



NATIONAL FOUNDATION FOR  
**Deaf & Hard of Hearing**

# **LISTEN UP, NEW ZEALAND**

**Risk of non-occupational Noise  
Induced Hearing Loss (NIHL) in New  
Zealand adolescents: Lessons from a  
pilot auditory screening programme  
in high schools.**

## Executive Summary

A majority of adolescents and youth globally now have access to personal hearing devices including smart phones and *iPods* that they use to listen to music, using headphones and earbuds, often at high volumes for extended periods. This, combined with regular attendance at music and other noisy recreational events, is contributing to what is now seen as a global trend of increase in non-occupational noise induced hearing loss. The World Health Organisation (WHO) estimates at least one billion people aged between 12-35 years are at risk of hearing loss due to such preventable recreational risk factors.

To determine whether the global trend was following a similar path in New Zealand, the National Foundation for Deaf and Hard of Hearing (NFDHH) embarked on a pilot programme of auditory screening of 479 year 9 high school pupils at three schools and found that 34% of them had compromised hearing, including mild to moderate, (and some severe cases of) hearing impairment requiring further assessment and monitoring. Data collected on their listening habits suggested these pupils were listening to music every day on personal devices for extended periods, and a number of these students' way beyond what the World Health Organisation's Safe Listening Standards prescribe for maintaining hearing health.

The pilot is a precursor to a larger hearing screening programme for year 9 to 13 pupils wherein the Foundation plans to track and monitor youth hearing loss rates and launch an awareness programme for prevention of any irreversible damage to hearing due to recreational factors. Those who are found to have significant hearing impairment in audiometry will be supported with referrals to healthcare professionals.

## Acknowledgements

We at the National Foundation for Deaf and Hard of Hearing (NFDHH) would like to express our sincere thanks to **Life Unlimited** and **Fit for Work** for a smooth running of the audiological screening programme involving hundreds of youth at selected high schools in New Zealand. The Principals and deputy principals of these schools (Rutherford College, Auckland; Manurewa High School, Auckland and Queen Charlotte College, Picton), their nurses, year 9 pupils and whanau all deserve a special thanks for acknowledging the significance of our brief ‘fact finding’ mission for the risk of non-occupational Noise Induced Hearing Loss (NIHL) in the target group and for offering their whole-hearted support and consent to be a vital part of it. Last but not the least, valuable feedback from experts at the offices of the health and disability ethics committee, Auckland and Counties Manukau District Health Boards (DHBs), the University of Auckland section of Audiology and the Eisdell Moore Centre for hearing and balance disorders provided us with innumerable learning opportunities along the way.

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## 1. Introduction

Non-occupational Noise Induced Hearing Loss (NIHL) is turning out to be a new public health challenge worldwide, with more and more youth experiencing hearing loss directly linked to their unsafe listening practices.

The World Health Organisation (WHO) estimates 1.1 billion people aged between 12-35 years are at risk of irreversible hearing loss, largely due to preventable causes including recreational exposure to loud sounds from prolonged use of personal music devices at high volumes and regular attendance at concerts, nightclubs and sporting events (WHO, 2019a).

With 43 million people in the same age group already living with disabling hearing loss (WHO, 2019b), the burden on national health services and potential loss of productivity is likely to balloon in the coming years if preventative measures are not taken. The numbers on the hearing loss do not take into account the impairment caused by old age, genetic, medical or occupational causes. Hence the term non-occupational NIHL.

Anecdotal evidence suggests the risk of non-occupational NIHL is no different in New Zealand youth. But in absence of any credible data on the nature or size of the problem, effectively targeting preventive measures including awareness campaigns, such as Make Listening Safe, and early treatment and rehabilitation of those who are diagnosed with non-occupational NIHL could be a challenge.

Make Listening Safe is a WHO initiative to “raise awareness about safe listening practices especially among young people and highlight the need for safe listening to policy-makers, health professionals, parents and others” (WHO, 2019b)

whereas rehabilitation programmes include a tailored Youth Apprenticeship programme at hearing accredited workplaces for school leavers with hearing impairment. The National Foundation for Deaf and Hard of Hearing (NFDHH) is in the process of launching these two initiatives.

## **1.1 Existing data**

New Zealand data on the incidence of hearing impairment in the under-24 age group ranges from 10% to 15% (categorisation as available in *Statistics New Zealand and Listen, Hear New Zealand* report, 2018). The disability survey 2013 data suggests 1% of children up to the age of 14 and 2% of 15 to 44 years olds experience moderate to severe hearing loss (the incidence rising to 34% of men and 23% of women over the age of 65).

The incidence of hearing impairment from all causes is higher amongst ethnic minorities such as Maori and Pasifika people, and socioeconomically deprived sections of New Zealand society, even after adjusting for confounders. The Deafness Notification Database report of 2017 further confirms this, reporting most of the 1561 notifications of deafness since 2010 were from high deprivation areas (NZDep 2013 scores of 8, 9 and 10).

Initially managed by the National Audiology Centre (NAC), the database was until 2005 the only source information on the number of New Zealand children diagnosed with different types of hearing impairments. It was launched again in 2010 by the New Zealand Audiological Society to prevent any missed cases for the purposes of planning and accurate monitoring of trends. Its 2017 report lists 1561 newly diagnosed cases of hearing loss in children from birth to 18 years of age since

2010, when the database was relaunched.

The Ministry of Health's Well Child/ Tamariki Ora programme funds comprehensive health checks, including hearing screening, for four-year olds. The B4School Check (MoH 2019) compliments the new born hearing screening conducted just before child goes home from hospital/delivery rooms and the two are meant to pick up any hearing impairment early and provide treatment.

The above two screening programmes do not take into account the enhanced risk of impairment among adolescents and the youth during their school years due to health and lifestyle factors including infections, lack of immunisations, injury or exposure to loud music for extended periods.

In 2000, Northland District Health Board began a comprehensive health and lifestyle screening of year 9 students from low decile schools in the region. The **HEEADSSS (Home environment, Eating and exercise, Education/employment, Activities, Drugs and Alcohol, Sexuality, Suicide and mood, Safety)** programme found some evidence of this hearing loss, but did not take into account the degree of loss and the causes thereof, or the strategies to address them before the youth leave school and enter the workforce. Under the HEADSSS programme, 1830 students were screened, of which 56 (3.05%) were referred to either an audiologist or an ear nurse for failed audiogram or tympanometry test (HEEADSSS, 2000).

## **1.2 Cost to the health system**

Unaddressed hearing loss poses huge costs to the health-care system and to the economy as a whole. Academic and/or learning difficulties, bullying, mental health problems, low employability etc are all associated with unaddressed hearing loss (Freeburg et al., 1991; Furlonger 1998; Gilani et. al., 2017; Hall et. al., 2018). Research



suggests uncorrected hearing loss impedes learning (Pittman 2011) and youth with Deafness or Hard of Hearing (DHH) face significant barriers while transitioning from school to community, primarily due to communication problems with the general public and the efforts to obtain gainful employment. These often lead to difficulty in forming adult identity, low self-esteem, social isolation and lack of assertiveness.

### **1.3 Lower rate of education, employment or training**

Youth with any kind of disability, including DHH, also have fewer qualifications and are twice as likely to be unemployed or underemployed. When they do manage to find gainful employment, they earn less than their peers without disability. NZ's *Labour Market Statistics (Disability): June 2019 quarter* shows 43.3 per cent of disabled youth aged 15–24 years were not in employment, education, or training (NEET). This was more than four times the NEET rate of nondisabled 15–24-year-olds. The labour force participation rate for disabled people aged 15–24 years was 31.1 percent, well below that of non-disabled people in the same age group (61.1 percent). The 2018 Statistics NZ figures showed 41% of disabled youth had no qualification, compared with 18.9 percent of non-disabled youth.

### **1.4 Global economic impact**

World Health Organization report titled *Global costs of unaddressed hearing loss and cost effectiveness of interventions* (WHO, 2017) puts the annual cost of unaddressed hearing loss in the range \$750–790 billion globally, primarily towards education, healthcare, loss of productivity and the societal cost resulting from social isolation, communication difficulties and stigma attached to hearing disabilities.

The costs are calculated on the basis of the monetary value attached to avoidance of a year lived with disability and draw upon disability-adjusted life years (DALYs) attributed to hearing loss. However, it takes no account of certain aspects of hearing loss such as the costs of providing informal care, or preschool learning and higher education for people with unaddressed hearing loss. Such costs are not well documented in the literature.

## **2 Rationale for the pilot**

The NFDHH embarked on the screening pilot at three high schools in New Zealand's Auckland and Picton regions to get an indication of common hearing-related issues among year 9 pupils. The initiative is a precursor to a planned larger auditory screening programme for New Zealand year 9-13 high school pupils. The objective is to check the trends in noise-induced audiometry threshold shifts over a period and identify non-occupational NIHL among the youth. Since early intervention is the key to preventing further damage to hearing and associated challenges, those identified with hearing loss will be regularly monitored for further changes to their hearing capacity. A concurrent awareness programme at high schools will make the pupils aware of the risks to their hearing and the ways to preserve it. Those with hearing loss as identified by screening will be referred to health professionals for further assessment.

The year 9 to 13 were selected as suitable subjects for screening to catch the adolescents and youth when they are just starting to become active on social media and increasing personal audio device use with headphones/ earbuds; and attempt

to reduce their risk in the hope of preventing future noise-induced NIHL by influencing their behaviour. Coincidentally, the biggest gap in the available data on hearing and ear-related problems seems to exist for this age group. The pilot, and the planned larger screening programme, is the first small attempt at addressing that information gap.

### 3. The pilot

Two high schools in Auckland, North Island and one in Picton (District Marlborough) in South Island, were involved in the pilot hearing screening project to get a snapshot of hearing problems, including potentially non-occupational NIHL, initially in year 9 pupils. Rather than opt for random sampling, all the year 9 pupils at Rutherford College (Auckland), Manurewa High School (Auckland) and Queen Charlotte College (Picton) were offered the screening by one of the two health care providers. The pupils represented a fair mix of New Zealand's ethnic and socio-economic diversity. Nearly all the pupils had access to phones, *iPods* or similar personal listening devices and were using either headphones or earbuds to listen to music every day.

The providers, ***Fit for Work*** and ***Life Unlimited***, were responsible for initiating the tests only after seeking and obtaining informed consent from the pupils and their legal guardians after explaining to them what the test was and why it was being conducted. Those who had an acute illness within the past six weeks and those who had an already diagnosed hearing loss of any degree were excluded from the screening as their condition was already being managed by their healthcare providers.

The year 9 school pupils were administered a hearing screening of 250 and/or 500Hz through to 8Hz in both ears, using screening audiometry to assess their baseline hearing levels. Otoscopy was performed to examine the ear canal for any obstruction (e.g., wax) and the condition of the eardrum, which can indicate inflammation, scarring or middle ear infections and referrals were made to school nurse to the pupil's GP where necessary. Pure tone audiometry uses an audiometer to play a series of tones through headphones in each ear, separately. The tones vary

in pitch (measured along a sound frequency spectrum of 250 or 500 to 8,000 Hertz) and loudness (measured in decibels, from -10 to 110). For most pupils, testing began at 500 Hz, because this frequency is easily heard by most and has the greatest test-retest reliability. The frequency sequence used by Life Unlimited for pure-tone threshold search testing was at 250, 500, 1,000, 2,000, 4,000, 8,000 and 1,000 (repeat), 500 Hz.

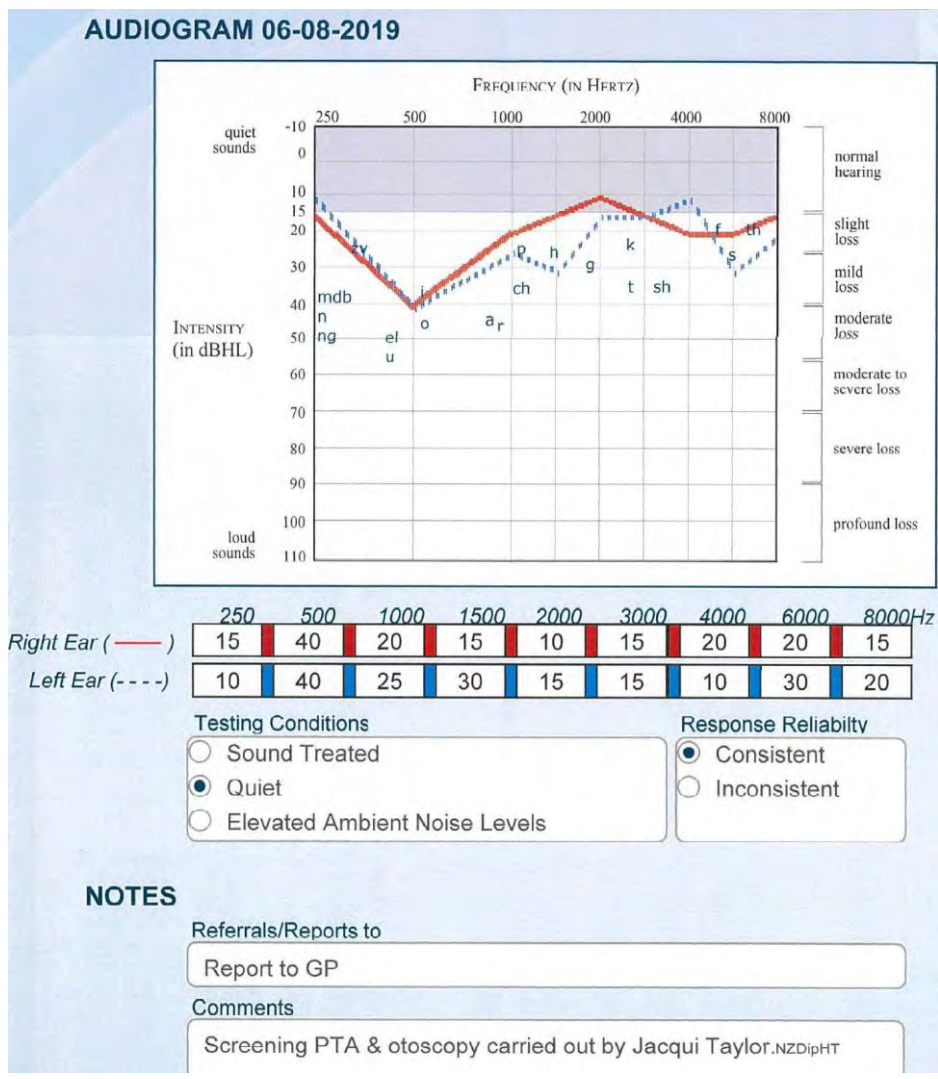


Figure 1: Example of an audiogram showing frequency thresholds

Fit for Work, however, did not include 250Hz. The results of each test were plotted on an audiogram which helps to show the pattern of any hearing loss. Testing conditions and response reliability was also plotted on the detailed audiogram reports.

(see Figure 1, above).

The pre-screening questionnaire recorded demographic data including age, gender, ethnicity and family history of hearing impairment, medical history of Ear/Nose/Throat infections and lifestyle factors (e.g. regularly listening to music on high volume for long hours, living near a noisy environment etc). The questionnaire was administered in a quiet room by the screening technician at the screening venue within the school premises (as designated by the school administration).

The data was compiled on Excel sheets and was forwarded to the NFDHH research office for analysis at regular intervals.

## 4. Key Results

A total of 479 (13 to 14-year-old) year 9 pupils at three high schools received free hearing screening between March and August 2019 (240 at Manurewa, 191 at Rutherford and 48 at Queen Charlotte). Of these, 34% (161/479) had abnormal hearing screen results suggesting varying degrees of hearing loss (mild/moderate and some with severe/profound) in screening audiometry. The figure does not include 78 pupils in Manurewa high school who exhibited slight variations in their hearing thresholds in audiometry. Since the other two schools did not test for or pick up a similar “slight change” in hearing thresholds, the numbers were excluded from the overall count of abnormal results and were assumed to have normal hearing. A school-wise break down of these numbers are illustrated below.

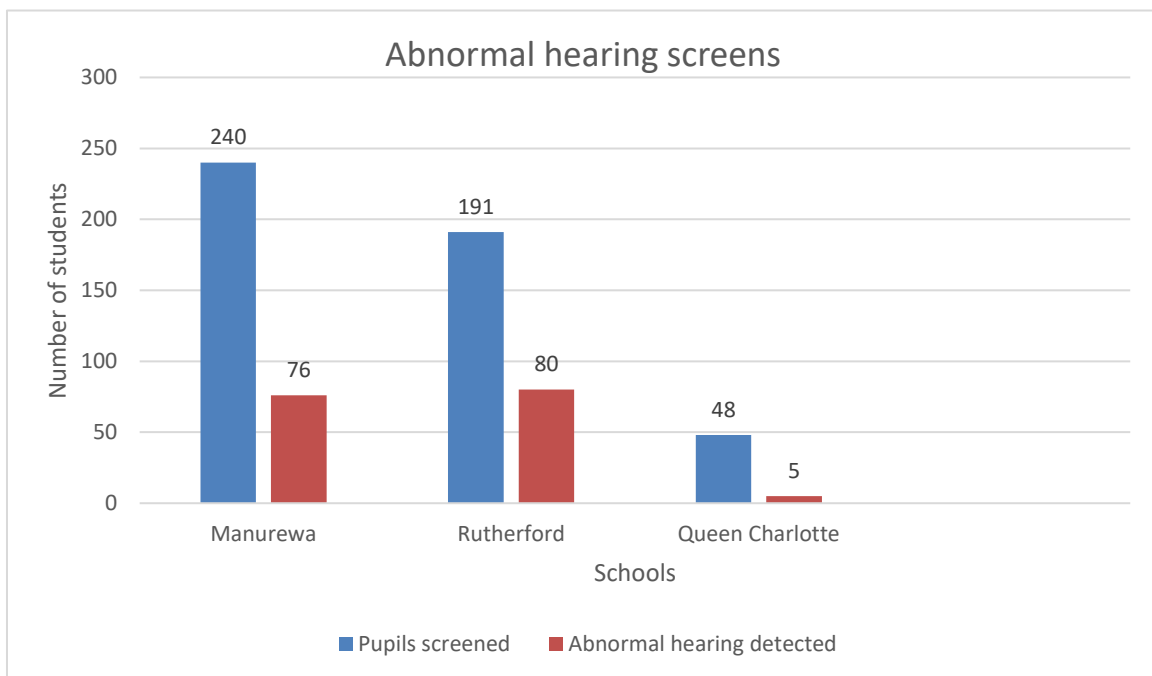


Figure 2: School-wise break down of results at glance

### a. Noise exposure

Analysis of the data on these pupils' listening habits points to a possible link to their listening habits and/or their exposure to noise from such recreational activities. Most of the pupils reported listening to music on personal devices for up to 10 hours daily (average 3 to 4 hours/day) on volumes mostly ranging from medium to maximum.

Of the 316 high school pupils on whom detailed listening data was available, for instance, 76 were listening to music on maximum volume (equating to 100-115 decibels on an *iPhone*), while 15 others admitted to listening at 70% or higher volumes.

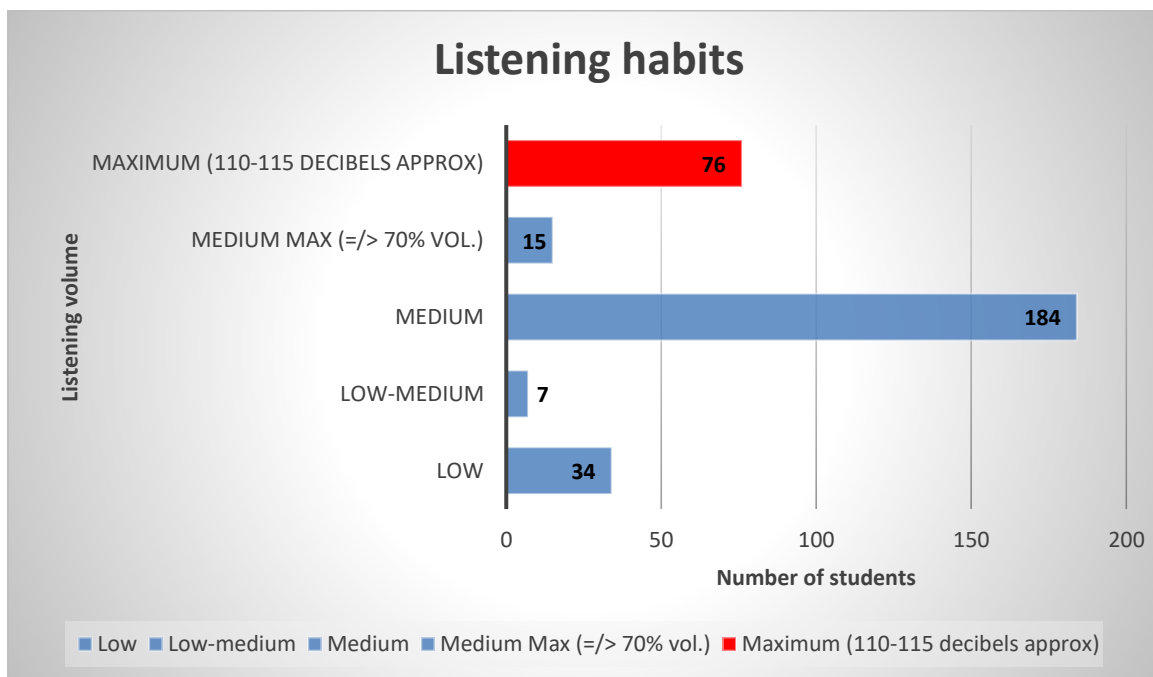


Figure 3: Pupils' self-reported listening habits

WHO's Make Listening Safe global standard recommends that young people limit their use of headphones to periodic rather than continuous listening and the prescribed weekly sound allowance from all sources to maintain healthy



hearing levels is only <75dB for children and <80dB for adults for no longer than 40 hours per week. The Sound Allowance table below demonstrates the higher the decibel the lower weekly allowance.

### Adult

**Table 1:** Example of weekly listening time for Mode 1

dB(A) SPL	Weekly (1.6 Pa <sup>2</sup> h)
107	4.5 minutes
104	9.5 minutes
101	18.75 minutes
98	37.5 minutes
95	75 minutes
92	2.5 hours
89	5 hours
86	10 hours
83	20 hours
80	40 hours

### Child

**Table 2:** Example of weekly listening time for Mode 2

dB(A) SPL	Weekly (0.51 Pa <sup>2</sup> h)
107	1.5 minutes
104	3 minutes
101	6 minutes
98	12 minutes
95	24 minutes
92	48 minutes
89	1 hours 36 minutes
86	3 hours 15 minutes
83	6 hours 24 minutes
80	12 hours 30 minutes
77	25 hours
75	40 hours

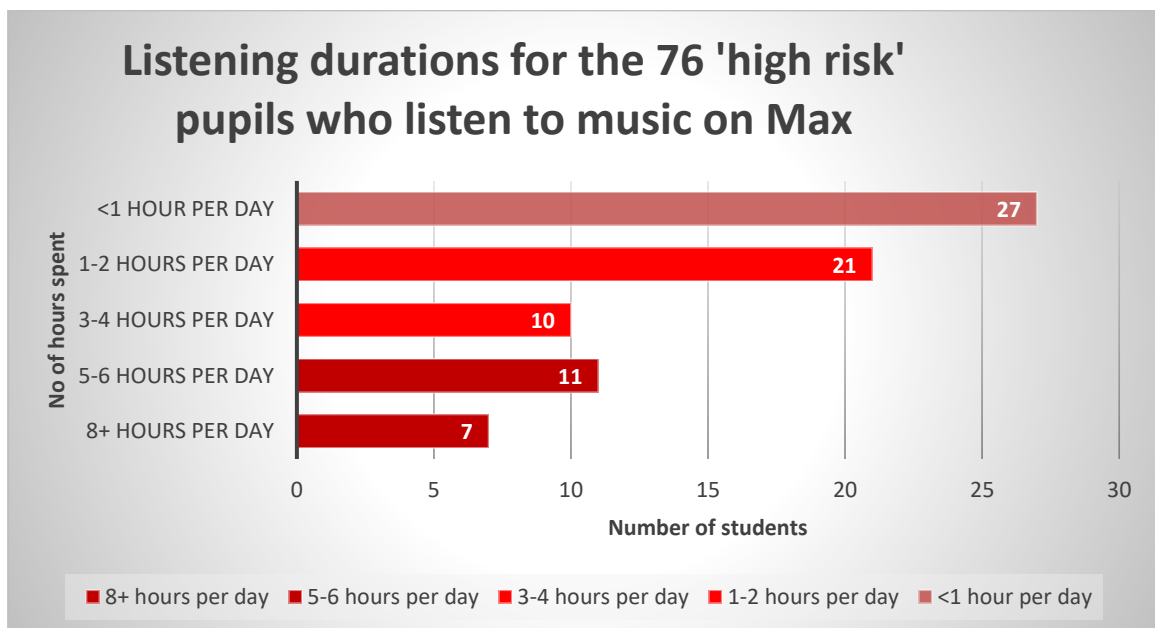


Figure 4: Average listening duration of 76 students at maximum volume

## b. Ringing in ears

Incidentally, around 40% of all pupils with abnormal (65/161) and 37% of all pupils with normal (117/318) screening results also complained of ringing in ears (depending on how often and how long this lasts for, ringing in ears could be a precursor to tinnitus, an early sign of damage to hearing), either occasionally or often. A school-wise break down of these cases is illustrated in the figures 5 & 6 below.

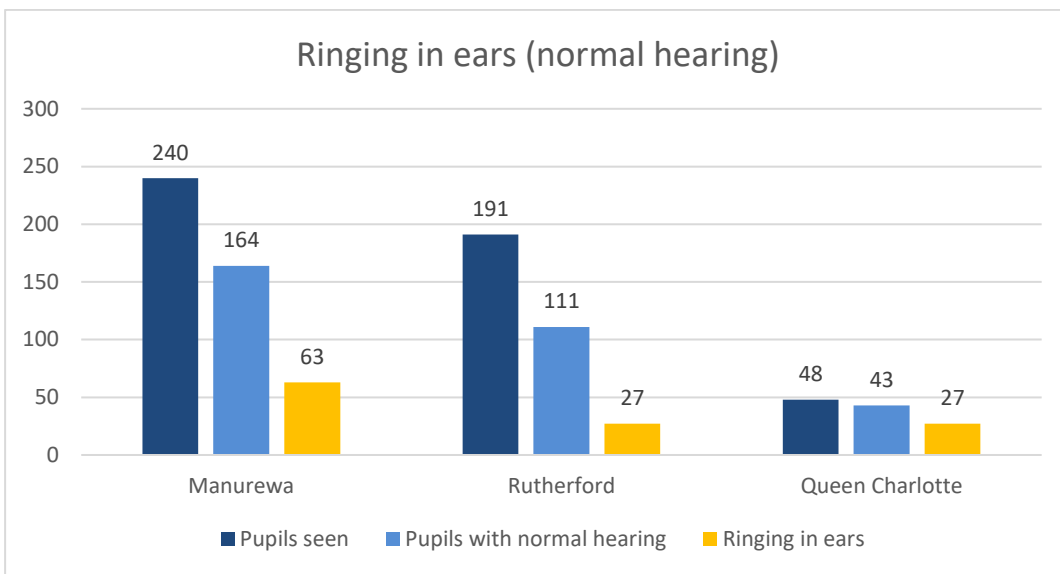


Figure 5: Number of students with normal hearing complaining of ringing in ears

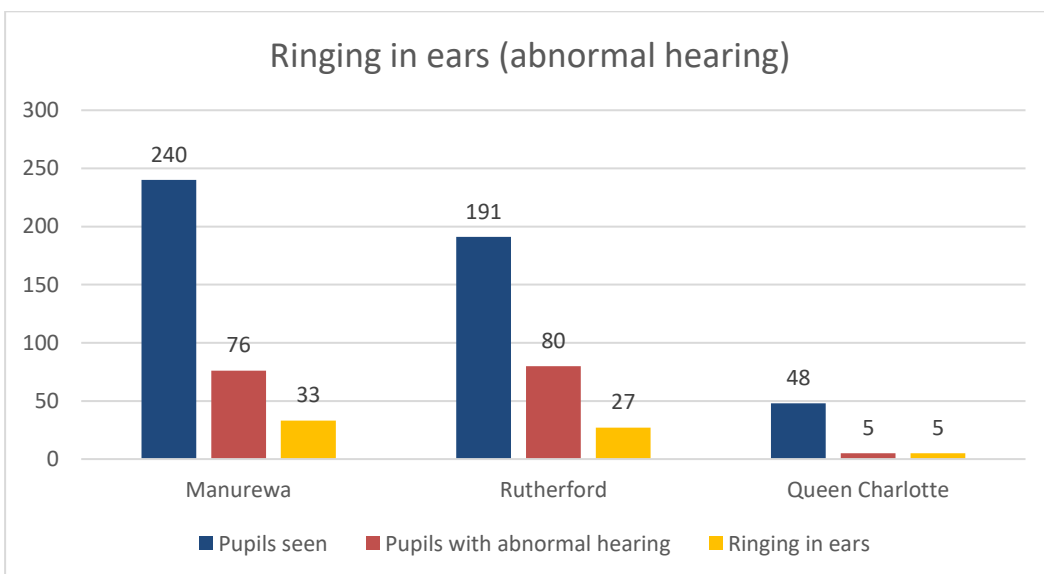


Figure 6: Number of students with abnormal hearing complaining of ringing in ears

In absence of wider randomised control trials and confirmatory diagnostic tests on pupils with failed audiometric tests, the results can at best be treated as a casual correlation. However, existing literature identifies the use of personal music devices for prolonged periods as a risk factor for developing non- occupational NIHL. In the United States, for example, the prevalence of hearing loss among 12 to 19-year-olds rose significantly from 3.5% to 5.3% between 1996 and 2006, corresponding with the number of people listening to music through headphones increased by 75% from 1990 to 2005 (Henderson et al, 2011).

The above findings, therefore, reinforce the need for the NFDHH-proposed wider screening programme, along with a robust research into this issue.

## 5. Prevention better than cure

New Zealand youth could be affected by the global trend of increasing incidence of non-occupational NIHL caused by unsafe listening practices. While noise-induced hearing loss is irreversible, it can be prevented. In the case of hearing loss caused by the unsafe use of personal audio devices, WHO recommends simple, effective practices such as keeping the volume within safe listening levels and limiting the time spent engaged in noisy activities that, if followed, can have a protective effect on people's hearing.

NFDHH believes prevention through early identification and management of causative factors such as otitis media and noise exposure are cost-effective and, therefore, would like to make the following suggestions:

- Early identification of hearing loss through screening of newborns, B4School checks and adults over the age of 50 years is already happening, screening of youth and adolescents needs to be added to the mix to address newer, lifestyle related factors.
- In early 2003, Ear Nurse Specialists were tasked with glue ear testing and management to prevent deafness (Kidshealth, 2019). Audiological screening could be an add-on service to that.

Launch of a Youth Prevention Programme to educate adolescents on safe listening practices and how to protect their hearing. This prevention would include:

- Collaborate with the government to ensure the prevention programme is far reaching, and in every school.
- Track and monitor youth hearing loss over the next 5 years through research project etc.

*WHO Make Listening Safe Practices including:*

- Addressing hearing loss as a public health issue.
- Allocating resources for access to ear and hearing care.
- Focusing on prevention, screening and early intervention of hearing loss.
- Gathering more country-specific data on the cost of unaddressed hearing loss and cost– effectiveness of interventions to strengthen available evidence.

***Listen Up, New Zealand*** is the latest effort by the NFDHH start to obtain country specific data on non-occupational NIHL through further screening and follow up of NZ youth with suspected noise-induced NIHL and by shining a light on the issue to launch awareness and prevention programmes.

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