

EFFECTS OF LOUD MUSIC ON HEARING

Hearing impairment and tinnitus (ringing in the ears or head noises) may impact on your enjoyment of listening to music. If you work in the music industry, job satisfaction and your ability to earn a living may also be affected.

Anyone who is exposed to loud sound (exceeding 80dB) is at risk of damaging his or her hearing. This includes:

- night club/hotel employees and patrons,
- users of personal listening devices,
- musicians (classical and rock),
- sound crews,
- recording engineers,
- dancers and aerobics instructors.

WHAT IS SOUND?

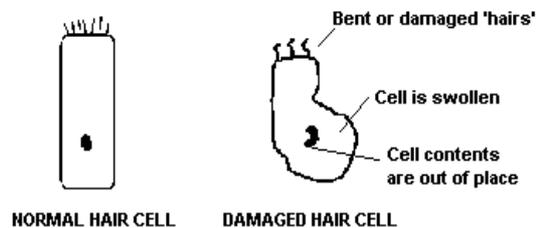
When air is mechanically disturbed, sound waves are created. Sound waves enter the ear canal causing the eardrum and a series of three small bones in the middle ear to vibrate. This vibration is carried further into the inner ear (or cochlea) which is filled with fluid. As the fluid vibrates, tiny hair cells in the cochlea sway and bend, resulting in the generation of electrical impulses which are carried to the brain via the hearing nerve. The brain interprets this as sound and characterises the sound by its pitch (frequency) and volume (intensity).

EFFECTS OF SOUND ON EARS

Ears were designed to process moderate levels of sound existing in our natural environment (e.g. quiet conversation). However, today we are often exposed to higher levels, for longer periods (e.g. rock concerts, power tools).

Temporary exposure to loud sound can overload the hearing system, resulting in symptoms of hearing loss and/or tinnitus, which often recover overnight. *If the exposure to the loud sound continues however, the damage to the hearing*

system that results is permanent, irreversible and will not respond to any medical or surgical treatment. This damage occurs at the level of the tiny hair cells in the cochlea and is known as hearing loss (nerve deafness).



High frequency hearing is affected first. With repeated exposure to loud noise, damage spreads to the lower frequencies.

Symptoms of Hearing Damage

Depending on its severity, people with noise induced hearing loss typically report varying degrees of:

- difficulty following conversation in a group
- difficulty following conversation in competing background noise
- difficulty following the television
- a lack of clarity of speech in a one to one listening situation
- distortion of music sound quality
- reduced tolerance to loud sounds
- tinnitus (see explanation below)

HOW MUCH IS TOO MUCH?

Occupational Health and Safety regulations have been established for heavy industry workers who are exposed to noise in their jobs. In the absence of any other rule, and because our ears don't distinguish between 'work noise' and 'having a

good time noise', this is how we determine safe levels of exposure to music.

OH&S 2004 (Noise) Regulations

These regulations state:

- For an **8 hour** period of exposure, an average of **85dBA** should not be exceeded, with a peak noise level never greater than **140dB(lin.)**.
- As the sound level *increases* by **3dB**, the safe period of exposure *decreases* by $\frac{1}{2}$.
- Therefore an average of **88dBA** should **not** be exceeded over **4 hours**; **91dBA** should **not** be exceeded over **2 hours** and so on.

NOISE DOSE LIMITS	
dBA Sound Level	Duration Per Day
94	1 hour
91	2 hours
88	4 hours
86	6 hours
85	8 hours

Source: Victorian Workcover Authority

The decibel (dB) table below compares some common sounds and shows how they rank in potential harm to hearing.

SOUND LEVELS AND HUMAN RESPONSE		
Common Sounds	Noise Level (dB)	Effect
Air raid siren	140	Painfully loud
Aeroplane taking off 100m away	130	
Pneumatic drill 10 feet away iPod at peak	110	Extremely loud
A night club dance floor	90-105	Very annoying
Heavy traffic	85	Hearing damage if exposure time > 8 hours
Noisy restaurant	70	Telephone use difficult
Normal conversation	60	Intrusive
Quiet office	40	Quiet

Sound Levels at Live Music Venues

Sound levels reaching the ear during a live performance will vary depending on:

- whether or not the music is **amplified** and by how much it is amplified
- the **size** and other physical/acoustic properties of the venue
- how **close** one stands to the speakers
- what **instrument** one plays.

HOW TO PRESERVE HEARING

Once you know the *volume* and *duration* of sound you are exposed to, it is a matter of calculating how much *attenuation* (reduction of volume) is necessary to ensure you are not being over-exposed. This will guide you in your selection of the appropriate hearing protection device.

Example: Todd plays in a rock band for an average of *4 hours* per day. Sound levels reach around *110dBA*. The 'safe' level of sound for a *4 hour* period of exposure is *88dBA* (see table). He therefore needs to find some hearing protection that gives him at least $110-88 = 22$ decibels of attenuation.

HEARING PROTECTION DEVICES

Many different types of hearing protection devices are available commercially. Most of these have been designed specifically for heavy industry workers, and may therefore be unsuitable for musicians' special requirements. **Musicians' Earplugs**, however, have been especially designed for the needs of musicians i.e. where the quality of sound still needs to be perceived, but at safer levels.

Musicians' Earplugs are custom made so as to be comfortable and discreet, whilst reducing the perceived echo or 'boomy' quality of the wearer's own voice (which may be related to an 'occlusion effect'). A special filter is placed in the earpiece to *attenuate* the frequencies more evenly. The resulting sound has a better balance of low and high frequency components, so that only the *volume* (intensity) and not the *quality* of the music are reduced.

Musicians' Earplugs are available in different degrees of attenuation. They will not, however, attenuate as much as the stronger industrial hearing protection devices (see below). Although initially a more costly option than disposable earplugs, Musicians' Earplugs are reusable for around *12 months*, after which point the earpieces need to be remoulded and the filters replaced.

In industrial settings, the most commonly worn **earplugs** are the one-size-fits-all, single use, disposable foam plugs. When rolled into a small cylinder and placed deeply into the ear canal they provide quite a lot of attenuation. Before the development of Musicians' Earplugs, they were the favoured method of hearing protection amongst musicians also.

Disadvantages, however, include:

- High frequencies are attenuated significantly more than low frequencies, resulting in a flatter, bassier quality to the music.
- Wearers may notice the occlusion effect, which is particularly troublesome for vocalists. Also, when worn for longer periods of time, earplugs may become uncomfortable.

Advantages include:

- They do effectively at reduce sound levels.
- They are easily obtainable at most pharmacies.

Earmuffs are available in varying degrees of attenuation. Generally, the more attenuating the earmuffs, the more tightly they clamp against the head, which decreases comfort of wear. Earmuffs, like earplugs, generally over-attenuate the high frequencies resulting in a reduction in quality of the music. Although often considered less cosmetically appealing than earplugs, earmuffs do effectively reduce sound levels.

PORTABLE MUSIC DEVICES

19% of students aged under 30 years own portable music devices. According to the Access Economics 'Listen Hear' report, 1 in 4 Australians using portable music devices are likely to develop permanent hearing loss caused by "excessive and damaging" audio levels. The combination of longer life batteries and an increased storage capacity encourages people with portable players to listen longer. Consequently, the ears are not given the chance to recover.

If a sound at 85 dBA can be safely heard for 8 hours, what level is that for an iPod? Noise dose limits for iPods vary, depending on what you are listening to your iPod with. The table below provides a guideline for safe iPod listening when iPod ear-buds are used.

NOISE DOSE LIMITS FOR IPODS			
% of Max. Vol. Control	Free-field Level dBA	Sound Equivalent	Duration Per Day
25%	65		Indefinite
30%	68		Indefinite
40%	73		Indefinite
50%	81		Indefinite
60%	87		4.5 hours
70%	92		1.6 hours
80%	98		23 minutes
90%	106		4 minutes
100%	111		1 minute

When listening to an iPod via insert earphones (such as the Etymotic ER-6is and Shure earphones), acoustic measurements indicate that levels are approximately 7 dB higher at the eardrum with these listening devices.

Source: Fligor BJ, Cox LC. (2004). Output levels of commercially available portable compact disc players and the potential risk to hearing. Ear Hear. 25:513-527.

Source: Fligor & Cox (2004)

WHAT CAN I DO TO PROTECT MY HEARING?

- Take regular breaks from your headphones to give your ears a rest.
- Turn down the volume a notch - even a small reduction in volume can make a big difference to the risk of damage to your hearing.
- Avoid using volume to drown out background noise, for example, the sound of the train or traffic.
- Invest in noise cancelling earphones. These help to decrease the temptation of increasing the volume.
- Determine if any volume control software is available for your personal listener.
- Avoid setting your volume at more than 60% of the maximum.
- Remember - If people around you need to shout for you to hear them, your music is too loud!

The Vicdeaf Rehabilitation and Information Team can come and talk to your music class or group on hearing loss prevention. Contact the Admin Officer on 9473 1111 for further details.

WHAT CAN BE DONE ABOUT SENSORINEURAL HEARING LOSS?

If hearing protection is incorrectly used or not used at all, the damage that results is **permanent**. As there is no medical cure for sensorineural hearing loss due to noise damage, hearing aids are fitted to provide access to the sounds that can no longer be heard unassisted by the damaged ear. Hearing aids do not restore normal hearing, but are of great help to many people and serve to enhance the remaining hearing.

WHAT CAN BE DONE ABOUT TINNITUS?

Any sound occurring in the ear or head that does not come from the environment is called tinnitus. Tinnitus has been described in many ways, for example, a 'ringing', 'buzzing', 'hissing', 'thumping' or a combination of sounds. Tinnitus can be a symptom of hearing damage caused by noise exposure. There are various management techniques that can be taught to people who are having difficulty coping with their tinnitus.

The Vicdeaf Rehabilitation and Information Team offer individual tinnitus therapy sessions, which involve the development of an individual tinnitus management plan. If you require any further information about: tinnitus, earplugs, or any other aspects of hearing loss please phone 1300 30 20 31 for automatic connection to your nearest centre.

Other Vicdeaf Information Sheets:

- *Our Ears and How we Hear*
- *Introduction to Tinnitus*
- *Noise, Hearing Protection and You*

Vicdeaf regularly updates our information sheets. To ensure that your information is current, or for further information about Vicdeaf and the services offered, please visit our website or contact us:

W: www.vicdeaf.com.au

Ph: 03) 9473 1111

TTY: 03) 9473 1199

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