Investigation into hearing impairment amongst Indigenous prisoners in the Victorian Correctional System

Project Report
Susan Quinn and Gary Rance
School of Audiology
University of Melbourne

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EXECUTIVE SUMMARY

The invisible handicap

Hearing loss places limitations on the individual’s ability to interact with the community. As a consequence of hearing loss the ability to communicate with other people, to listen and respond to speaking is reduced. For hearing impaired individuals within the correctional system, the reduced ability to communicate with ease may impact detrimentally on daily interactions with prison officers and other prisoners. A hearing problem which is not fully recognised and compensated for may impede the hearing impaired individual’s progress through correctional rehabilitation programs, and in the longer term may limit potential employment prospects, and restrict participation in relationships. The latter two outcomes may contribute to the likelihood of recidivism.

Whilst studies of prison inmates overseas and in Australia are few in number, they have generally reported a higher prevalence of hearing loss than in the general population. Indigenous prisoners are considered to have an additional risk of hearing impairment because of the high prevalence rates of middle ear disease and conductive hearing loss found in some Indigenous paediatric populations in regional Australia. To date little research has been undertaken into the hearing status of Indigenous adults in the Australian community. Indigenous prisoners are disproportionately over represented in prisons across Australia, a fact which throws into high relief any possible burden of disease which may be contributing to this unfortunate situation.

Methodology

This study tested the hearing status of 109 Victorian Indigenous prisoners at five prison locations. At the time the study was implemented, this number amounted to approximately fifty percent of the Indigenous prisoners in the Victorian correctional system. Weekly day-trips to the various prison locations were undertaken by the audiologist over a period of 5 months, from Feb’06 to June’06, totalling 15 prison visits. Around seven Indigenous prisoners were tested during each visit, in a quiet environment at each prison. The prisons visited were Port Phillip Prison and the Dame Phyllis Frost Centre (women’s prison), in Melbourne’s outer west; Loddon prison in Castlemaine central Victoria; Fulham correctional centre in Gippsland; and Barwon prison near Geelong. Following provision of information about the project, each prisoner’s participation in the project was voluntary (written consent obtained). All of the Indigenous women who were in the Dame Phyllis Frost Centre (during the period of audiologist visits) participated in the study.
A face to face, history questionnaire was completed by the audiologist with each prisoner at the outset of each hearing test. This questionnaire documented self-reported hearing disability, ear health trouble, noise exposures and tinnitus. Visual inspections of the external ear canal and eardrum (otoscopy), and objective tests of middle ear function (tympanometry) were performed. Hearing thresholds were measured using pure tone audiometric procedures. And for every hearing test carried out, an audiological report, which included individual recommendations for appropriate follow up, was delivered to the prison Health Service.

The extent of the problem

The underlying hypothesis behind this investigation was the expectation of finding a higher proportion of Victorian Indigenous prisoners with conductive hearing loss due to middle ear disease, than found in the general adult population. The results showed that this was not the case. However, the population of Victorian Indigenous prisoners was found to be one which would have significantly more hearing problems than would be expected in the general Australian adult population. These results were consistent with the self-reported findings of hearing disability.

There are three main components to the audiometric findings from this study:

i. For the purposes of indicating expected difficulty with speech a “significant” level of hearing impairment is defined as at least 25dBHL, which is an average of hearing thresholds levels over the four frequencies 0.5, 1, 2 and 4 kHz (4FAHTL). Prevalence rates are reported for the level of hearing loss in the better ear. Hearing disability has been defined on measures in the better ear, as a person’s overall functional communication ability relies on the hearing level in their better ear. The study found 6% of Victorian Indigenous prisoners had a mild hearing loss in both ears. The prevalence figure of 6% is just on the edge of the highest expected prevalence of hearing disability in an age-matched Australian adult population. In other words the “worst case scenario” level of hearing disability that could be expected in a general adult population.

ii. Prevalence rates are also reported for worse ear measures (4FAHTL) which reflects the extent of hearing impairment amongst Victorian Indigenous prisoners. Having a hearing impairment in only one ear can produce misunderstandings in communication. A hearing impairment in one ear produces increased problems understanding speech in adverse listening conditions. Environments that are excessively noisy, highly reverberant, have competing speech, and/or have the primary talker some distance from the listener are all adverse listening conditions. Hearing loss
in one ear also interferes with the ability to localise the direction of a sound source. The study found 12% of Victorian Indigenous prisoners had a hearing loss $\geq 25\text{dBHL}$ in at least one ear. This prevalence rate is larger than the maximum expected prevalence rate in an Australian adult population (age-matched). Hearing loss was found to be predominantly mild in nature, although almost a quarter (23%) of those prisoners with hearing loss, experienced a loss that was severe or worse ($\geq 65\text{dBHL}$) in at least one ear.

iii. The study also found widespread, high-frequency hearing loss at the 4 & 6 kHz frequencies, attributable to noise exposure, in the prison sample. The self-reported findings found the majority of the 109 Victorian Indigenous prisoners, one hundred prisoners (92%) had exposures to loud noise. A noise induced hearing loss typically has associated tinnitus (noises or ringing, in the ears or head). Tinnitus was reported by almost three quarters (72%) of the prisoners. A bigger proportion of prisoners reported tinnitus “sometimes” than reported in the general adult population in the UK. Overall, more than a third of Victorian Indigenous prisoners (36%) had a significant level ($\geq 25\text{dBHL}$) of high-frequency hearing impairment in one or both ears (Max. HTL 4, 6 kHz). The study also found a large percentage of Indigenous prisoners had high-frequency hearing thresholds that were below the 90th percentile norm for their age. A high-frequency type of hearing impairment reduces the ability to hear many consonants in speech (such as “s”, “th” and “f”) and this problem is exacerbated in listening environments where there is competing background noise.

**Recommendations**

1. That education of correctional staff about the prevalence and implications of hearing loss, be instituted to assist with day to day management and rehabilitation of Indigenous prisoners through optimisation of communication and listening environments.

2. That routine hearing screening of sentenced and remand male and female Indigenous prisoners be instituted in the Victorian correctional system, including counselling about identified hearing impairment, and provision of personal hearing aids as required.

3. That the prevalence of hearing impairment amongst the non-Indigenous prisoners in the Victorian correctional system be measured to ascertain whether it is necessary to involve all prisoners in a program of hearing screening.
4. That Department of Justice ensure that meeting areas in prisons are designed and acoustically treated to have good “acoustics”, with low levels of reverberation and background noise.

5. That consideration be given to the installation of sound field loud speakers in meeting areas (for example in rooms where rehabilitation programs are held), to improve the signal to noise ratio of the presenter’s voice over any ambient noise.

6. That protocols be established for all Victorian correctional facilities to ensure clear delivery of all announcements over the prison public address system.

7. That courtroom design be reviewed to ensure that a hearing impaired defendant can hear all proceedings.

8. That an investigation be conducted into the compliance of on-site prison industries with the Victorian Occupational Health & Safety regulations for industrial Hearing Conservation programs (AS/NZS 1269.4:2005).

9. That a pilot study, designed to investigate and develop an appropriate hearing screening protocol for the prison population be undertaken by the Department of Justice for the Victorian Correctional system.

Further recommendations for other jurisdictions:

10. That a commitment be made by correctional services organisations in all states and territories to undertake audiological research into the hearing status of Indigenous prisoners.

11. That further research be commissioned, which uses representative adult population samples to audiologically assess the general prevalence of hearing impairment amongst Australian adult Indigenous populations.
1. INTRODUCTION: Context and background

Why undertake this project

It is widely recognised that there is an enormous disparity between Indigenous and non-Indigenous health. Socioeconomic factors contribute fundamentally to the poor health status of Indigenous people, with gross disadvantage evident in educational attainment, employment opportunities and income, (Thomson et al 2004, Australian Bureau of Statistics 2001 Census).

Indigenous prisoners are an “at risk” group for hearing impairment because of the high prevalence rates of middle ear disease and hearing loss frequently found in the Indigenous population. Ear disease particularly otitis media (OM), and associated hearing impairment are significant public health problems in many Aboriginal communities, particularly in remote areas and among children (Burrow and Thomson 2006). Rates of OM vary in different regions, but OM typically occurs more frequently and in more severe forms amongst the Indigenous population than in the general Australia population (Thomson et al 2004). The reasons for this are multifactorial, and include environmental factors (many rural and remote communities have overcrowded housing, inadequate access to water, sewerrage systems, and waste removal), poor nutritional status and inadequate access to treatment and health services.

If there is an increased likelihood of hearing loss in a cohort of prison inmates, then clearly this has significant implications for the correctional system in terms of effective management and rehabilitation of those prisoners.

It should be remembered that Indigenous Australians are vastly overrepresented in prisons. In the March quarter 2004, the national Indigenous rate of imprisonment (per 100,000 adult Indigenous population) was seventeen times the non-Indigenous rate (ABS 2004).

Scope of the project

The project’s primary aim was to investigate the prevalence rates of hearing impairment in male and female Indigenous prisoners in the Victorian prison system, using audiological methods, and to analyse the findings in order to determine whether prevalence rates differ from that found in the general Australian adult population. The project covers sentenced and remand prisoners in both public and private prisons. Once evidence and information is gained and understood, concerning the size, nature and extent of hearing impairment amongst Victorian Indigenous prisoners, then an optimal approach and response to the situation can be appropriately formulated, planned for and implemented.
Epidemiological approach

There are only a limited number of studies internationally that have audiologically assessed the prevalence of hearing impairment in adult populations. A large scale, multi-centre epidemiological study called the National Study of Hearing (NSH), was carried out by researchers in the United Kingdom during the late 1980s, directed by Professor Adrian C. Davis at the MRC Institute of Hearing Research, Glasgow, UK. The first study in Australia to assess prevalence of hearing impairment from a representative adult population survey using audiological methods, was undertaken by Wilson et al (1999), who followed the criteria for hearing impairment used by the British National Study of Hearing. The findings on the prevalence of hearing impairment amongst the Australian adult population are comprehensively presented in the recent report by Access Economics (2006), commissioned by the CRC for Cochlear Implant &Hearing Aid Innovation and Victorian Deaf Society. The investigation into the hearing status of Victorian Indigenous prisoners followed the epidemiological approach and format of these studies.

Background: Explanation of terms, function of the normal ear, measurement of, and types of hearing impairment.
(source Audiology Services – The University of Melbourne and Royal Victorian Eye & Ear Hospital, RVEEH)

The ear is divided into three parts: the external ear, the middle ear and the inner ear. Each part performs an important function in the processing of sound. The external ear and the middle ear conduct sound; the inner ear receives it. The normal middle ear is a small air-filled space, with three small bones connected to the eardrum (tympanic membrane), which act as a transformer to transmit energy of the sound vibrations to the fluids of the inner ear (the cochlea). If there is some difficulty in the external or middle ear, a conductive hearing loss occurs. If the trouble lies in the inner ear, a sensorineural hearing loss is the result. See Fig.1.1. When there is difficulty in both the middle and inner ear, a combination of conductive and sensorineural impairment exists, termed a mixed hearing loss.

Sensorineural hearing loss can result from either damage within or malformation of the cochlear, or from damage to the auditory nerve that runs from the cochlea to the brain. Sensorineural hearing loss is permanent, whereas conductive hearing impairment can often be medically or surgically managed. Another key difference between conductive and sensorineural impairment, is that sensorineural hearing impairment not only produces a reduction in audibility of speech, but also a loss of clarity, or distortion of speech. The key reason people seek help with their hearing is to be able to hear speech more clearly.
Tinnitus can also occur when there are hearing disorders. Tinnitus is the awareness of noises in one or both ears and/or in the head, when noises are not present in the environment. The name tinnitus comes form the Latin word “tinniere” which means “to ring”. Tinnitus is not a disease but a symptom of malfunction in the auditory or hearing system (which includes the ears and the brain). Tinnitus is often present when the inner ear has been damaged by excessive noise exposure.

Tympanometry is a well recognised clinical procedure for objectively measuring the acoustic resistance of the middle ear system; from these measurements it is then possible to draw conclusions about the condition of the middle ear. The main parameter in tympanometry is the static compliance, (which represents the mobility of the middle ear system), which changes as a function of positive and negative air-pressure changes in the external ear canal.

Otitis media is an inflammation of the middle ear which can occur in many forms. Chronic otitis media (COM) is persistent inflammation of the middle ear which can lead to perforation of the eardrum, and generally has associated conductive hearing loss. Information about studies reporting the high prevalence of middle ear disease in pediatric Indigenous populations, particularly in remote regions of Australia, is readily available (Australian Indigenous HealthInfoNet). However,
there is a marked lack of data on the prevalence of conductive hearing loss and middle ear disease in adult Indigenous populations. The only systematic adult population study of middle ear disease, which used audiological methods, was the UK National Study of Hearing (Browning & Gatehouse 1992).

The degree of hearing loss ranges over a continuum from a slight, mild, moderate, to a severe or profound hearing loss. A slight or mild hearing loss can produce difficulty hearing in some situations. For example, when listening in a noisy environment, listening over a distance, or if the speaker is looking away. A person with a moderate loss will usually benefit from a hearing aid. A person with a severe/profound loss would have significant difficulty communicating orally in all environments.

Hearing acuity is routinely tested using pure tone audiometry, where hearing thresholds are measured across the range of frequencies associated with speech sounds (generally from frequencies 250Hz-8000Hz), and recorded on an audiogram. Sounds can be presented by headphones or insert tube phones (air conduction), and also by a small transducer placed on the skull bone behind the ear which transmits sound energy directly to the inner ear (bone conduction). When there is a possibility that the test signal may crossover (by bone conduction) from the test ear to the non-test ear, then masking procedures (presentation of appropriate masking noise to the non-test ear) must be introduced to accurately measure hearing thresholds. On the audiogram a conductive hearing loss shows a gap between the air and bone thresholds, termed “air-bone gap” (ABG). The air conduction thresholds are poorer than the bone thresholds, with conductive hearing loss, due to reduced sound transmission through the impaired middle ear system. Pure tone audiometry is a subjective method of measurement of hearing loss, and requires a behavioural response from the individual as to whether or not the sound level (in decibels) was heard.

Objective hearing tests measure a physiological response from the individual. For example, evoked otoacoustic emissions OAEs are sounds detectable in the ear canal, which originate in the inner ear after stimulation by either a click or a tone. A tiny probe, containing a microphone and a speaker is placed in the ear canal. For most cases of normal middle ear transmissions, low level evoked OAEs tend to indicate damage to the inner ear that may not be detectable with pure tone audiometry. Research has shown that hearing decline has a preclinical phase in which no significant permanent change in hearing thresholds occurs. Evoked OAEs may be used a useful tool for the early warning of potential hearing impairment (AS/NZS 1269.4:2005).
Sometimes people may have hearing impairment in a specific region of the speech spectrum. For example, a noise induced hearing loss (NIHL) typically produces a reduction in hearing which manifests in a sensorineural “noise notch” configuration on the audiogram at the frequencies 3, 4 or 6 kHz (frequencies that provide early indication of noise damage to the inner ear). See Figure 1.2. The implications of having a hearing impairment in the high frequency (HF) portion of the speech spectrum, (such as a noise induced hearing loss), is a reduced ability to hear the high-pitched sounds of speech, particularly in a noisy environment. For example the consonants “s”, “th” and “f” may be inaudible or have reduced audibility. High pitched consonants are softer than other speech sounds (they are produced with lower sound intensity compared with the intensity level of lower pitched speech sounds eg vowels) and are more easily lost in a competing background of noise. Typical comments from people who have a HF hearing loss are “I can’t hear the ends of the words”, “Speech is muffled and unclear”, and “I cannot follow conversations in group situations or in noisy places”.

Figure 1.2 Noise Induced Hearing Loss as shown on an Audiogram

A hearing impairment can occur in one or both ears. There are some situations in which having a hearing loss in one ear can impair communication. People with unilateral hearing loss (one affected ear) have increased difficulty understanding speech when there is background noise, compared to people with normal hearing in ears; they experience problems hearing in social situations, or at meetings, where there are groups of people; or when people are on their “bad side”. Our brains need the input from two ears to work out the direction of a sound. People with hearing in only one ear usually cannot tell where a sound is coming from; they have difficulties with spatial identification of sound.
As hearing loss can differ from one ear to the other (asymmetrical hearing loss), prevalence rates can be reported for either the better or the worse ear, in terms of level of hearing loss. Having better hearing in one ear than the other impacts on the ability to communicate, and may lessen the overall effect of the degree of hearing loss in the worse ear. That is, hearing loss in the better ear provides a functional reflection of hearing disability. As such, disability in epidemiological hearing studies has been defined on measures of the better ear; where better ear measures reflect loss of wellbeing or “burden of disease”. When reporting hearing loss prevalence rates, “better ear” measures would provide conservative estimates, while “worse ear” measures may more accurately reflect the full extent of hearing impairment (Davis 1989, Wilson 1999, Access Economics Listen Hear! report 2006). This investigation of Victorian Indigenous prisoners has used prevalence of hearing disability to refer to hearing loss in the better ear, and the prevalence of hearing impairment to refer to hearing loss in the worse ear.
2. METHODS

2.1 Subjects and prison liason

The project covered sentenced and remand Indigenous male and female prisoners in the Victorian prison system. This included three publicly operated prisons (Dame Phyllis Frost Centre, Loddon Prison and Barwon Prison) and two privately operated prisons (Port Phillip Prison and Fulham Correctional Centre) at different locations in Victoria. Corrections Victoria facilitated the audiologist’s access to all prison locales and the appropriate space in which to conduct the hearing assessments. Prisoners were informed of the project, and prisoner participation in the project was voluntary (individual written consent was obtained); see Appendix B (i) & (ii). Corrections Victoria assisted in the recruitment of participants.

2.2 Prison visits

Fifteen audiology prison visits were undertaken over the period Feb’06 to June’06, generally on a one day per week visiting basis. Five prisons with the greatest numbers of Indigenous prisoners were visited: Port Phillip Prison (PPP), Loddon Prison, the Dame Phyllis Frost Centre (DPFC), Fulham Correctional Centre and Barwon Prison. Female Indigenous prisoners were tested at the DPFC. The total number of Indigenous prisoners at the five locations (at 14 December 2005) was 157. A total of 109 Indigenous prisoners were tested in the study, 96 male and 13 female prisoners (all female prisoners at DPFC in March 2006 participated in the study). See Appendix A.

2.3 Equipment and calibration

Audiological assessments were performed in a quiet room at each prison location.

- Port Phillip Prison: Government Functions area;
- Dame Phyllis Frost Centre: Prison Chapel;
- Loddon Prison: Medical Centre;
- Fulham Correctional Centre: Medical Centre;
- Barwon Prison: Programs Area.

- Sound level measurements were performed using a portable sound level meter (SLM 1565-C General Radio USA). Ambient noise levels in each test environment were \( \leq 45\text{dBA} \).
• Otoscopy (visual inspection of the external ear canal) was carried out using a Heine otoscope (Germany CE).
• Hearing thresholds were measured using a portable audiometer, Madsen Audiometer Model TBN-80, with TDH-39 headphones and Earlink insert earphones (sizes 3A, 3B & 3C), conforming with the Australian standard (AS 1269-1989).
• Tympanometry was undertaken using a Maico Impedance Bridge Model MI24.
• Strict calibration of all equipment was undertaken in the week prior to the commencement of the project, organised by the University of Melbourne School of Audiology.

2.4 Test procedures and audiology reports

Sound level measurements of background noise levels were performed in each test room, using a portable sound level meter (SLM). At each prison location, pre-assessment calibration measures were undertaken to confirm that no shift in thresholds occurred in each test environment.

The audiologist completed a written, face to face history questionnaire with each prisoner at the outset of testing; see Appendix B (i). Self-reported information on hearing problems, ear health problems, noise exposures and tinnitus was documented. Otoscopic examination of each external ear canal and eardrum was performed prior to any testing. Air conduction hearing thresholds were measured in each ear, at eight frequencies: 250Hz, 500Hz, 1000Hz, 2000Hz, 3000Hz, 4000Hz, 6000Hz & 8000Hz. Bone conduction thresholds were obtained at 0.25, 0.5, 1, 2, & 4 kHz. Masked thresholds were obtained as required, using appropriate masking noise procedures.

A full audiology report for each individual prisoner tested was completed, and forwarded following prisoner consent, to the prison health service, with recommendations for further action as appropriate.
3. RESULTS  Summary of the prevalence of hearing impairment amongst Indigenous prisoners in the Victorian Correctional System.

3.1 Prevalence of hearing impairments of various magnitudes.

The results of pure tone audiometric testing have initially been summarised over the major portion of the speech spectrum, in order to indicate expected difficulty with conversational speech (Wilson 1999, ASA Guidelines 2001). The parameter “four frequency average hearing threshold level” (4FAHTL), is the average hearing level at frequencies 500, 1000, 2000 and 4000 Hz (air conduction thresholds) and represents all types of hearing loss. The 4FAHTL was determined for each ear, with each prisoner. Individual prisoner’s better and worse ears were then identified.

The prison population sample (n=109) mostly comprised persons aged in their 20s or 30s, as displayed in Figure 3.1.1. Only 2 prisoners were aged over 50 years; 12 prisoners were aged over 40 years; the youngest prisoner in this study was aged 17 years.

Figure 3.1.1 Distribution of Age of Victorian Indigenous Prisoners across age groups. Note:– 107 prisoners aged 50 yrs or younger; 97 prisoners aged 40 yrs or younger.

Distribution of Ages
109 Victorian Indigenous Prisoners
(96 males and 13 females)

The prevalence of hearing impairment is the number of people who have a specific degree of hearing impairment, within a particular population. This can also be expressed as a percentage. Prevalence of hearing impairment was analysed amongst the 107 prisoners in the age-group “15-50 years”, to enable direct comparison with the Australian adult epidemiological study (Wilson 1999).
Results have been predominantly analysed for the whole group of Indigenous prisoners (within specified age ranges), rather than by gender, as there were only 13 females in the prison sample compared with 96 males.

3.1.1 Prevalence of hearing impairment by severity, in the better and worse ears (male and female prisoners).

The categories used for degree of hearing loss (or severity of hearing impairment) are:

<table>
<thead>
<tr>
<th>Category</th>
<th>dBHL Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slight</td>
<td>&gt; 15dB and &lt;25dBHL</td>
</tr>
<tr>
<td>Mild</td>
<td>≥ 25dB and &lt;45dBHL</td>
</tr>
<tr>
<td>Moderate</td>
<td>≥ 45dB and &lt;65dBHL</td>
</tr>
<tr>
<td>Severe</td>
<td>≥ 65dBHL</td>
</tr>
</tbody>
</table>

In the results analysis, the cutoff for defining the categories (of degree of hearing loss) was exactly at those boundary levels. For example, a 4FAHTL average of 24.5 was placed in the “slight” hearing loss category (was not rounded up to 25).

Table 3.1.1a. shows the prevalence of hearing impairment (dB hearing threshold average over 0.5, 1, 2, 4 kHz) in the better ear, for the 15-50 years age-group of indigenous prisoners in the study (107 prisoners, of whom 13 were females).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Better ear (dBHTL)</th>
<th>Total ≥25dB (Mild, Mod. &amp; Severe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian Indigenous Prisoners (n=107) (male and female)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slight</td>
<td>Mild</td>
</tr>
<tr>
<td>15-50 years</td>
<td>12.1%</td>
<td>5.6%</td>
</tr>
<tr>
<td>(13 prisoners)</td>
<td>(6 prisoners)</td>
<td>(0 prisoners)</td>
</tr>
</tbody>
</table>

| Australian Adults (male & female Persons) | | |
| 2.3% | 0.4% | 0.1% | 2.8% |
| (0.0-6.2) | |

In the recently published report “Listen Hear! The Economic Impact and Cost of Hearing Loss in Australia” published by Access Economics (Feb 2006). The report was commissioned by the Cooperative Research Centre HEAR and the Victorian Deaf Society (adult data was sourced from Wilson 1997 and Australian Hearing 2005).
The single point prevalence value of 5.6%, representing prisoners with significant hearing impairment in both ears (Table 3.1.1a. “better ear”) lies within the 95% confidence interval for the Australian adult population of (0.0-6.2), but only just. The single point prevalence value of 12.1%, representing prisoners with significant hearing impairment in at least one ear (Table 3.1.1b. “worse ear”) is significantly higher than the upper limit of the 95% confidence interval for the Australian adult population (0.7-9.7).

Table 3.1.1b. Prevalence (%) of hearing impairment in the Worse ear (average 0.5,1,2 and 4 kHz dBHL), by category of hearing loss. Source of Australian Adult prevalences “Listen Hear!” Report Feb. 2006. The 95% confidence intervals for the Australian adult prevalence values are given in parentheses (Wilson 1999).

<table>
<thead>
<tr>
<th>Age group</th>
<th>Worse ear (dBHTL)</th>
<th>Slight</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
<th>Total ≥25dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian Indigenous Prisoners (n=107) (male and female)</td>
<td></td>
<td>22.4%</td>
<td>9.3%</td>
<td>0.0%</td>
<td>2.8%</td>
<td>12.1%</td>
</tr>
<tr>
<td>(24 prisoners)</td>
<td>(24 prisoners)</td>
<td>(10 prisoners)</td>
<td>(0 prisoners)</td>
<td>(3 prisoners)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australian Adults (male &amp; female Persons)</td>
<td>3.2%</td>
<td>1.3%</td>
<td>0.6%</td>
<td>5.1%</td>
<td>(0.7-9.7)</td>
<td></td>
</tr>
</tbody>
</table>

The total prevalence rates of hearing loss ≥ 25dBHTL in the better ear (6% in prison sample), and in the worse ear (12% in the prison sample) are displayed in Figure 3.1.2; they are roughly double the prevalence rates in the Australian adult population.

Figure 3.1.2 Comparison of prevalence rates of hearing loss in prison sample and Australian adult population, in the better ear and the worse ear, where hearing averaged over the frequencies 0.5, 1, 2 and 4 kHz.
Note that the “total” prevalence values listed in Tables 3.1.1a and 3.1.1b, include the prevalence rates in the mild, moderate and severe categories of hearing loss only. The rate of prevalence in the “slight” hearing loss category is not included in the total, as the focus at this stage, is on those hearing impairments of 25dB or worse (≥ 25dB) deemed to be a significant level of hearing loss.

The degree of hearing loss amongst hearing impaired Indigenous prisoners (whether their hearing loss is mild, moderate or severe) is evident in Table 3.1.1a and Table 3.1.1b. Six subjects in the prison sample had a significant hearing loss in both ears; all of these 6 hearing impaired prisoners showed a mild degree of hearing loss in their better ear (Table 3.1.1a). That is, 100% of those Indigenous prisoners with significant hearing disability (≥25dB average hearing loss in both ears) had a mild degree of hearing loss. Thirteen subjects in the prison sample had a significant hearing loss in at least one ear (worse ear), see Table 3.1.1b. Of those 13 persons, 10 prisoners showed a mild degree of hearing loss in their worse ear, and 3 prisoners showed a severe degree of hearing loss in their worse ear. That is, 77% of those Indigenous prisoners with significant hearing impairment in at least one ear, had a mild degree of loss, and 23% of prisoners had a severe degree of hearing loss.

### 3.1.2 Prevalence of hearing impairment, by severity and gender

Because of the small number of female Indigenous prisoners assessed (n=13), a detailed gender analysis of the prevalence of hearing impairment in Victorian Indigenous prisoners has been restricted to male prisoners. See Tables 3.1.2a and 3.1.2b.

**Table 3.1.2a** Prevalence (%) rates of hearing loss in the Better ear (average 0.5, 1, 2 and 4 kHz dBHL), for Male Indigenous prisoners. Source of Australian Adult prevalences “Listen Hear!” Report Feb. 2006; Based on Wilson (1997) and Australian Hearing (2005)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Better ear (dBHTL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slight</td>
</tr>
<tr>
<td>Victorian Indigenous Prisoners (n=94) (males)</td>
<td></td>
</tr>
<tr>
<td>15-50years</td>
<td>12.7%</td>
</tr>
<tr>
<td>(12 males)</td>
<td>(6 males)</td>
</tr>
</tbody>
</table>

| Australian Adults (males) | 3.0% | 0.6% | 0.1% | 3.7% |

21
Table 3.1.2b Prevalence (%) rates of hearing loss in the Worse ear (average 0.5,1,2 and 4 kHz dBHL), for Male Indigenous prisoners. Source of Australian Adult prevalences "Listen Hear!" Report Feb. 2006; Based on Wilson (1997) and Australian Hearing (2005)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Slight (%)</th>
<th>Mild (%)</th>
<th>Moderate (%)</th>
<th>Severe (%)</th>
<th>Total ≥25dB (% Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victorian Indigenous Prisoners (n=94)</td>
<td>24.4% (23 males)</td>
<td>9.6% (9 males)</td>
<td>0% (0 prisoners)</td>
<td>3.2% (3 males)</td>
<td>12.8%</td>
</tr>
<tr>
<td>Australian Adults (males)</td>
<td>4.6%</td>
<td>2.1%</td>
<td>1.0%</td>
<td>7.7%</td>
<td></td>
</tr>
</tbody>
</table>

The average hearing level (0.5, 1, 2, 4 kHz dBHL), found in each ear of the thirteen female Indigenous prisoners, (whose ages ranged from 21 years to 47 years), is presented in Figure 3.1.3. All Indigenous prisoners who were at the women's prison DPFC, during March 2006, were tested in the study. It can be seen that only one female prisoner had an average hearing loss ≥25dB. All other women had average hearing levels that were better than 20dB.

Figure 3.1.3 Average Hearing Loss (dBHTL across 0.5,1,2,4 kHz) in 13 Female Victorian Indigenous prisoners, aged 20-50 years, in Right and Left ears.
3.2 Prevalence of high-frequency type of hearing impairment.

Up till now, the analysis of prevalence of hearing impairment has used the average of hearing thresholds at the four frequencies 0.5, 1, 2 and 4 kHz, sometimes termed the mid-frequency average threshold, referring to the mid frequencies of the speech spectrum, (Davis 1999). However, this “mid-frequency” average does not show the extent of hearing impairment in the high-frequency portion of the speech spectrum. The prevalence of hearing loss in the high-frequency region of speech, was summarised by focusing on the frequencies 4000Hz and 6000Hz, deemed to be the established frequencies for noise induced hearing loss (Murray and LePage 2001). The maximum value hearing threshold obtained at either 4000Hz or 6000Hz (max. value at 4 or 6 kHz), was identified in each ear, for each individual. The prevalence of significant, high-frequency hearing impairment amongst Indigenous prisoners is displayed in Figure 3.2, for the “better” ear (20%), and the “worse” ear (36%) for the prisoner age-group 17-50 years (107 prisoners).

**Figure 3.2 Prevalence of High Frequency Hearing Impairment ≥ 25dBHL.**  
in Better and Worse ears (Max.HTL at 4 or 6 kHz)

<table>
<thead>
<tr>
<th>Severity ≥25dB (Max.HTL 4, 6 kHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Better ear</td>
</tr>
<tr>
<td>20%</td>
</tr>
</tbody>
</table>

107 Victorian Indigenous Prisoners  
(94 males and 13 females) aged 17-50 years  
Prevalence of High Frequency Hearing Loss  
Indigenous Prisoners aged 17 to 50 years
3.2 Comparison of high-frequency median hearing thresholds in the Indigenous prison sample with population norms (by age-group).

Hearing thresholds measured in the prison sample were compared to the age-based norms presented in the Australian Standard Statistical distribution of hearing thresholds, to further examine the nature of the high-frequency hearing impairment in the prison sample. Median hearing thresholds in sample populations are compared sometimes, rather than mean hearing thresholds, because of the nature of the distribution of hearing impairment which is not normal, but lognormal (Davis 1999, AS ISO 7029-2003). To maximize the prison sample size, median values were calculated from the combined set of both the right ear and the left ear hearing thresholds. Age groups analysed were 17-29 years and 30-39 years; this comprised 97 of the 109 indigenous prisoners. It was not meaningful to analyse the older 40-49 yr old age group as there were too few prisoners (n= 10). Figures 3.3.1 and 3.3.2 show the median and 90th percentile values of prisoner hearing thresholds across frequencies 2, 3, 4, 6 and 8 kHz, for the two age groups 17-29 yrs and 30-39 yrs, respectively. They are compared with the median thresholds and 90th percentile values for otologically normal adults aged 20 yrs, 30 yrs and 40 yrs.

Figure 3.3.1 Comparison of high-frequency median hearing thresholds in Victorian Indigenous prisoners aged 17-29 years, with otologically normal 20 year old adults (AS ISO 7029-2003).
In both Figure 3.3.1 and Figure 3.3.2 the “notched” configuration around 4kHz and 6kHz is obvious in the median values of the prisoners compared with the age-matched norms. A sensorienural “noise notch” audiogram configuration is consistent with noise exposure and damage to the inner ear.

**Figure 3.3.2** Comparison of high-frequency median hearing thresholds in Victorian Indigenous prisoners aged 30-39 years, with otologically normal 30 year old and 40 year old adults (AS ISO 7029-2003).

Table 3.3 presents the number of prisoners whose high frequency thresholds (Max. HTL at 4 or 6 kHz), in at least one ear (worse ear), were poorer than the 90th percentile for their age, using norms for 20 and 30 year old males from the 2003 Australian Standard (AS ISO 7029-2003). The analysis found that 7 of the 9 prisoners (78%) aged 17-20 years had a high-frequency threshold which was poorer than the 90th percentile norm for a 20 year old male (at 6kHz); in the group aged 21-30 years, there were 23 of the 52 prisoners (44%) with a high-frequency threshold that was poorer than the 90th percentile norm for a 30 year old male (at 6kHz). Analysis for prisoners aged over 30 years was not possible, as the high-frequency norms for a 40 year old, are significantly higher than norms for a 30 yr old, and as such are not appropriate comparisons for prisoners aged in their early thirties.
Table 3.3  Percentage (%) of Victorian Indigenous prisoners in groups aged 17-20yrs, and aged 21-30yrs, whose high-frequency hearing thresholds, dBHL (Max.HTL 4 or 6 kHz), in at least one ear, were poorer than the 90th percentile for otologically normal 20 year old and 30 year old adults, respectively.

<table>
<thead>
<tr>
<th></th>
<th>4kHz HTL</th>
<th>6kHz HTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Norms: age 20 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90th Percentile</td>
<td>11dB</td>
<td>12dB</td>
</tr>
<tr>
<td>Male Norms: age 30 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90th Percentile</td>
<td>14dB</td>
<td>16dB</td>
</tr>
</tbody>
</table>

Age group: 17-20 years
9 Victorian Indigenous Prisoners (n=9)       (78%)
7 prisoners with (Max.HTL 4,6 kHz) poorer than 12dB, 90th percentile at 6kHz

Age group: 21-30 years
52 Victorian Indigenous Prisoners, (of whom 6 were aged 30yrs). (n= 52)      (44%)
23 prisoners with (Max.HTL 4,6 kHz) poorer than 16dB, 90th percentile at 6kHz

3.4 Prevalence of conductive type of Hearing Impairment associated with middle ear disease.

A conductive component to a hearing impairment is defined here as the presence of an average air-bone gap (ABG) of greater than or equal to 15dB (≥15dB HL), over frequencies 0.5, 1, and 2 kHz. There had to be an ABG of 15dB or greater, (over 0.5, 1 and 2 kHz) in one or both ears, to ascribe any diagnosis of conductive component. Individuals who did not have such an ABG were considered to have a sensorineural type of hearing impairment. Prevalence of conductive hearing loss was analysed in this way in the UK National Study of Hearing (Browning & Gatehouse 1992). There was a lack of any comparative Australian adult population studies, on prevalence of conductive hearing loss and middle ear disease. The British adult study found a considerable prevalence of Chronic Otitis Media (COM) with perforated eardrums (defined as perforated eardrum with active COM, or with inactive COM). None of the Indigenous prisoners were found to have a perforated eardrum in either ear. The conductive impairments were analysed in three groups, as described by the subscripts in Table 3.4.

The Victorian Indigenous prisoner sample showed a prevalence value for conductive hearing impairment (inclusive of COM) of 7.3% compared to 6.8% in UK adults. The prisoner prevalence value lies within the upper prevalence value determined from the 95% confidence intervals. As such, the rate of conductive hearing impairment in Victorian Indigenous prisoners is within the general adult population (UK) prevalence range (age matched).
Table 3.4 Prevalence (%) of Conductive hearing impairment (ABG of ≥15dB averaged over 0.5, 1, 2, kHz) in one or both ears for Victorian Indigenous prisoners (n=107), and United Kingdom adults (source Browning et al 1992), by age group 18-40 years. The 95% confidence intervals for the UK prevalence values are given in parentheses.

<table>
<thead>
<tr>
<th>Age group 15-40yrs</th>
<th>Victorian Indigenous Prisoners</th>
<th>United Kingdom</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n=107)</td>
<td></td>
<td>15-40 years</td>
</tr>
<tr>
<td>Number prisoners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Unilateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conductive loss:</td>
<td>7</td>
<td>1.6% (0.6-2.6)</td>
</tr>
<tr>
<td>Bilateral</td>
<td>0</td>
<td>1.5% (0.5-2.5)</td>
</tr>
<tr>
<td>Conductive loss:</td>
<td>0</td>
<td>0.3% (0.1-0.5)</td>
</tr>
<tr>
<td>Prevalence</td>
<td>7.3%</td>
<td>1.6% (0.6-2.6)</td>
</tr>
<tr>
<td>(apart from Chronic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Otitis Media, COM)</td>
<td></td>
<td>1.5% (0.5-2.5)</td>
</tr>
<tr>
<td>COM involving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>perforated eardrum</td>
<td>0%</td>
<td>2.5% (1.0-4.0)</td>
</tr>
<tr>
<td>Active COM</td>
<td></td>
<td>2.5% (1.0-4.0)</td>
</tr>
<tr>
<td>Inactive COM</td>
<td></td>
<td>0.9% (0.2-1.6)</td>
</tr>
<tr>
<td>Total prevalence</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inclusive COM</td>
<td>7.3%</td>
<td>6.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sum of “upper” prevalence values: 11.2%

UK subscripts 1= otosclerosis group; 2= healed OM group; 3= Eustachian tube dysfunction group

Results from the Victorian prison study showed permanent sensorineural impairment in all of the 6 significantly impaired “better ears” (100% were sensorineural). In the 13 significantly impaired “worse ears” there were 6 sensorineural and 7 conductive-mixed types of hearing loss (predominantly conductive impairment with sensorineural component, ie mixed type of impairment). In the prison sample there were no ears which showed an entirely conductive impairment; they all had a sensorineural component, typically a high-frequency sensorineural hearing loss. In the worse ears, there was roughly the same proportion of sensorineural impairment as conductive (mixed) impairment, (ratio 0.9:1). The UK National Study of Hearing also found this sized ratio of sensorineural versus conductive impairment in the worse ear of the 18-40 year age group (Browning and Gatehouse 1992). The UK study found much more sensorineural than conductive impairment in the better ear (4:1 ratio).
3.5 Tympanometry results (middle ear function test)

Results of tympanometry (objective test of middle ear function) indicated that all eardrums were intact (no perforated eardrums) amongst Victorian Indigenous prisoners. In contrast, the British study found a 3.4% prevalence of chronic otitis media (COM) involving perforated eardrums, in the otoscopic findings of the 18-40 years age group of the UK adult population; with upper prevalence value of 5.6% as indicated by the 95% confidence interval (see Table 3.4).

Tympanograms were classified according to the recognised Jerger types, which are described below (Jerger et al 1972):

Type A: consistant with normal middle ear function;
Type As: consistant with normally air-filled middle ear, and abnormally reduced middle ear compliance;
Type Ad: consistant with normally air-filled middle ear, and abnormally high middle ear compliance;
Type C: consistant with reduced middle-ear air pressure (retracted eardrum) and normal compliance;
Type B: consistant with markedly reduced, middle ear mobility (for an intact eardrum condition).

**Figure 3.5** Prevalence of Tympanogram types amongst 109 Victorian Indigenous prisoners (where tympanometry is a test of Middle ear function)
Figure 3.5 shows the prevalence of the different tympanogram types amongst the 109 Victorian Indigenous prisoners. Whenever a prisoner had a different type of tympanogram in each ear (indicating varying middle ear conditions in each ear), then the type recorded in Figure 3.5 was the tympanogram which indicated the potentially most seriousness middle ear condition. For example, an individual with a Type B in one ear and a Type A in the other ear, was counted as a prisoner with a Type B tympanogram in one or both ears. Of the 4 prisoners with Type B tympanogram in one or both ears, 1 prisoner had bilateral Type B and 3 prisoners had unilateral Type B tympanograms. There were 8 prisoners with a Type C tympanogram in one or both ears, 4 of whom had a bilateral Type C, and 4 prisoners had a unilateral Type C with other ear Type A. There were 10 prisoners with a Type Ad tympanogram in one or both ears, 8 of whom had unilateral Type Ad with Type A in other ear, and 2 prisoners with bilateral Type Ad tympanograms.

Looking at Figure 3.5 it can be seen that 75% of prisoners had Type A tympanograms consistent with normal middle ear function in both ears. Almost ninety percent (89%) of prisoners had normally air-filled middle ears (75% Type A, 5% Type As and 9% Type Ad). Reduced middle ear air-pressure as indicated by a Type C tympanogram (typically associated with a cold), was measured in 7% of prisoners. There were 14% of prisoners with a Type As or Type Ad tympanograms. Most prisoners who had a Type As tympanogram (abnormally reduced middle ear compliance) also showed a slight low-frequency conductive hearing loss in that ear. Type As tympanograms are consistent with the condition of tympanosclerosis (scarring of the eardrum), and typically occur when there has been a history of recurrent ear disease (ASA 2001).

The Type B tympanogram was measured in one or both ears of 4% of prisoners. That is 4% of prisoners had tympanometric results consistent with a serious middle ear condition, requiring medical investigation and typically also associated with conductive hearing impairment. Four of the five ears with a Type B tympanogram, had an associated significant conductive hearing impairment. The British National Study of Hearing (Browning et al 1992) found the prevalence of abnormal but intact eardums was roughly 10% (95% CI: 8.6 to 14.4) in the 18-40 years age group. The upper limit of the 95% confidence interval in the UK adult population is similar to the prevalence of the Type As & Type Ad tympanograms in the prison sample (14%). It is unclear, though, whether the UK figures include the prevalence of retracted eardrums in their “abnormal intact eardrum” category. Unfortunately there is a paucity of adult tympanometry studies to which the prison tympanometry findings can be compared.
3.6 History questionnaire findings and qualitative data: Self reported hearing disability, ear trouble, noise exposures and tinnitus.

The prevalence of hearing disability, ear trouble (adult & childhood), noise exposure and tinnitus, reported by Victorian Indigenous prisoners is summarised in Figure 3.6.1. This information was obtained from the history questionnaires (see Appendix B i) completed by the audiologist in a face to face setting with each of the 109 prisoners in the study.

**Figure 3.6.1** Self-Reported hearing disability, ear trouble, noise exposure and tinnitus reported by 109 Victorian Indigenous prisoners

![Reported Hearing Disability, Ear trouble, Noise Exposure & Tinnitus by 109 Victorian Indigenous Prisoners (13 female)](image)

Almost one in two prisoners (48% of prisoners) reported ear trouble, where this referred to earache (pain in the ear) or to some form of ear infection. Earache was reported roughly twice as often as ear infections, and this is represented by the line division on the stacked bar graph in Figure 3.6.1. When asked about childhood ear health problems some of the prisoners couldn’t remember, however, 41% of prisoners reported ear trouble as a child.

When prisoners reported hearing trouble, they were asked if this problem occurred sometimes or alot. The line division on the bar labelled “Hearing trouble” in Figure 3.6.1 indicates these proportions, with the larger portion referring to reported hearing trouble “sometimes”; the small cap on the stacked bar graph is the reported hearing trouble “alot”. In total 58% of prisoner reported having hearing trouble sometimes, with 4% of prisoners reporting alot of hearing trouble.
The UK National Study of Hearing provides some comparative figures on the amount of hearing disability reported in the general adult population (18-80 years). Davis (1997), director of the UK National Study of Hearing, reported hearing disability in 15% adults of “as shown by having at least slight difficulty hearing in quiet”. Davis (1997) also said that “one in four people report that they have great difficulty hearing what is said in a background of noise”.

There have been few studies of reported disability in the Australian Indigenous population. One study was undertaken in 1991 in Taree NSW, which investigated reported disability in 907 Indigenous residents. Virtually nothing is known about the overall level and types of disability among Indigenous people in other parts of Australia (Thomson et al 2004). The Taree study found that 8.4% of Indigenous residents reported hearing loss (age data not available).

Examples of comments made by Victorian Indigenous prisoners who reported hearing trouble:
- Has to ask “What did you say?” (almost one in three prisoners of those who reported hearing trouble, said they needed repeats)
- “People think I’m being a smart arse when I say I didn’t hear you”.
- Has to be close to speaker
- Has to concentrate to hear,
- Needs to see the person’s face; has to watch a person’s mouth
- Trouble hearing in background noise
- “I hate it when people talk with their head down”.
- Problems if person talks softly
- Pretends he hears
- Needs people to talk clearly
- Avoids being in groups of people
- “Some people get pissed off with me when I ask them to speak loudly”.
- “Can’t hear my girl on the phone; it affects our relationship”.
- “Got into trouble ’cos I didn’t hear what the prison guard told me to do”.

The history questionnaire was expanded slightly following the third prison visit, (after testing 27 prisoners) when it became clear that the prisoners were generally willing to discuss their hearing problems with the audiologist. The expanded questionnaire was used with 82 Indigenous prisoners over 12 prison visits. An analysis of those situations within the criminal justice system where reported hearing difficulty occurred, was undertaken with 82 Victorian indigenous prisoners. Figure 3.6.2 shows the percentages of prisoners (n=82) who reported hearing disability in these five areas: trouble hearing other prisoners (20%); trouble hearing prison staff (24%); trouble hearing announcements over the prison public address system (7%); trouble hearing in court (26%); trouble hearing the police (1%). Some prisoners (17%) had trouble hearing in multiple situations which arise within the criminal justice system.
The majority of the 109 Indigenous prisoners, one hundred prisoners (92%), reported exposure to loud noise. This is consistent with the prevalence of high frequency, sensorineural “noise notch” hearing loss measured in this investigation. Roughly a quarter of prisoners reported exposures to multiple types of loud noise. Looking at Figure 3.6.1 the line divisions on the stacked bar labelled “Noise exposure” refer to the broad proportions of types of noise exposures: around a quarter of prisoners reported exposure to gunfire; about a third reported occupational noise exposure (predominantly factory and/or farm work); and approximately a third of prisoners reported recreational noise (loud music).

Tinnitus (noises or ringing in ears or head) was reported by almost three quarters (72%) of the 109 Victorian Indigenous prisoners. Most prisoners who reported tinnitus, said they experienced tinnitus “sometimes” (61%), and 11% of prisoners reported having tinnitus “alot”. These proportions are indicated by the line division on the stacked bar labelled “Tinnitus” in Figure 3.7.1. Based on the UK National Study of Hearing, the prevalence of tinnitus which is of a level comparable to the category “sometimes” (used in the prison study), occurs in about 35% of adults in the general UK population (Coles 1997). This prevalence value of 35% referred to adults who “remember an experience of tinnitus of some type or duration at some time; while many of these are not troublesome, even the non-spontaneous and short duration ones appear to be a nuisance to some of the people experiencing the tinnitus.” It is evident that a much bigger proportion of prisoners reported tinnitus “sometimes” than reported in the general adult population in the UK. This may be a reflection of the noise exposure history reported extensively by prisoners.
Around one in ten prisoners (11%) reported they experienced tinnitus “alot”, which would appear to be similar prevalence to that reported in the general population. Based on the UK National Study of Hearing, the prevalence of tinnitus which is of a level comparable to the category “alot” (used in the prison study), has been reported at about 10% of adults (Coles 1997). This prevalence value of 10% refers to adults who “appear to have or have experienced spontaneous tinnitus lasting over 5 minutes”; (also termed PST prolonged spontaneous tinnitus).

3.7 Results obtained at each prison location.

To provide an indication of the findings at each of the five prison locations involved in this project, a prison-by-prison summary of results is contained in Appendix C. However, sample sizes at individual prisons are generally too small for detailed prevalence analysis. The purpose of the results summarised by prison location, is to provide evidence that the overall findings of this investigation into hearing impairment amongst Indigenous prisoners (magnitude of hearing loss, noise induced hearing loss, and middle ear status) generally relate to each of the Victorian prisons in the project. For each of the five prisons, PPP, DPFC, LODDON, FULHAM and BARWON, these three sets of results are shown in Appendix C:

i. Hearing test results for prisoners at each of the 5 prisons locations:
   a. Average mid-frequency hearing (4FAHTL), better and worse ears;
   b. High-frequency hearing loss (Max.HTL 4, 6 kHz), right and left ears
ii. Tympanogram (middle ear function test) results, by total ears, at each prison.

Loddon Prison and the Dame Phyllis Frost Centre (women’s prison) had no Indigenous prisoners with significant hearing disability (significant hearing impairment in both ears). It should be remembered that apart from Port Phillip Prison (where 45 prisoners were tested), the numbers of Indigenous prisoners tested at each prison were small (less than 20 persons) at each prison. Of the six Indigenous prisoners with significant hearing disability, four were located at Port Phillip Prison, one at Fulham Correctional Centre and one at Barwon Prison. A further four prisoners at Port Phillip Prison, another one at Fulham Correctional Centre and one prisoner at Barwon Prison had a significant hearing impairment in one ear. There was one female prisoner at DPFC with a significant hearing impairment in one ear. Loddon Prison did not have any Indigenous prisoners who had a significant hearing impairment in either ear.

Evidence of high-frequency, sensorineural hearing loss was measured amongst Indigenous prisoners at all of the prison locations, with the least amount occurring at the women’s prison, DPFC.

Tymanomometry results indicated generally healthy middle ear function in a large number of the Indigenous prisoners at each prison location. Only Port Phillip Prison and Barwon Prison held Indigenous prisoners with Type B tympanograms (consistent with a serious middle ear condition).
4. DISCUSSION

4.1 Discussion of results and implications for the Victorian Correctional System

The results of the investigation into hearing impairment amongst Victorian Indigenous prisoners have been analysed extensively in this report, and are summarised and listed in this section from 1. to 9.

1. The middle ear function test results (tympanometry) showed that all Victorian Indigenous prisoners in the study had intact eardrums, bilaterally. Tympanometry results indicated almost ninety percent of prisoners had normally air-filled middle ears. The Type B tympanogram, indicating markedly reduced middle-ear mobility requiring medical investigation, occurred in 4% of prisoners (in one or both ears).

2. The prevalence of conductive hearing impairment in Victorian Indigenous prisoners was 7%, which was similar to the prevalence found in the general adult population in the United Kingdom (age matched).

An unexpected finding from this investigation, was the small numbers of subjects with significant conductive hearing loss amongst Victorian Indigenous prisoners, and the substantial amount of normal tympanometry results (middle ear function test). These findings were comparable to the prevalence rates found in the general UK adult population. Audiological studies on the prevalence of hearing impairment amongst adult populations are scarce, and there is a particularly marked absence of such studies of Indigenous adults. The high prevalence of ear disease, particularly otitis media, often reported amongst Australian paediatric Indigenous populations, was not found in this adult study of Victorian Indigenous prisoners. It has been reported that the prevalence amongst Indigenous children, of chronic middle ear disease and associated mild to moderate conductive hearing impairment, can vary significantly across different regions of Australia. It is likely that the prevalence of conductive hearing loss and middle ear disease in adults, would also vary amongst Indigenous adults in different parts of Australia.

This study identified hearing impairment amongst Victorian Indigenous prisoners at the prevalence rates described below.

3. 6% of Victorian Indigenous prisoners showed a mild hearing loss in both ears (average 0.5, 1, 2 and 4 kHz HTL). When compared to the 95% confidence intervals for population prevalence of hearing impairment in an age-matched Australian adult population, 95% CI (0.0-6.2), the prevalence figure of 6% is just on the edge of the highest expected prevalence (see Table 3.1.1a.).
4. When considering hearing impairment in the worse ear (see Table 3.1.1b), more than one in ten prisoners (12%) had a hearing loss of at least a mild degree compared with a 5% prevalence rate in an age-matched Australian population. The prevalence of significant hearing loss in at least one ear, amongst Indigenous prisoners was larger than the upper limit of the 95% confidence interval (0.7-9.7), in an age-matched Australian adult population (Wilson 1999).

Whilst understanding that hearing loss in the “better ear” provides an indication of functional hearing, this does not mean that a hearing impairment in one ear can be dismissed as inconsequential. A hearing impairment in one ear produces increased problems understanding speech in adverse listening conditions, compared with a normally hearing person. Environments that are excessively noisy, highly reverberant, have competing speech, and/or have the primary talker some distance from the listener are all adverse listening conditions. Hearing loss in one ear also interferes with the ability to localise the direction of a sound source. Recent research has identified substantial, perceived hearing disability amongst people with unilateral hearing loss (Power et al 2006). Misunderstandings in communication which may occur when a person has a unilateral hearing impairment or a mild hearing disability, can sometimes be unfairly blamed on the hard of hearing person, who may be then mistakenly labelled as being rude, lacking intelligence or having a generally uncooperative attitude.

5. Hearing loss was found to be predominantly mild in nature, although almost a quarter (23%) of those prisoners with hearing loss, experience a loss that is severe or worse (≥65dBHL) in at least one ear (Table 3.1.1b).

In Australia, a large study of NSW prison inmates found that the hearing acuity of prisoners was poorer than a normative Australian population, when measured using the objective, evoked otoacoustic emissions (OAEs) technique (Murray et al 2004). The study compared mean and 95% CI data (using a defined OAE parameter) for the NSW prison group, with Australian population norms, by age-group. The presence of evoked OAEs eliminates all but a mild hearing loss. Low level OAEs (through a normal functioning middle ear) can indicate inner ear damage which is not yet detectable with measurement of hearing thresholds. As evoked OAEs do not detect the threshold of hearing, the findings are not a description of the degree of hearing loss amongst NSW prisoners (see discussion of OAEs in section 4.2). Overseas studies of hearing impairment in prison populations (involving pure tone audiometry) have used a wide assortment of criteria to define hearing impairment, making it difficult to draw meaningful comparisons. American studies undertaken in the 1970s & 1980s generally reported the prevalence of hearing loss in prison inmates as being higher than in
the general population. Of those few prison studies which measured hearing thresholds, (rather than a pass/fail hearing screening test), some used a very low “fence” of 15dBHL, rather than a 25dB HL “fence”. Consequently the reported prevalence rates included persons with borderline-normal hearing (15dBHL), and “slight” hearing loss (>15dB and <25dBL). A New Zealand study of Maori prisoners reported 83% of prisoners with a hearing loss of 15dB or more (Bowers 1986). A small American study of 34 prison inmates (Jacobson et al 1989) found 29% presented with some degree of hearing impairment.

A study of 50 urban Indigenous adults in Brisbane (Ward 1991, Australian Indigenous HealthInfoNet) found the prevalence of hearing loss (in one or both ears) was 36%, predominantly in the “slight” hearing loss category. Amongst Victorian Indigenous prisoners, the prevalence of hearing loss > 15dBHTL in both ears was 18%, and in at least one ear was 35% (see Tables 3.1.1a. and 3.1.1b). That is, around a third (35%) of Victorian Indigenous prisoners had a hearing loss exceeding 15dBHL in one or both ears. Whether the prevalence rate of 35% is high, compared with the general Australian adult population cannot be determined, as there is no large adult population prevalence study which reports prevalence of hearing loss exceeding 15dB HL, including 95% confidence intervals.

In addition to the prevalence of average mid-frequency hearing loss, measured over the middle portion of the speech spectrum (0.5, 1, 2 and 4 kHz), there was also a substantial prevalence of high-frequency hearing impairment amongst Victorian Indigenous prisoners. As discussed in the introduction section, a high-frequency type of hearing impairment reduces the ability to hear many consonants in speech (such as “s”, “th” and “f”), particularly in environments where there is competing background noise.

6. More than a third of Victorian Indigenous prisoners (36%) had a significant high-frequency hearing impairment in one or both ears (Max.HTL 4, 6 kHz). See Figure 3.2.

7. The comparison of high-frequency median hearing thresholds (frequencies 2, 3, 4, 6 and 8 kHz) in the Victorian Indigenous prisoner sample, with population norms (by age-group), showed an obvious sensorineural “notch” configuration around 4 and 6 kHz. See Figures 3.3.1 and 3.3.2. This provides clear evidence of high-frequency hearing loss consistent with noise exposure amongst Victorian Indigenous prisoners.

8. Table 3.3 shows the large percentage of Indigenous prisoners whose high-frequency hearing thresholds were below the 90th percentile for their age, in at least one ear: 78% of prisoners aged 17-20yrs were below the 90th percentile norm for a 20 year old, and 44% of prisoners aged 21-30 years were below the 90th percentile norm for a 30 year old male.
When this extent of high-frequency hearing loss is considered in combination with the prevalence of hearing impairment (average 0.5, 1, 2, 4 kHz thresholds), it is clear the population of Victorian Indigenous prisoners is one which would have significantly more hearing problems than would be expected in the general Australian adult population. This view is consistent with the self-reported findings of the investigation:

9. Case history qualitative information, obtained in a face-to-face interview format, provided measures of hearing disability amongst Victorian Indigenous prisoners and self-reported ear health problems, noise exposure and tinnitus. See Figure 3.6.1.

a) Over half (58%) of the prisoners reported having hearing trouble sometimes, and another 4% of prisoners reported having a lot of hearing trouble. The UK National Study of Hearing, reported hearing disability in 15% adults “as shown by having at least slight difficulty hearing in quiet”.

b) The majority (92%) of the 109 prisoners reported having been exposed to loud noise (occupationally, recreationally or exposure to gunfire)

c) Around 60% of prisoners reported that they experienced tinnitus “sometimes”. In the UK, a reported 35% of adults in the general adult population “remember an experience of tinnitus” (Davis 1999). Around one in ten prisoners reported they experienced tinnitus “alot”.

Overall, the results of the investigation into hearing impairment amongst Indigenous prisoners in the Victorian correctional system provide evidence supporting the need for routine hearing assessment within the system. Whilst there was not extensive middle ear disease, the correctional system needs to be aware that there is a cohort of Indigenous prisoners who do have a significant hearing impairment in at least one ear. Results showed hearing disability (significant hearing impairment in both ears) to be largely of “mild” degree amongst Victorian Indigenous prisoners. The finding of widespread, significant high-frequency hearing impairment amongst the Indigenous prisoner sample, expands the overall level of hearing disability. Implementation of a hearing screening program would enable identification of those prisoners with significant hearing impairment and disability, leading to management of the prisoners’ individual needs (medical management, personal hearing aids, counselling and so forth).

More broadly, all correctional staff need to be mindful that some prisoners will have significant hearing impairment, and that a larger proportion of prisoners will have hearing problems in some listening situations. There needs to be a general response by the correctional system to ensure that their staff is informed about and aware of the implications of the “invisible handicap” of hearing impairment. This would assist the staff in their day to day communication with and management of prisoners who have hearing loss. Prison staff need to be sensitive to the fact that misunderstandings or non compliance with directions from staff may be due to hearing impairment, rather than recalcitrant or deliberately uncooperative behaviour by a prisoner.
4.2 Discussion of hearing screening tools

This section discusses the use an evoked otoacoustic emission (OAE) test to screen hearing, compared with the use of conventional pure tone audiometry (PTA) as the hearing screening tool in the Victorian Indigenous prison population. Pure tone screening is generally regarded as the most valid method of hearing screening in the adult population (Scudder et al 2003). However, PTA is a behavioural test requiring subjective responses from the subject, and it is much more time consuming to perform than an OAE test. This study found that the majority of Indigenous prisoners cooperated reliably with PTA.

Evoked OAEs are an objective physical measure of ear performance and do not require the active cooperation of the person tested. Adult evoked OAE testing takes about four minutes per person, and can be carried out in any quiet environment, less than 45 dBA (AS/NZS 1269.4:2005). Evoked OAEs do not detect the threshold of hearing. Therefore they are unable to differentiate between moderate, severe and profound levels of hearing loss. Once the possibility of hearing impairment had been detected by evoked OAEs, a full auditory assessment is necessary. There are two main types of evoked otoacoustic emissions, distortion product OAEs (DPOAEs) and transient OAEs (TOAEs).

Any type of hearing screening program requires a quiet test environment (below 45dBA). Click evoked otoacoustic emission tests, OAEs, were performed in NSW prisons in background noise levels of less than 45 dBA (Murray et al 2004). Audiological pure tone threshold testing was undertaken in background noise levels which were below 45 dBA, in the five Victorian prisons involved in this investigation. The time needed to measure pure tone thresholds in the non sound proof prison environment (approx. 30 minutes) was sometimes longer than the corresponding test time in sound proof conditions, as cessation of testing was necessary from time to time, when the background noise levels increased to unacceptable levels in adjacent areas (where day to day prison activities and functions were being performed); mostly interruptions were for less than a minute at a time. Ambient noise level variations would similarly increase the overall time for evoked OAE testing.

Primary hearing screening is a pass/fail procedure to identify those prisoners who need further diagnostic hearing assessment, to assist in the diagnosis of the degree, type and aetiology of hearing loss. Referral criteria and the system of management of all Indigenous prisoners who failed the screening would need to be clearly delineated. Personnel would include suitably trained staff to perform the hearing screening, together with qualified personnel to coordinate supervise and maintain the hearing screening program. The logistics of provision of follow-up audiological investigation of the primary hearing screening findings is not discussed here.
Otoscopy and tympanometry are recommended components of any hearing screening program whether it uses OAEs (Uchida et al 2006) or PTA. Otoscopic examination of the external ear canal and eardrum, identifies the likelihood of a normal / abnormal eardrum. Tympanometry, an objective test of middle ear function is quick to perform and provides useful information enabling conclusions to be drawn on the likelihood of normal / abnormal middle ear function. Screening with tympanometry alone produces an excessive over-referral rate and is not recommended. The inclusion of case history, otoscopic visual inspection and pure tone audiometry is recommended to provide adequate sensitivity to ear disease while minimising the false positive rate (Margolis et al 1987).

Screening for hearing loss in adults is generally associated with the provision of hearing conservation programs and involves pure tone audiometry (in accordance with the relevant OHS regulations). If the aim is not industrial hearing conservation, then a PTA screening protocol which utilised selected speech frequencies could be used with adults. Typically PTA screening includes the frequencies 1, 2 and 4kHz (Scudder et al 2003). However, as one in every two prisoners in the Indigenous prison population were found to have a significant high-frequency hearing loss at 4 or 6kHz, there would likely be a high failure rate for the 4kHz screening. Perhaps PTA screening along the lines of a hearing conservation program is what would be most suitable for the prison population, given the extent of evidence of high-frequency, noise induced hearing loss.

In terms of the relatively typical middle ear health status found amongst Victorian Indigenous prisoners, it would suggest that OAE hearing screening could be feasible screening tool. A prisoner population with a high proportion of Type B tympanograms &/or chronic otitis media would be unsuitable for OAE hearing screening.

When OAE measurements are recorded, the sound energy is conducted inwards and outwards through the middle ear system, but the degree to which the middle ear condition affects the OAEs level remains obscure (Uchida et al 2006). If a significant middle ear problem is present, then no OAE can be measured. The Victorian Indigenous prisoners were all found to have intact eardrums. The 75% of prisoners with tympanograms consistant with normal middle ear function would be appropriate candidates for OAE screening. OAEs would be absent from those 4% of prisoners with abnormal Type B tympanograms. The remaining 21% of prisoners had tympanograms consistant with air-filled middle ear systems, but which showed abnormal negative air pressure &/or abnormal middle ear compliance. These conditions can have a negative influence on OAE measurements, and consequently tympanometric assessment must always be taken into account when OAEs are used for estimation of cochlea function (Uchida et al 2006).
OAE measurements are associated with outer hair cell function within the cochlear of the inner ear; they do not measure actual hearing sensitivity. There is published evidence that cochlear damage may be present and detectable with OAE measurements before any changes in actual hearing thresholds are detected (LePage et al 2001; http://www.nal.gov.au/, Scudder et al 2003). This may cause some participants to fail an OAE screen when in fact they do not exhibit hearing loss. A small proportion (about 4%) of the adult population with normal hearing thresholds have absent OAEs, so there would always be some false positive results. Overall, when an OAE is absent or reduced there is some uncertainty about actual hearing sensitivity, and a subsequent hearing test is needed to determine whether any hearing loss is associated. When an OAE is found to be present, it rules out an inner ear hearing loss of greater than 30dB or 40dB depending on the type of evoked OAE equipment used (Transient OAEs or Distortion Product OAEs).

It would seem that OAEs do offer considerable potential as a hearing screening tool (in conjunction with otoscopy and tympanometry). A problem may be the extent of false positive results associated with OAEs. The Distortion Product OAE hand-held screener, used in the study of hearing screening tools by Scudder et al 2003, was found to lack predictive validity for actual hearing loss. A pilot study, which included the evaluation and comparison of findings from both PTA and OAE screening tools, would help to clarify the necessary protocols and components of a suitable hearing screening program for the Victorian Correctional System.
5. RECOMMENDATIONS

5.1 That education of correctional staff about the prevalence and implications of hearing loss, be instituted to assist with day to day management and rehabilitation of Indigenous prisoners, through optimisation of communication and listening environments.

Rationale
This study found roughly one in nine prisoners had at least a mild, hearing loss in one or both ears. In addition to this prevalence rate, it was found that one in three prisoners had a significant high frequency hearing impairment in one or both ears. Basic strategies for communicating with hearing impaired people which are relevant to correctional staff, include an understanding of the importance of initially gaining the attention of a hearing impaired person before speaking, then talking face to face, and avoiding background noise. Rather than “hearing when they want to” (a comment made by one prison officer during this study) it is much more the case that hearing impaired prisoners “hear when they can”.

5.2 That routine hearing screening of sentenced and remand male and female Indigenous prisoners be instituted in the Victorian Correctional System, including counselling about identified hearing impairment, and provision of personal hearing aids as required.

Rationale
This study found the prevalence of a significant hearing disability (better ear $\geq 25$dB) to be at the highest expected prevalence level in an Australian adult population (age matched). Prevalence rate was on the edge of the 95% confidence interval range, at the poorest end. Hearing impairment in at least one ear (worse ear $\geq 25$dB) was found to be significantly higher in the prison sample, compared to an Australian adult population, for mild, moderate and severe degrees of hearing loss. Hearing impairment in one ear can have a negative impact on communication. The study also found that high frequency hearing loss, consistent with what would be expected from noise exposure, was widespread. Frustration, isolation, loneliness and despair can occur with unrecognised hearing loss. This study identified that misunderstandings and confrontations had occurred between prisoners, and also between prisoners and prison officers, when hearing problems were not mutually recognised.
5.3 That the prevalence of hearing impairment amongst the non-Indigenous prisoners in the Victorian Correctional System, be measured to ascertain whether it is necessary to involve all prisoners in a program of hearing screening.

Rationale
It is quite likely that non-Indigenous prisoners would have a similar level of sensorineural hearing impairment as found amongst the Victorian Indigenous prisoners in this study.

5.4 That Department of Justice ensure that meeting areas in prisons are designed and acoustically treated to have good “acoustics”, with low levels of reverberation and background noise.

Rationale
Attention to the provision of adequate room acoustics will assist with ease of listening by any hearing impaired prisoners. This in turn will assist with communication and foster positive rehabilitation outcomes.

5.5 That consideration be given to the installation of sound field loudspeakers in meeting areas (for example in rooms where rehabilitation programs are held), to improve the signal to noise ratio of the presenter’s voice over any ambient noise.

Rationale
Research has shown that people with hearing loss need an increased signal to noise ratio, to understand speech, compared with a normally hearing person.

5.6 That protocols be established for all Victorian correctional facilities to ensure clear delivery of all announcements over the prison public address system.

Rationale
Hearing impaired people need to rely on visual facial cues when listening, which are not available with voices over a PA system.

5.7 That courtroom design be reviewed to ensure that a hearing impaired defendant can hear all proceedings.

Rationale
This study found evidence that many prisoners had difficulty hearing in the courtroom situation when spoken to from a distance. Typically the courtroom distance between magistrate and defendant was mentioned by prisoners as causing reduced audibility of the magistrate’s voice. Sound intensity decreases over distance, and it should also be...
remembered that hearing disability increases when the person is feeling worried or stressed.

5.8 That an investigation be conducted into the compliance of on-site prison industries with the Victorian Occupational Health & Safety regulations for industrial Hearing Conservation programs (AS/NZS 1269.4:2005). Basic components required by the OHS act include:

- Noise level assessment and noise reduction at the source;
- Noise dose measurements, received over time;
- Provision of, and education about, hearing protections devices;
- Reference and monitoring hearing tests (pure tone audiometry).

5.9 That a pilot study, designed to investigate and develop an appropriate hearing screening protocol for the prison population, be undertaken by the Department of Justice for the Victorian Correctional System. For example a pilot study could be designed, using otoacoustic emissions (OAEs), tympanometry and pure tone audiometry (PTA), which allow for evaluation of the level of correlation of the OAE findings with actual prisoner hearing loss (as measured by pure tone audiometry).

**Rationale**
This would assist in determining the efficacy and predictive validity of hand held OAE instruments as a hearing screening tool in the prison population.

**Further recommendations for other jurisdictions:**

5.10 That a commitment be made by correctional services organisations in all states and territories to undertake audiological research into the hearing status of Indigenous prisoners.

**Rationale**
Unlike the findings from this investigation of Victorian Indigenous prisoners, there may well be high prevalence rates of conductive hearing impairment and middle ear disease, amongst Indigenous prisoners in other parts of Australian, particularly remote regions, in addition to sensorineural hearing impairment.

5.11 That further research be commissioned, which uses representative adult population samples to audiologically assess the general prevalence of hearing impairment amongst Australian adult Indigenous populations.

**Rationale**
This would enable appropriate planning for provision of prevention and care of hearing disorders. This investigation into hearing impairment amongst Indigenous prisoners in Victoria, found a marked lack of any such audiological studies.
### APPENDIX A

**Audiologist Prison Visits 2006 and Number of Hearing Tests Performed:**  
SUSAN QUINN

<table>
<thead>
<tr>
<th>Visit</th>
<th>MONTH 2006</th>
<th>Number of Hearing Tests</th>
</tr>
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<tbody>
<tr>
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<tr>
<td></td>
<td><strong>FEBRUARY</strong></td>
<td></td>
</tr>
<tr>
<td>1)</td>
<td>Mondays 6(^{th})</td>
<td>Port Phillip Prison (Laverton)</td>
</tr>
<tr>
<td>2)</td>
<td>Monday 13(^{th})</td>
<td>Port Phillip Prison</td>
</tr>
<tr>
<td>3)</td>
<td>Monday 20(^{th})</td>
<td>Port Phillip Prison</td>
</tr>
<tr>
<td>4)</td>
<td>Monday 27(^{th}) Feb’06</td>
<td>Port Phillip Prison</td>
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<td></td>
<td></td>
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<tr>
<td>5)</td>
<td>Monday 6(^{th})</td>
<td>Port Phillip Prison</td>
</tr>
<tr>
<td>6)</td>
<td>Thursday 16(^{th})</td>
<td>Dame Phyllis Frost Centre</td>
</tr>
<tr>
<td>7)</td>
<td>Monday 27(^{th}) Mar’06</td>
<td>Dame Phyllis Frost Centre (women’s prison Deer Park)</td>
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<td></td>
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<tr>
<td>8)</td>
<td>Monday 3(^{rd})</td>
<td>Loddon Prison (Castlemaine)</td>
</tr>
<tr>
<td>9)</td>
<td>Monday 10(^{th})</td>
<td>Loddon Prison</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>10)</td>
<td>Monday 1(^{st})</td>
<td>Fulham Prison (Sale)</td>
</tr>
<tr>
<td>11)</td>
<td>Monday 8(^{th})</td>
<td>Fulham Prison</td>
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<tr>
<td>12)</td>
<td>Monday 15(^{th})</td>
<td>Fulham Prison</td>
</tr>
<tr>
<td>13)</td>
<td>Monday 22(^{nd})</td>
<td>Port Phillip Prison, (Laverton)</td>
</tr>
<tr>
<td>14)</td>
<td>Monday 29(^{th}) May’06</td>
<td>Barwon Prison (Geelong)</td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15)</td>
<td>Monday 5(^{th}) June’06</td>
<td>Barwon Prison (Geelong)</td>
</tr>
</tbody>
</table>

Total 15 prison visits  
Total number of prisoners tested = 109

(Approx 30 minutes per adult hearing test:- average 7 hearing tests per day visit)
HISTORY QUESTIONNAIRE

Name: 
Age: 
Date: 
Location: 

1.1) Do you have any trouble hearing / understanding what people say?  
   NO
   o  YES  sometimes  a lot
   o  Both ears  Right ear  Left ear

Comments

1.2 Do you have trouble hearing in prison?  Yes / No
   o  with staff
   o  with prisoners

1.3 Do you have trouble hearing in court?  Yes / No

1.4 Do you have trouble hearing with police?  Yes / No

2) Do you have any ear troubles?  NO / YES  Which ear(s)?  Right / Left / Both ears
   o  ear infections
   o  ear discharge
   o  ear pain
   o  ear operations
   o  Any ear troubles as a young child?  NO / YES

3) Have you been exposed to loud noise?  NO / YES
   o  Loud machinery
   o  Gun / rifle fire
   o  Loud Power tools
   o  Loud music

4) Do you have noises / ringing in your ears / head (tinnitus)?  NO / YES, which ear(s)?
   o  Right / Left / Both ears / Not sure
   o  Sometimes / Alot / All the time
1) **PORT PHILLIP PRISON, Victoria**

Hearing Impairment (average 0.5, 1, 2, 4 kHz)

45 Indigenous prisoners from Port Phillip Prison

4FAHTL: Better ear and Worse ear for each prisoner

High Frequency Hearing Loss, dB (Max 4, 6 kHz)

45 Indigenous prisoners from Port Phillip Prison

Maximum threshold at 4 or 6 kHz: LEFT and RIGHT ears
2) DAME PHYLILLIS FROST CENTRE, Victoria

Hearing Impairment (average 0.5, 1.2 and 4 kHz)
13 Female Victorian Indigenous prisoners
(comprised all female Indigenous prisoners at the
Dame Phyllis Frost Centre during March 2006)

High Frequency Hearing Loss, dB (Max 4, 6 kHz)
13 Indigenous prisoners from Dame Phyllis Frost Centre
Maximum threshold at 4 or 6 kHz: LEFT and RIGHT ears
3) LODDON PRISON, Victoria

Hearing Impairment (average 0.5, 1, 2, 4 kHz)
17 Indigenous prisoners from Loddon Prison
4FAHTL: Better ear and Worse ear for each prisoner

High Frequency Hearing Loss, dB (Max 4, 6 kHz)
17 Indigenous prisoners from Loddon Prison
Maximum threshold at 4 or 6 kHz: LEFT and RIGHT ears
4) FULHAM CORRECTIONAL CENTRE, Victoria

Hearing Impairment (average 0.5, 1, 2, 4 kHz)  
19 Indigenous prisoners from **Fulham prison**  
4FAHTL: Better ear and worse ear for each prisoner

![Bar chart showing dBHL Average Hearing level (0.5, 1, 2, 4 kHz) for each prisoner.]

High Frequency hearing Loss, dB (Max 4, 6 kHz)  
19 Indigenous prisoners from **Fulham Prison**  
Maximum threshold at 4 or 6 kHz: LEFT and RIGHT ears

![Bar chart showing dB HL (Max. 4, 6 kHz) for each prisoner.]
5) BARWON PRISON, Victoria

**Hearing Impairment (average 0.5, 1, 2, 4 kHz)**

15 Indigenous prisoners from **Barwon Prison**

4FAHTL: Better ear and worse ear for each prisoner

**High Frequency Hearing Loss, dB (Max 4, 6 kHz)**

15 Indigenous prisoners from **Barwon Prison**

Maximum threshold at 4 or 6 kHz: LEFT and RIGHT ears
TYMPANOMETRY (middle ear function test)
Results from each of the 5 prison locations

MIDDLE-EAR FUNCTION (Tympanograms)
90 EARS: 45 Indigenous prisoners from Port Phillip Prison

- 82% "Normal" middle-ears (Type A tympanograms)

MIDDLE-EAR FUNCTION (Tympanograms)
26 EARS: 13 female Indigenous prisoners from Dame Phyllis Frost Centre

- 85% "Normal" middle-ears (Type A tympanograms)

MIDDLE-EAR FUNCTION (Tympanograms)
34 EARS: 17 Indigenous prisoners from Loddon Prison

- 91% "Normal" middle-ears (Type A tympanograms)
MIDDLE-EAR FUNCTION (Tympanograms)

38 EARS: 19 Indigenous prisoners from Fulham Correctional Centre

- 81% "Normal" middle-ears (Type A tympanograms)

MIDDLE-EAR FUNCTION (Tympanograms)

30 EARS: 15 Indigenous prisoners from Barwon Prison

- 84% "Normal" middle-ears (Type A tympanograms)
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