Bridge

Department of Health

This Newsletter aims to promote communication between schools and the Student Health Service of the Department of Health

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Editorial

From the Editor

In the hustle and bustle of Hong Kong, we may encounter different sounds such as those from people's talking, car engine running, telephone ringing and television programmes etc. Many people will agree that noise is unwanted. We also know that noise may disturb students while they are doing their homework and communicating with others. However, many of us may not know about the impact of excessive noises on our hearing. We may think that the music we encountered during school activities or leisure such as from MP3 and MP4, is enjoyable and entertaining. In fact, such music may become a source of noise which may induce hearing damage.

In the feature article, the Audiologist of Student Health Service tells us how to "protect our hearing against noise". He shares with us the types of noises in our daily life, the hearing function of our ears and how noise damages our hearing. He also introduces the common sources of noise encountered by children and adolescents as well as the practical preventive measures. We hope that all of us can adopt good habits to protect our hearing so that we can enjoy the wonderful music, nature's sound and the fun of communicating with people.

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Protect Your Hearing Against Noise

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Feature Article

Introduction

Normal hearing is essential for development in various aspects of life such as acquisition of languages and other knowledge, social interaction and appreciation of music. Children and teenagers are susceptible to a wide range of agents that could damage hearing (e.g. noise, drugs, diseases, head injury) and some of them can be effectively prevented. We shall look at the type of noises in our daily life and hearing function of human ears and then find out how noise can damage hearing; common sources of noise encountered by children and teenagers; and practical preventative measures.

Loudness and frequency of sound

The loudness of sound can be measured in terms of decibel (dB), the larger the dB value, the louder is the sound. Healthy ears can hear sounds as soft as 5 dB (like the rustling of leaves in the breeze) and tolerate sounds as loud as 100 dB (such as disco music). Usually sounds that we hear from daily living are less than 75 dB and would not cause damage to our hearing. Noise can be defined differently in various contexts. Here, we define noise as any sounds that are undesirable to physical and mental health. Background noise exceeding 55 dB may cause annoyance and reduce performance in learning and work. Exposure to noise exceeding 85 dB for over 8 hours would be hazardous to hearing.

Loudness of sound in daily living

Sounds in daily living	Loudness level
Undisturbed sleep	Less than 30 dB
Conversation	30-65 dB
TV, home electrical appliances	Less than 75 dB

The frequency of sound can be measured in term of Hertz (Hz), the larger the Hz value, the higher is the frequency of sound. Human ears can hear sounds between 20-20000 Hz, the frequency range for speech is between 100-6000 Hz (mainly 500-4000 Hz).

If someone can only hear sounds louder than 26 dB within the frequency range for speech (500-4000 Hz), he/she can be regarded as hearing impaired. Normally children and teenagers can hear sounds as soft as 20 dB. Most men younger than age 40 and women younger than age 50 can hear sounds as soft as 25 dB.

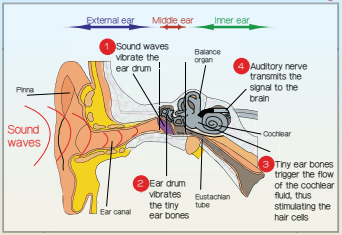
Examples of sounds of different frequencies

Frequency (Hz)	Examples
Low frequencies (lower than 1000 Hz)	Dog barks, knocking on doors, Vowels (/æ/ in cat , /u/in actual) in speech
Middle frequencies (between 1000-3000 Hz)	Consonants /p/ in pencil and /k/ in key
High frequencies (higher than 3000 Hz)	Ring tone of telephone; consonants /s/ in sea and /f/ in flower

Hearing function of the ears

Sounds pass through the external ear canal and vibrate the ear drum located at the end of the canal. The vibrations are then amplified by the chain of three tiny ear bones in the middle ear and transmitted to the cochlea in the inner ear. The vibrations trigger the flow of fluid within the cochlea, stimulating the hair cells in the cochlea. The hair cells actively moderate the vibration within the cochlea and so the vibration signal can be clear and precise. Hair cells also convert sounds into electrical signals which are then transmitted through the auditory nerve to the brain and then we can hear the sounds. The number of cochlea hair cell is fixed since we were born. The hair cells die gradually as we grow old and our hearing deteriorate with age. About 30% of people above age 65 can be classified as hearing impaired.

Structure of the ear and the mechanism of hearing



Noise can damage hearing

Excessive noise would cause damage and deformity of cochlear hair cells. Then the signal of sounds cannot be transmitted to the brain clearly and results in permanent sensorineural hearing loss. Noise can damage hearing in two ways:

1.Gradual hearing damage due to chronic noise exposure

In situation of high noise level, cochlear hair cells could be injured and could cause hearing loss. If the time of exposure is short or the level of noise is not too high, the hair cells may recover from the damage. If the noise exposure is long and repetitive or the noise level is too high, cochlear hair cells cannot recover, resulting in permanent hearing loss. So there are specified time limits for exposure to different noise levels:

Noise level and daily limits of exposure

Noise level (dB)	Daily time limit for exposure (without hearing protection)	Examples
>130	Reaching the threshold of pain	Firecracker
120	Dangerous even for a short period of time	Disco music
115	< 1minute	Rock concert
109	< 2 minutes	Car horn
106	3.75 minutes	Video game centre
103	7.5 minutes	Toy gun
100	15 minutes	Music through earphones (highest volume setting)
94	1 hour	Music through earphones (mid to high volume setting)
91	2 hours	Electrical drill
85	8 hours	Vacuum cleaner

Impulse noise (noise level rise and fall suddenly e.g. shooting, hammer, and firecracker) and fluctuating noise (noise level change drastically over time e.g. road traffic noise, rock music) are more damaging than continuous noise with the same noise level. Some people are more susceptible to noise damage, which may be related to poor recovery capacity of their cochlear hair cells:

- people already with sensorineural hearing loss
- people who smoke or use drugs that are detrimental to hearing (some antibiotics and chemotherapy drugs)
- people with malnutrition (deficiency of vitamin A, C or E)
- people with Hypertension and Diabetes

2.Instant acoustic trauma due to exposure to very loud noise:

Very loud impulse noise such as firecracker and shooting can kill cochlear hair cells within a very short time. In adults, noise as loud as 140 dB can cause permanent cochlear damage within a very small fraction of a second. Sounds cause stronger resonance in children's ears than that in adults' ears. Based on experimental results of young animals, noise level of 120 dB is already dangerous for young children, even for a very short duration of time.

Continuous high pitch ringing in both ears is usually the early sign for noise related hearing loss. Gradually, affected people would notice problem hearing other people when they speak very fast, when there are two or more people talking or in noisy situations. The language abilities of children are not yet mature and they are not able to guess the missing parts from the grammatical context. As a result, noise induced hearing loss can be more detrimental to children's communication. The part of cochlea that is responsible for hearing high pitch sounds is the most vulnerable. Hearing thresholds at 4000 Hz and 6000 Hz are usually affected first and most severely. People with noise

induced hearing loss would usually miss high frequency consonant in the final position of English word such as /s/ in bus, /f/ in self and /t/ in cat.

Noise induced damage on hearing is accumulative and may not always appear in teenage. Some problems will not arise until after 5 to 10 years of exposure. For example, if someone listens to music with his earphones in high volume setting since 13 years old, tinnitus and listening problem in noisy situation may arise when he is 21 years old. If the exposure prevails, his hearing would deteriorate to a level comparable to a 60 year-old man when he reaches his mid 30 ' s. In a survey involving 5249 children and teenagers between 6 and 19 years old, 12.5% have different extent of noise induced hearing problem, some of them were temporary and some were permanent.

Common sources of noise

The noises that students encountered in their daily activities can be potentially harmful to hearing e.g. practicing in a rock band, singing in a karaoke box, listening music with earphones with high volume setting. It is important for us to recognize the potential source of damaging noises.

Listening to music or other sounds with earphones (including MP3, MP4, mobile phone)

Based on the WHO Guidelines for Community Noise:

Time limit for listening with earphones would be one hour and the average sound level should not exceed 85 dB and the maximum sound level should not exceed 110 dB

If the volume is set at middle to low level, (volume setting 1-5, with 1= softest and 10=loudest) the average sound level is 60-75 dB which is acceptable. If the volume is set at high level, (volume setting 8, with 1=softest and 10=loudest) the average sound level is 94 dB, only 60 minutes is sufficient for causing hearing loss. If a group of people use this volume setting for listening to music 1 hour per day; 5 days a week for 5 years, 72% of them would suffer from tinnitus (ringing in ears) and 45% of them would face the risk of permanent hearing loss. A " 50%/60 " safety rule is proposed for using earphones: set the volume at 50% or below of the maximum level (volume setting 5 or below, with 1=softest and 10=loudest) and less than 60 minutes per day.

The background noise in train or bus can sometimes reach 85-100 dB. Never try to cover the background noise with music/ radio listening from your earphones. A 15-minute exposure to sound at 100 dB is enough for damaging your hearing. Insert earphones (small earphones that can be inserted deep down to the ear canal) are popular among listeners of portable stereo recently. These earphones can attenuate 15-25 dB of the background noise, so you do not need to turn up the volume in order to listen to the music/message clearly. Compared with conventional earphones, the insert earphones are closer to the ear drums. So the sound level generated by earphones could be louder than conventional earphones by 6-9 dB with the same volume setting. A " 30%/60 " safety rule is proposed for insert earphones: set the volume at 30% or below of the maximum level (volume setting 3 or below, with 1=softest and 10=loudest) and less than 60 minutes per day. Never use earphones while you are on the street as it would be dangerous when you cannot hear the sounds of the traffic.

Celebration and entertainment events

Based on the WHO Guidelines for Community Noise:

Patrons should attend such events for less than 5 times per year and less than four hours each time. The average sound level should not exceed 100 dB and the maximum sound level should not exceed 110 dB

The average sound level measured in pop/rock concerts and disco can reach 97-120 dB. A daily exposure in such sound level for 30 minutes is enough for causing hearing damage. About 47% of teenagers who go to disco or rock concert frequently have tinnitus and hearing loss, only 14% of those who go there occasionally would suffer from similar problems. When you go to disco or rock concerts, it would be better to keep a distance of 3 meters or more from the loudspeakers. The volume setting of loudspeakers in karaoke boxes is adjustable. Choose middle to low volume setting. Never point the microphones to the loudspeakers as the acoustic feedback can generate very loud transient sounds which are harmful to hearing even instantly.

Music activities and training

Professional musician (especially rock musicians and brass players in orchestra) are exposed to music with average sound level of more than 95 dB daily. Tinnitus and hearing loss are not uncommon among them but such problems can be effectively prevented by appropriate use of hearing protection devices (e.g. musician ear plug). Music activities among students are less frequent and the duration of exposure is short, so the risk for hearing damage is relatively small. Students can decide whether to use hearing protection devices under the guidance of music teachers. Musician ear plug can attenuate excessive noise without affecting your performance in ensembles; they are usually available from shops for musical instruments or hearing aid. Practice/ performance venues with sound absorption facilities would lower the reverberation (echo), so the musicians would be exposed to a lower overall sound level and have a lower risk for hearing damage.

Toys, firecrackers and fireworks

Based on the WHO Guidelines for Community Noise:

Children should never be exposed to any sound with its peak sound pressure level exceeding 120 dB (it is equivalent to maximum level of 110 dB in music); adults should never be exposed to any sound with its peak sound pressure level exceeding 140 dB.

Firecrackers and fireworks can generate impulsive noise as loud as 160 dB while measured 2 meters away from the source. One incident of explosion in short distance is enough for permanent hearing damage.

According to the American guidelines for toy-noise:

- Handheld, tabletop toy should not produce noise with average sound level exceeding 90 dB while measured 25 cm from the sources.
- Close-to-ear toy should not produce noise with average sound level exceeding 70 dB while measured 25 cm from the sources.

However, it was found that most of the toys produce sounds exceeding these limits:

- Handheld, tabletop toys (e.g. toy wrench and toy gun) produce sounds with average sound level of 90-120 dB
- Close-to-ear toy (e.g. electronic harmonica and toy mobile phone) produce sounds with average sound level of 85 dB

For short term management, cellulose tape can be used to seal the sound port of the toys to lower the noise. In the long run, toys producing loud sounds should not be purchased for young children. Toys that produce loud sounds should never be placed in a young child's/ baby's bed as the child/baby may press against such toys frequently.

Principles and methods for protection against noise

Experts suggested the following methods to lower the risk of noise related hearing problems.

* Decrease the exposure to noise: Noise related damage can be accumulative. If you have exposed to noise for quite a long time during the day, avoid further exposure that day. If the background noise is so loud that you need to raise your voice to make yourself to be heard, shorten the time of staying in such situation. For very loud impulsive noise, the best preventive measure is to avoid any exposure and keep far way from the source.
* Use hearing protection devices: If noise exposure is unavoidable, use ear plug or ear muff to protect your hearing. The industrial safety ear plug (available from shops that sell metal products) can attenuate 25 dB of the noise level. Noise protection ear muff can attenuate 30 dB of the noise level. If you do not have any noise protection device while you are exposed to loud noise, press your tragus (the triangular flap near the entrance of your ear canal) against your ear canal and walk away from the noise source.
* Keep healthy: Be healthy: quit smoking, exercise more and obtain adequate amount of vitamin A, C and E from your diet. This may improve the recovery capacity of your cochlear hair cells.

Summary

For the sake of healthy growth of our youngsters, it is important to let our students and children be aware of the potential risk of noise related hearing problems and preventive measures. Please seek help from health professional promptly if they show any signs or symptoms of hearing problems (e.g. continuous tinnitus, weakened speech perception in noisy environment).

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MY View, Your View

Good hearing ability enables us to communicate effectively and enhances our learning ability. We can be more sensitive and alert to the surrounding environment and keep away from danger. Our students understand the importance of good hearing ability and share with us their opinion on how to protect our ears.

Answer: 3
Noise related damage to ears can be accumulative, therefore, we should avoid exposure to very loud noise or stay there for too long. If exposure to short period of very loud noise could not be avoided, we have to wear ear plug or ear muff to protect our ears, or we could press the tragus (the triangular flap near the entrance of the ear canal) and leave the site.

Normal hearing is so crucial that we must strive to protect our hearing. If there is persisting tinnitus, it may be a sign of hearing damage or it can be a warning sign of other diseases. The following letter shows that tinnitus will influence our learning and emotion. Therefore, we must face our physical problems promptly.

Friends of Health Box,

How are you? I am a sixteen-year-old girl. I had tinnitus recently. I lost my balance when I was standing and I felt like rocking in a boat when I was sitting. I couldn't concentrate in my homework, and my school performance deteriorated! Even though I had seen the doctor, the conclusion was unknown cause or psychological effect. I worry very much about my health and academic performance and wish that you can help me solve the problem.

Mei-yan

Dear Mei-yan,

Thank you for your letter.

You mentioned that you were upset about your tinnitus. I understand that you also worried about your health and academic problem. If you have already consulted the doctor and after thorough examination, the conclusion was that the cause was unknown, you may try to manage the discomfort caused by tinnitus. Tinnitus refers to the perception of sound without an external acoustic source. The sound is "meaningless" but may affect our life or emotion. Here are some suggestions to reduce the tinnitus. Or, you may find more information on tinnitus in our website. http://www.studenthealth.gov.hk/english/health/health_ehs/health_ehs_tin.html

Our brain can adjust our response to sounds and mask the "meaningless" sound. Normally, children and adolescents may adapt to tinnitus within half year's time. Your adaptation will be faster if you can relax and treat it lightly and optimistically. If you cannot sleep because of tinnitus, you may try playing low volume sounds of raining, running water or waves, through the speaker. This may help you relax and reduce the impact of tinnitus. In addition, relaxing exercise can reduce your unnecessary worries, anxiety and tension.

We understand the difficulties you face. We hope that you can relax and manage your tinnitus problem positively. Furthermore, you can talk to your family and friends in order to express your difficulties. Finally, you should seek help from professional social worker if needed.

Best regards,

Health Box

Interesting knowledge Q&A

Which of the following measures are protective to the ears?

1. use a hard object to clean the ears
2. use earphones to listen to music for a long period and at a high volume setting
3. when exposed to loud noise, use ear plug or ear muff to protect the ears
4. stay for a long period in a place with loud noise

(Answer: find it out from the newsletter)

Health Tips

When we try out the music players in musical shop, or when we use other people's earphones or MP3, we should turn the volume down and then adjust the volume setting to suit us before we start to listen to the music. This is because a sudden loud noise could lead to discomfort and damage to the ears.

For enquiries of student's health problem, please write to "Health Box"