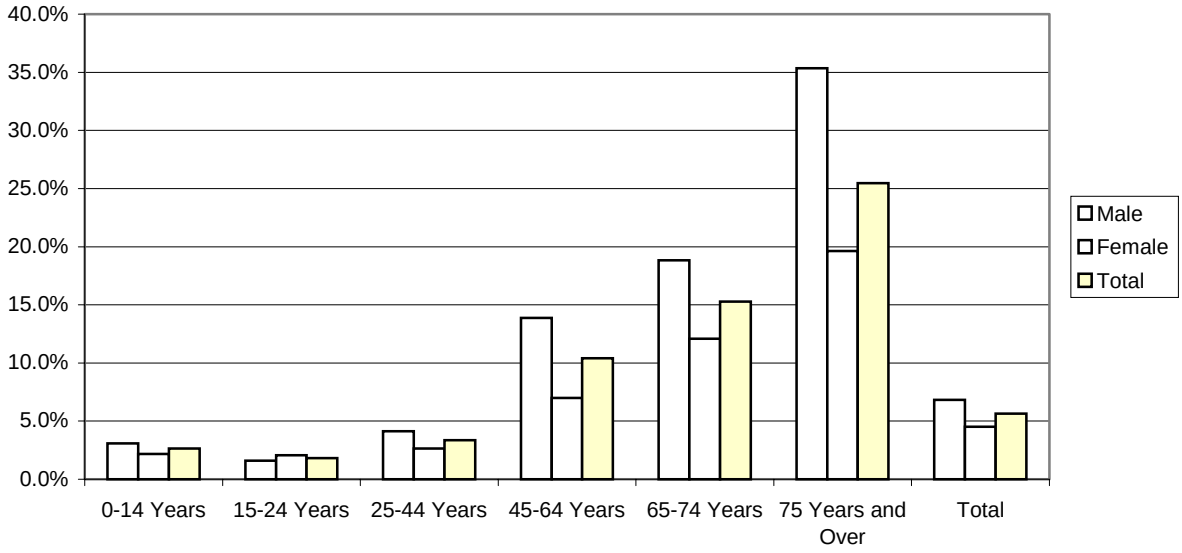
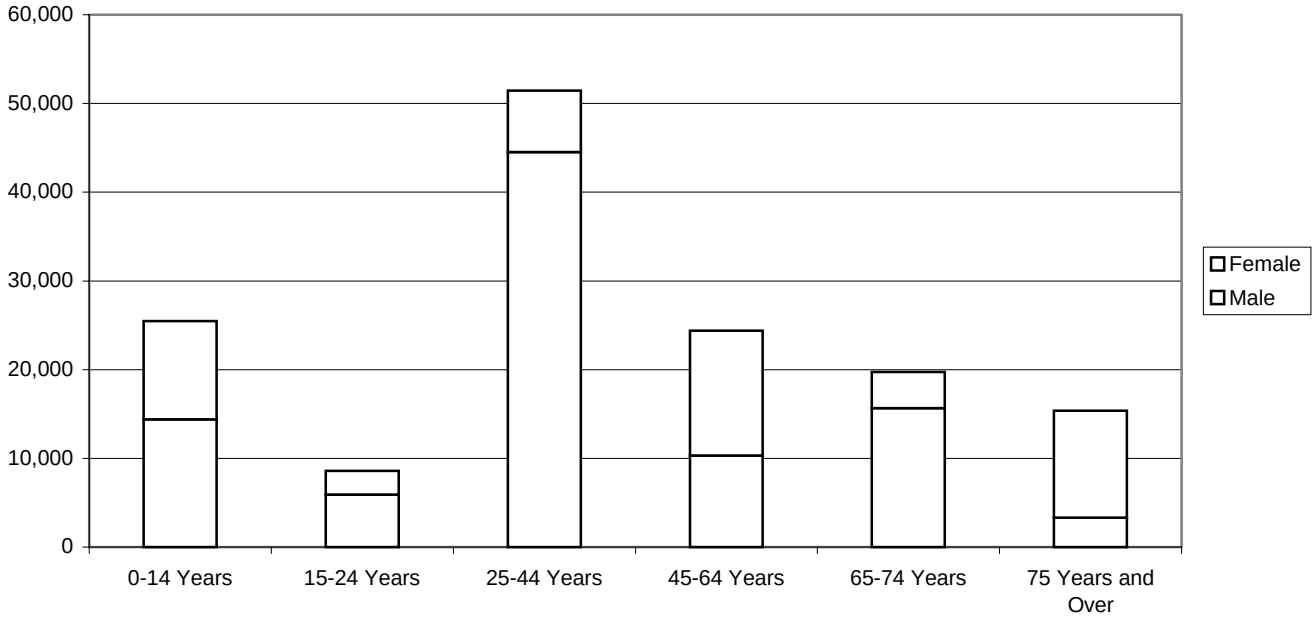


Figure 4. Numbers of people with hearing loss causing disability 1996/97 study



A considerable difference in prevalence between males and females emerges in the 25-44 year age group. This is the period when men (predominantly) working in noisy industries begin to show the effects of industrial hearing loss. Support for this explanation of the difference comes from the British National Study on Hearing (Davis, 1995) – see Table VII. A considerable male-female difference is evident in this population as well, and the difference appears restricted to people with manual occupations. Both the gender difference and the difference in prevalence between manual and non-manual workers emerge first in the 51-60 year age group. Another analysis looking at audiometric thresholds for the high frequencies, which would be more sensitive to noise-induced hearing loss, showed the difference emerging from the youngest age group.

It is of interest that both male and female manual workers showed higher prevalence of hearing loss when compared with those in non-manual occupations, but that the difference was more pronounced for males, who tend to work more often in noisier conditions.

Table VIII: Prevalence rate of hearing loss (4-frequency average >30 dB HL) in UK people (from Davis, 1995)

Age group	Non-manual		Manual	
	Male	Female	Male	Female
18-30	0.1	0.8	0.1	1.1
31-40	1.3	1.3	3.6	3.3
41-50	6.5	3.3	6.8	7.2
51-60	6.5	6.9	17.9	12.5
61-70	27.1	24.1	37.0	18.1
71-80	45.0	61.6	48.4	49.3
Overall	9.8	9.9	13.5	10.8

An American report from the National Institute for Occupational Safety and Health found a direct correlation between prevalence of self-reported bilateral hearing loss and noise levels measured in worksites where people were employed.

In the New Zealand data, above 44 years of age, the male-female difference decreases somewhat – probably due to the onset of otosclerosis, which tends to affect more women than men, and first appears during the middle years. The combined effect of noise induced hearing loss and presbycusis is evident in the high prevalence of hearing loss among men in the 65-74 year age group. It is interesting that there is a 15% increase in prevalence among women 75 years of age and over, compared with the 65-74 year group, while men show only a 10% increase. This difference may be explained by a lower life expectancy of men from the lower socio-economic groups, who tend to be those employed in noisy occupations.

In the 1996 US data, male-female differences in prevalence increase from 0.8% for those under 45 years of age, to 10% in the 45-64 year group, and again to 14.4% for those over 65 years.

It should be noted that amongst the New Zealand population 75 years and older, although the prevalence rate of hearing loss for men is almost double that for women, the absolute numbers are not much higher, because of lower life expectancy for men.

Amongst this population therefore, are a considerable number of people relatively unprovided for in terms of state-provided hearing aid funding. The most generous schemes for funding of hearing aids are targeted to people with noise induced hearing loss (either via the ACC or War Pensions schemes), and there is extremely limited financial assistance for the 35-52,000 (depending on the definition used) elderly women with hearing loss, whose only source of financial assistance for purchasing hearing aids is the hearing aid subsidy which has remained static at $89.10 since 1988, despite huge increases in the cost of hearing aids. Moreover, in the confusion created by repeated waves of health reforms, the hearing aid subsidy is not available in all parts of the country. New Zealand's policies regarding public funding for hearing aids are in stark contrast with those of Australia, where complete funding of hearing aids for elderly people was extended downward in age eligibility from 65 to 60 years in the early 1990s.

Ethnicity

The 1991/92 study found that in the total non-institutionalised population, Maori had a lower prevalence rate of hearing loss (7.9%) than non-Maori (10.0%). This finding was somewhat surprising, given that many studies of specific populations have found a much higher incidence of hearing loss among Maori compared with non-Maori. The difference is explicable by the dramatically reduced life expectancies of Maori. When adjustments were made for this, the prevalence rate for Maori was found to be 12.1% compared with 9.6% for non-Maori.

Ethnic data from the 1996/97 survey are shown in Table IX.

Table IX: Prevalence estimates for age bands and racial grouping for hearing loss causing disability among New Zealand population (1996/97 study).

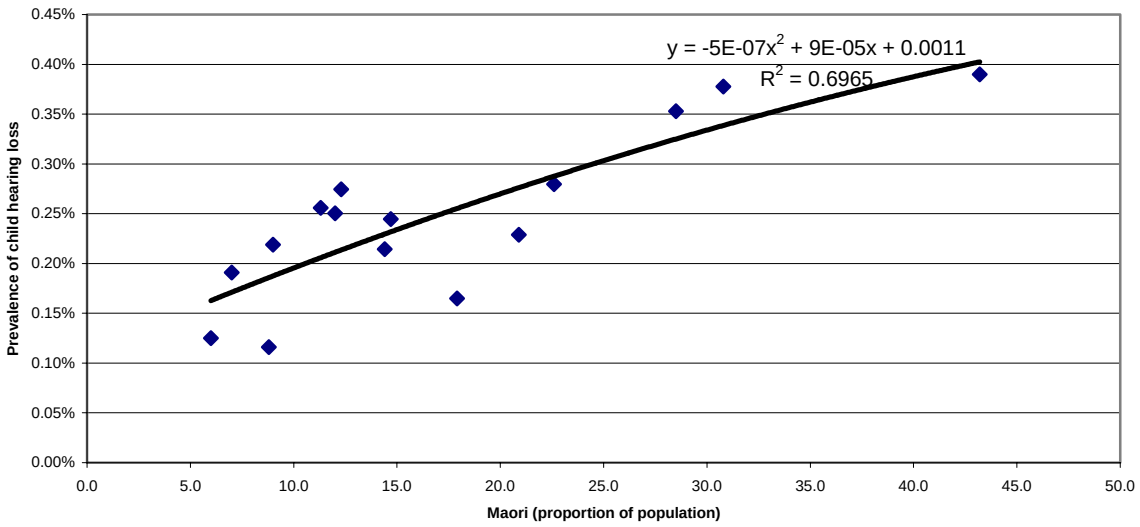
	NZ Maori	Pacific Island	Other
0-14 years	9,000 4.6	1,500 2.6	10,300 1.9
15-64 years	15,000 5.0	4,000 3.9	96,500 5.5
65 + years	2,200 14.3	150 2.6	75,650 20.7
Total	26,200 3.4	5,650 2.5	182,450 6.5

In an audiometric study of prisoners in Auckland, Bowers (1976) found that 27% of Maori compared with 7% of Europeans had a hearing disability rated at least 5% on the Australian National Acoustic Laboratories scale.

Among children prelingually deaf or permanently hearing impaired, Maori are known to be over-represented. An analysis of the National Audiology Centre's database of such children

showed that 31.7% (605 of 1904 where race was indicated) were of Maori descent compared with 24.5% of the total child population (1996 census). Analysis of the attributed cause of deafness showed a higher rate of association with a family history of deafness (26.4% of Maori children, compared with 17.7% of other ethnic groups), suggesting a genetic explanation for ethnic differences. There is also a fairly strong direct correlation between the proportion of Maori in the general population and the prevalence rate of child hearing aid users (see Table XXII and Figure 5).

Figure 5. Maori population & hearing loss prevalence for each region of New Zealand



Insufficient numbers of Pacific Islanders were included in the 1991/92 survey to establish a valid prevalence rate. The patchy nature of settlement of Pacific Islanders (with high concentrations in Auckland and parts of Wellington, and very low concentrations elsewhere), make this population difficult to assess on a national scale.

Data emerge on hearing loss among Pacific Island peoples in the 1996/97 survey (see Table IX). This shows a low prevalence of hearing loss causing disability across the age groups (2.6-3.9%). These data are inconsistent with data available elsewhere relating to measurable hearing loss in Pacific Island people.

For example, the National Audiology Centre collates the results of hearing screening tests on all new school entrants (i.e. 5 year old children) in New Zealand annually. Over the last two years where data are available (July 1998 – June 2000) the highest failure rates were for Pacific Island children -15.2% - compared with 13.8% for Maori and 5.2% for all other children.

Among children with permanent hearing loss, Pacific Island children were over-represented (9.7% compared with 7.6% of the total child population) on a similar scale to Maori children.

The inconsistency between the National Audiology Centre data and the self-report census data suggests that either Pacific Island people are unaware of hearing loss as an issue or find the preliminary question in the 1996/97 study concerning disability even more confusing than do people from other ethnic groups.

It is likely that were a less culturally biased census study carried out that the prevalence rate for Pacific Island people would mimic that of Maori, since the populations are very similar in many respects, including reduced life expectancies.

The pattern of results emerging above is quite different from that found in the 1996 US study, and probably accounts for the overall higher prevalence of hearing loss found in New Zealand. The only ethnic comparison available from the US data is for white-black groups. There is a much *lower* prevalence of hearing loss among the American black population (3.9%) compared with the white population (9.2%). For all age groups, blacks have half or less the prevalence of hearing loss compared with whites. Examination of the fine detail of the American data suggests that not only are American blacks less likely than whites to suffer from childhood problems such as otitis media, they also appear to be less vulnerable to adult hearing problems such as noise-induced hearing loss. In New Zealand, by contrast, Maori and Pacific Island children appear more vulnerable than the rest of the population to both otitis media and its effects and to permanent hearing loss. Data concerning ethnic differences among adults are not yet adequate to comment on vulnerability regarding noise-induced hearing loss.

Socio-economic factors

The 1991/92 study identified various social and financial correlates of hearing loss. Those that reached statistical significance are detailed in Tables X and XI. The first table gives unadjusted rates, and in the second, rates are adjusted for differences in age composition of populations. When adjustments are made for the age skewing of populations, fewer differences remain significant.

Table X: Statistically significant relationships between social measures and hearing loss, compared with population reporting no hearing loss, unadjusted (1991/92 study).

		People with no hearing loss	People with hearing loss
Health funding	Community Services Card	31.2	40.1
	High User's Card	3.2	9.2
Income	Family income <$20,000	17.7	23.2
	Family income >$30,000	38.8	28.9
	Combined income >$40,000	27.7	18.9
Income support	Age-related benefit	12.9	36.8
	Non-age-related benefit	27.4	21.3
Family	Live alone	7.1	13.5
	Live as a couple with no dependent children	22.0	36.8
	Live as a couple with dependent children	56.8	39.0
Employment status	Not in labour force	35.0	49.0
	Employed	58.5	45.1

A similar relationship between income and hearing loss is evident as is found in the US data (see Figure 6), where hearing loss prevalence is greater in low-income families in all age groups, and lower for high-income families.

Figure 6. US Family income & hearing impairment

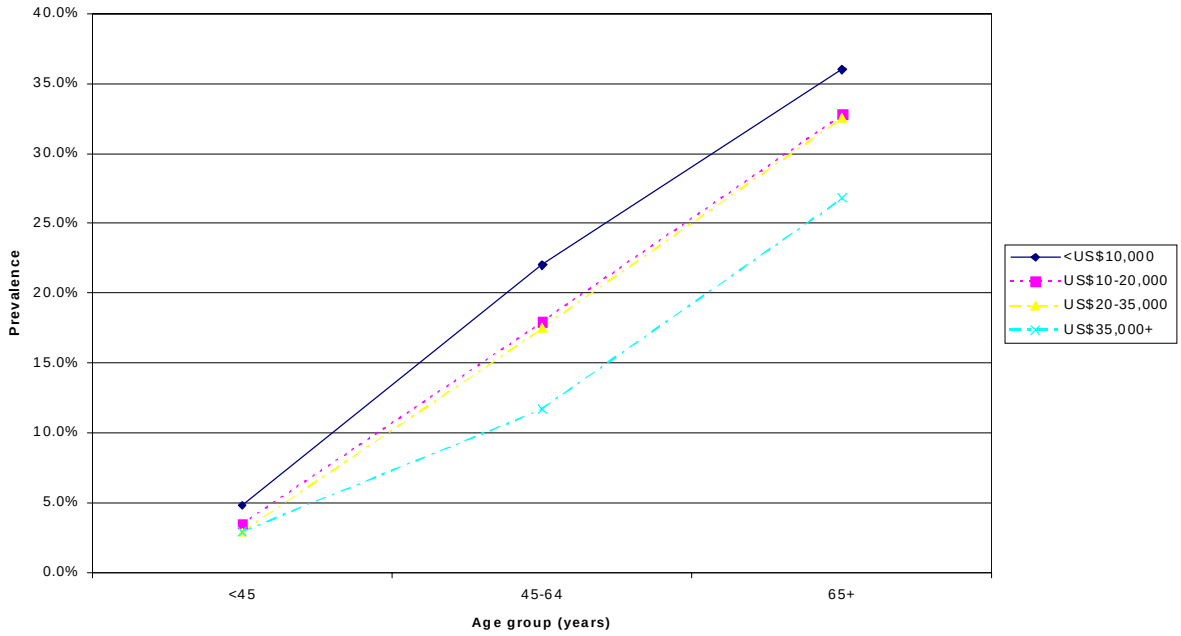


Table XI: Statistically significant relationships between social measures and hearing loss, compared with population reporting no hearing loss, adjusted for age differences between populations (1991/92 study).

		People with no hearing loss	People with hearing loss
Health funding	Community Services Card	31.2	41.8
	High User's Card	3.3	9.3
Income	Combined income <$15,000	20.5	26.5
	Combined income >$40,000	27.3	20.5

Less analysis relating to social and economic correlates has been carried out with the 1996/97 data. Results available are given in Table XII.

Table XII: Percentages related to socio-economic measures, age group and hearing loss, compared with population reporting no hearing loss (1996/97 study).

		Age group	People with no hearing loss	People with hearing loss
Income	Personal income <$20,000	15-64 years	53.7	55.9
		65 years+	85.2	87.0
	Personal income >$20,000	15-64 years	46.3	44.1
		65 years+	14.8	13.0
Employment	Employed	15-64 years	67.4	61.4
	Unemployed & seeking work	15-64 years	5.7	3.9
	Not in labour force	15-64 years	23.7	34.7

From the same dataset, 17.9% of people with hearing loss reported receiving a disability benefit – the lowest of all disability groups. However, 43% of "deaf" people (i.e. those who reported being unable to hear one other person talking) received a benefit. This is higher than all other groups apart from those with intellectual disability. Results for all disability groups are shown in Table XIII.

Table XIII: Disability type by disability benefit received for adults (1996/97 study)

Disability	Total numbers	Percent receiving benefit
Hearing Impaired	202,700	17.9
Deaf†	1,900	43.0
Hearing impaired & deaf†	*204,700*	*18.1*
Intellectual disability	18,500	53.2
Learning disability	50,700	41.2
Blind	4,400	36.5
Psychiatric/psychological disability	77,600	35.6
Remembering disability	81,600	34.2
Speaking disability	41,200	28.4
Partially sighted	66,200	26.4
Other disability type	100,400	24.7
Agility disability	280,100	24.4
Mobility disability	328,600	23.7

† Inability to hear one other person talking

The "deaf" group identified in the 1996/97 study is a difficult one to analyse because of the extremely small numbers involved. 75% of the sample were 55 years of age or more. 83% reported having hearing loss for more than 20 years, compared with 34% of the hearing impaired group. The definition as deaf relied solely on inability to hear a speaker, and not on time of onset of hearing loss, which is more usually the case, so some caution should be used in interpreting these data.

Institutionalisation

The relative prevalence of hearing loss for institutionalised compared with non-institutionalised people is available only from the 1996/97 survey (see Table XIV) and presumably in future from the 2001/2 survey. It should be noted that institutionalised in this context refers to people residing in rest homes and similar institutions – it does not include for example jail populations.

Table XIV: Numbers and percentages of those with different degrees of hearing loss from within households, and institutionalised (1996/97 study)

	Hearing loss causing disability	Hearing loss causing disability requiring assistance
Adults (15+) with hearing impairment – household survey	212,400 93.6	143,100 90.4
Adults (15+) deaf† – household survey	2,000 0.9	1,900 1.2
Total – household survey	214,400 94.5	145,000 91.6
Adults (15+) – with hearing impairment institutionalised	11,800 5.2	12,500 7.9
Adults (15+) deaf† – institutionalised	700 0.3	700 0.5
Total – institutionalised	12,500 5.5	13,200 8.4
Overall total	227,000	158,300

† Inability to hear one other person talking

For comments re deaf sample, see previous page.

Multiple handicaps

In the 1991/92 study data are available about the numbers of people with hearing loss also having other disabilities. Results are presented in Table XV. All differences were found to be significant. A considerable amount of the male-female differences shown in this table are related to the younger overall composition of the male hearing impaired population compared with women. When age adjustments are carried out, a somewhat different picture emerges (see Table XVI). Again, all differences were found to be significantly different from the population not reporting hearing loss.

Table XV: Percentages of people with and without hearing loss with other disabilities – unadjusted (1991/92 study).

Disability	People with no hearing loss	People with hearing loss	Men with hearing loss	Women with hearing loss
Sight loss	4.5	24.2	24.0	24.6
No mobility limitation	87.1	66.3	73.9	53.5
Limited mobility limitation	8.9	22.4	17.8	29.9
Serious mobility limitation	3.1	10.7	7.4	16.2
Other physical disability	5.1	17.9	17.6	18.3
Excellent health	53.5	25.9	31.3	17.1
Good health	39.4	48.7	46.2	52.9
Poor health	7.1	25.4	22.5	30.0

Table XVI: Percentages of people with and without hearing loss with other disabilities, adjusted for varying age distributions (1991/92 study).

Disability	People with no hearing loss	People with hearing loss	Men with hearing loss	Women with hearing loss
Sight loss	4.7	16.2	17.6	14.8
No mobility limitation	85.8	75.7	83.1	68.7
Limited mobility limitation	9.7	16.5	11.2	21.6
Serious mobility limitation	3.6	7.1	9.6	16.2
Other physical disability	5.4	15.2	13.9	16.5
Excellent health	52.6	25.5	33.7	17.5
Good health	39.9	52.6	46.7	58.4
Poor health	7.5	21.9	19.6	24.2

The 1996 census data showed a very high percentage of people with hearing loss also having other disabilities (see Table XVII). The high rate of multiple disabilities among the children with disability caused by hearing loss in the 1996/97 survey (54%) is considerably higher than the 3% found in the National Audiology Centre deafness database (Lane, personal communication)**.** In turn, this estimate would be higher than expected for the *total* paediatric hearing impaired population, because of conductive hearing loss (by far the greatest cause of hearing loss in children) being even less likely to be associated with multiple handicaps.

From the discrepancies between the data sources, it is clear that the nature of the questioning in the 1996/97 survey has significantly biased the sample towards those with multiple handicaps, and one of the presumably unintended results of this skewing is to reduce the prevalence estimate of those with hearing loss alone considerably.

Table XVII: Percentages of people with varying degrees of disability caused by hearing loss having other disabilities (1996/97 study).

**	Hearing loss causing disability	Hearing loss causing disability requiring assistance
Children with hearing loss & other disabilities	12,500 54.1%	
Adults with hearing loss & other disabilities	155,650 62.2%	114,650 82.3%
Total multi-handicapped	168,150 67.2%	114,650 82.3%

Regional distribution of hearing loss

The various census-related studies do not provide direct measures of the regional distribution of hearing loss because of insufficiently large sample sizes.

However, differences in age distributions between regions are known, and since age is such a strong correlate of hearing loss, estimates of regional variations can be calculated. Racial differences at least as far as Maori population makeup can also be adjusted for. Prevalence estimates are given in Table XVIII.

Table XVIII: Estimates of prevalence and numbers with hearing loss for non-institutionalised population in each region, based on regional differences in age and ethnicity distribution.

Region	Population (2000 census)	% >65 years	% Maori	Adjusted prevalence	Adjusted numbers
Northland	143,660	11.0	30.8	9.6	13,800
Auckland	1,165,280	10.4	12.0	9.7	113,050
Waikato	360,500	10.1	20.9	9.6	34,600
Bay of Plenty	243,080	11.8	28.5	9.8	23,800
Gisborne	44,360	10.7	43.2	9.6	4,250
Hawkes Bay	145,960	12.1	22.6	10.0	14,600
Taranaki	101,790	11.8	14.4	10.0	10,200
Manawatu-Wanganui	220,650	12.0	17.9	10.0	22,050
Wellington	424,460	10.1	12.3	9.6	40,750
Nelson/Marlborough	129,930	13.4	8.4	10.3	13,400
West Coast	34,150	12.3	8.8	10.0	3,400
Canterbury	491,570	13.2	7.0	10.2	50,150
Otago	192,940	13.0	6.0	10.2	19,700
Southland	93,630	10.5	11.3	9.7	9,850
New Zealand	3,791,940	11.3	14.7	9.8	368,600

There are also regional differences in employment patterns, which could potentially produce regional variations in the prevalence of hearing loss amongst, predominantly, men (see Table XIX). Wellington and Auckland have much smaller percentages of their working population in noisy industries, and the difference between these regions and others is largely within the agriculture/forestry/fishing sector. An assumption could be made that prevalence of hearing loss could be further adjusted upward or downward if the region has a particularly high or low rate of people employed in noisy occupations.

Table XIX: Percent of working population (after Appendix 6b in the Hearing Report, 1984) employed in various sectors of the economy (1996 census)

Region	Agriculture/forestry/fishing	All potentially noisy occupations
Southland	21.8	50.0
Nelson-Marlborough	20.6	46.5
Taranaki	18.1	46.4
Hawkes Bay	18.6	44.5
Gisborne	22.0	44.1
Northland	21.2	44.1
West Coast	16.3	44.1
Waikato	18.1	42.9
Bay of Plenty	13.1	39.4
Canterbury	9.1	37.7
Manawatu-Wanganui	14.5	37.4
Otago	11.4	36.1
Auckland	2.4	31.6
Wellington	2.7	23.1
NZ overall	9.8	36.1

The Occupational Safety and Health service collects data relating to noise-induced hearing loss. However, this is not inclusive – notifications tend to be representative rather than for all cases of hearing loss, producing a significant under-estimate of noise-induced hearing loss (Noise Induced Hearing Loss, 1996). Notifications for 1992-1996 indicated a regional variation from 0.02 to 0.64 per 1000 population. Even at the greatest 5-yearly incidence, these figures would predict a noise-induced prevalence of about 0.5% of the population, far removed from the actual prevalence of at least 5% of men, equating to over 80,000 people as indicated in the 1991/2 study.

Some information relating to regional variation in children's hearing status is available from the national hearing screening statistics collated annually by the National Audiology Centre. These data refer to failure of hearing screening tests carried out at school entrance (i.e. normally age 5 years). Averaged data for the last two years where data are available are presented in Table XX. A high regional failure rate at school entrance will normally be associated with a higher than normal rate of ongoing middle ear problems through the early school years. This is of concern because of potential educational consequences.

Table XX: Failure rate of hearing screening carried out at school entrance by region (1998-2000, Patel, National Audiology Centre, personal communication)

Region	Overall	Maori	Pacific Island	Other
Northland	12.6	17.8		8.4
Bay of Plenty	12.3	23.5	24.5	7.5
Hawkes Bay	11.5	20.0	21.4	4.5
South Auckland	10.8	14.0	15.5	7.2
West Auckland	9.9	14.9	15.5	8.1
Waikato	8.4	14.6	16.9	5.7
Southland	8.2	15.4		7.2
Wellington	7.4	13.5	19.1	4.8
Central Auckland	6.6	9.0	13.4	3.8
Taranaki	6.4	11.6		5.1
Canterbury	5.8	9.9	9.9	5.2
Gisborne	5.1	7.1	9.1	2.3
Manawatu-Wanganui	4.9	8.1	10.7	3.7
West Coast	4.5	15.3		3.5
Otago	3.2	7.0	5.7	3.0
North Shore, Auckland	3.1	8.2	11.4	2.3
Nelson/Marlborough	2.8	9.4		2.2
New Zealand	7.7	13.5	15.2	5.2

The National Audiology Centre also maintains a database of deaf and hearing impaired children accessing the children's hearing aid fund which pays for hearing aids fitted by local audiologists. Regional distribution data are presented in Table XXI. Regions with particularly high rates of deaf and hearing-impaired children are Gisborne, Northland, and the Bay of Plenty, all of which areas have particularly large Maori populations.

Regions with low rates of accessing hearing aid funding are the West Coast, Otago and Manawatu-Wanganui (with low Maori populations). The relationship between the Maori population and prevalence of child hearing aid usage is also shown in Figure 5.

Table XXI: Numbers of hearing impaired and deaf children accessing the National Audiology Centre's hearing aid fund (1998-2001) from each region

Region	Child Population (2001)	Maori child population rate (%) (1996)	Deaf/hearing impaired children (1998-2001)	Prevalence %
Gisborne	15,400	43.2	60	0.39
Northland	47,400	30.8	179	0.38
Bay of Plenty	77,100,	28.5	272	0.35
Hawkes Bay	46,150	22.6	129	0.28
Wellington	123,100	12.3	338	0.27
Southland	28,950	11.3	74	0.26
Auckland	351,900	12.0	881	0.25
Waikato	117,200	20.9	268	0.23
Nelson/Marlborough	37,050	9.0	81	0.22
Taranaki	32,200	14.4	69	0.21
Canterbury	135,700	7.0	259	0.19
Manawatu-Wanganui	69,750	17.9	115	0.16
West Coast	10,400	6.0	12	0.12
Otago	54,400	8.8	68	0.12
New Zealand	1,146,450	14.7	2,805	0.24

Assuming that the age distribution for deaf and hearing-impaired people is the same as the rest of the population, a national population figure of 6,400 can be calculated for permanently prelingually hearing-impaired and deaf adults.

Conclusions

Prevalence rates are in general consistent with those obtained elsewhere where larger sample sizes have been available. The most parallel data come from the1996 US household survey, and from this an overall prevalence 1.5% lower than that of New Zealand is seen. Age comparisons show that New Zealand has a higher prevalence rate of hearing loss in children. In addition, ethnic differences are large – American blacks have much lower prevalence than whites, and in New Zealand, Maori and Pacific Island children have higher rates of hearing loss both temporary and permanent than do the rest of the population. These ethnic differences, combined with the overall higher rate of hearing loss from otitis media and its consequences in children generally, probably account for most of the difference between New Zealand and US populations.

The small sample sizes in the census studies thus far completed limit the amount of valid analysis that can be carried out. There are plans with the 2001/2 census study to over-sample some groups eg Maori and Pacific Island people, in order to obtain more reliable ethnic data, which would be a positive step. Regional data would not be available without a major increase in sample size.

There is a need to work on reliable and valid questions to improve the quality of census data relating to hearing loss in the future. Certainly, it is clear that the use of a precursor question on age-related disability is inappropriate for hearing impaired people, and that a direct question of whether the person suffers from hearing loss as in the NZ 1991/92 survey and in the American Vital Statistics series (most recently published for 1996) gives a more accurate picture of the hearing impaired population.

The census data described above provide little reliable or valid information relating to the size of the prelingually *deaf* adult population. Inference as to population size is possible by extrapolation from the children's data. Included in this estimate of 6,400 would be a considerable proportion, probably about 2/3, with mild or moderate hearing losses, leaving an estimate of about 2,100 with severe or profound hearing loss.

Changes over time

Noise induced hearing loss in adults

There is some degree of hope for future reductions in the numbers of people suffering from hearing loss, because of a decrease in the proportion of the population employed in "noisy" industries. At the time of the 1981 census, 45% of the population were employed in potentially noisy occupations. In 1996, this figure had shrunk to 36%.

However, services related to hearing conservation have become less readily available, with the removal of public funding, and in its place requirements under the Health and Safety Act for employers to provide such services for their employees. Self-employed and small businesses remain less likely to access appropriate services.

The NODS system managed by OSH is clearly grossly inadequate as an indicator of the extent of the problem of noise-induced hearing loss. OSH should develop a system of accurate monitoring of the full numbers of people with noise-induced hearing loss, and should ensure that control measures are policed in order to reduce the extent of the problem, since this is clearly New Zealand's greatest public health problem relating to hearing loss. The American National Institute for Occupational Safety and Health's 1988 study of self-reported hearing loss and noise exposure indicates that self-report of hearing loss may be a more practical and valid way of *large-scale* monitoring of health outcomes that audiometric testing.

The World Health Organisation estimated in 1997 that in developed countries the costs of noise range from 0.2-2.0% of GDP. Currently New Zealand's Accident Compensation Corporation accepts 2,600 new cases annually and spends $13 million annually providing rehabilitative services for those with occupational noise induced hearing loss or acoustic trauma. This is in addition to the millions the state spends on War Pensions for 23,700 people, for about half of whom hearing loss is the major complaint. Obviously war is a difficult situation in which to try to prevent hearing loss, but in normal circumstances, occupational noise exposure should not automatically translate into noise induced hearing

loss. Additional public resources need to be allocated in order to deal adequately with this issue.

The World Health Organisation recommended in 1997 that excessive noise exposure be reduced by introduction of new quiet technology, or failing that by isolation of noise sources. Effective, appropriate, acceptable and affordable hearing conservation programmes should be provided if the first two steps fail to reduce noise exposure to a safe level.

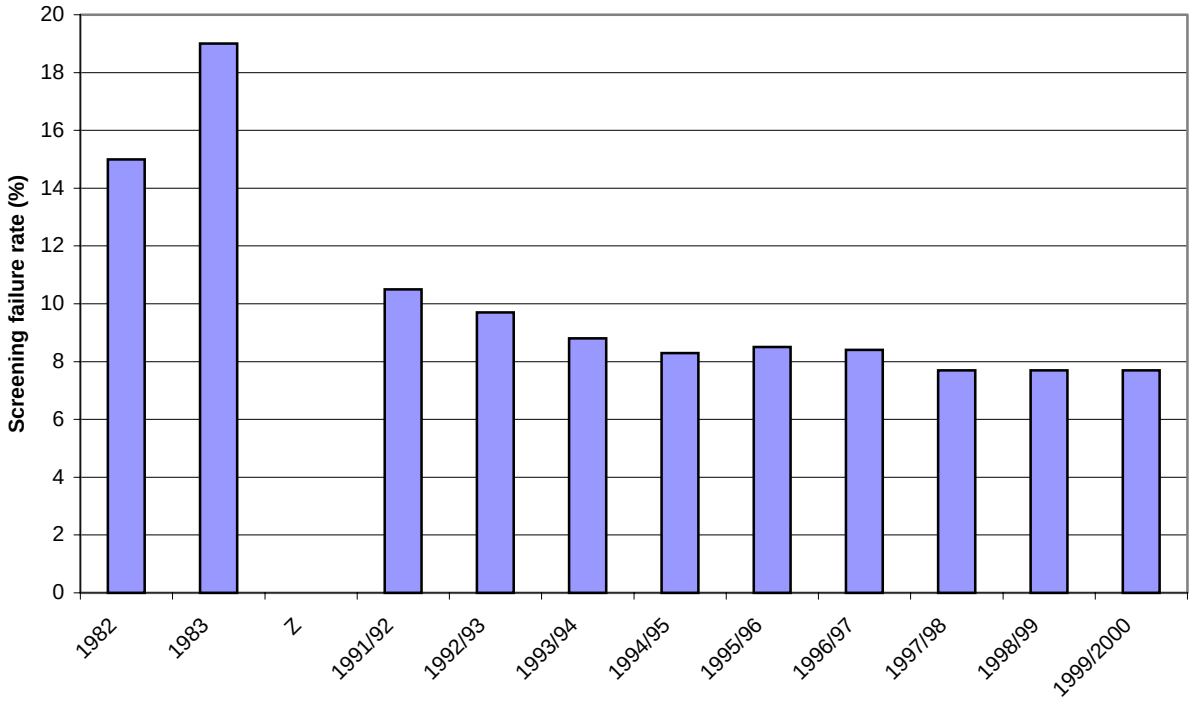
Temporary hearing loss in children

There has been a dramatic improvement in the numbers failing hearing screening tests at new entrant level since the publication of the Hearing Report in 1984. National new school entrant failure rates of 15% and 19% were reported in 1982 and 1983 respectively. The average national failure rates of 7.7% for 1998/2000 are clearly a big improvement. A major change in the interim has been the introduction of screening by tympanometry, and the concomitant introduction of a criterion that children not be considered as having a hearing loss warranting referral until they have failed screening tests twice in succession. This criterion has had the effect of stopping referral of children with temporary self-limiting ear defects. The pattern of audiometric and tympanometric results has also resulted in more effective referral of children – either to the medical system if the problem appears to be located in the outer or middle ear, or directly to an audiologist if the problem appears to be sensorineural. Credibility of screening results has significantly improved.

Because of the change in pass-fail criteria, it is difficult to know how much of the improvement over the last 15 years has been related to genuine decreases in the numbers of children reaching school age with hearing disorders – but in 1991 when repeated testing was introduced in Central Auckland, the difference in failure rates between single occasion and repeated testing was found to be 6.3% (NZ hearing screening statistics, 1992).

National hearing screening failure rates have been published by the National Audiology Centre annually since 1992. In that time, there has been a decrease from 10.5% to 7.7% (see Figure 7). This equates to over 1500 children annually who might have once have started school with chronic hearing loss who now are free of this condition.

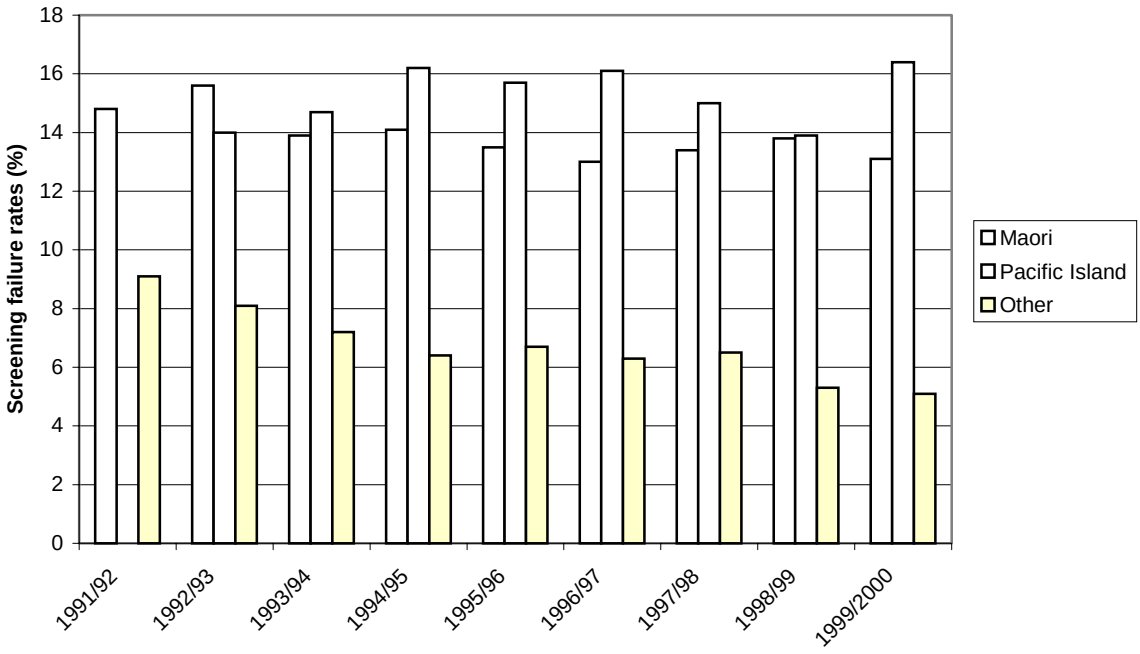
Figure 7. NZ new entrant hearing screening



However, improvement has not been seen in all sectors (see Figure 8). There has been an improvement of about 2% for Maori children, none for Pacific Island children, and 4% for "other" children. Some of this would be due to refinement of the results reporting – for example, at the start of the 1990s results were not isolated for Pacific Island children in many parts of the country. Nevertheless, concern should remain concerning the numbers of Pacific Island and Maori children with ongoing ear conditions causing hearing loss from the commencement of their school careers.

Overall, New Zealand children appear to suffer more from otitis media and its consequences than do children in many other developed countries.

Figure 8. NZ new entrant hearing screening by ethnic group



Permanent hearing loss in children

There has also been a slight decrease in the numbers of deaf and hearing-impaired children – from 2.6‰ under the care of Advisers on Deaf Children in 1984 (Hearing Report, 1984) to 2.4‰ accessing hearing aid funding more recently. This is probably mainly due to a reduction in the numbers of children suffering from maternal rubella. The prevalence remains a little higher than that reported elsewhere (eg summarised by White, 1997), and may be due to ethnic differences (for Maori and Pacific Island children) in susceptibility to permanent childhood hearing loss.

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