NOISE INDUCED HEARING LOSS AMONG GRASS TRIMMING WORKERS

By

DR.NABEEL IBRAHEEM JAAFAR

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LIST OF ABBERVIATIONS

dB = decibel

kHz = kilohertz

DPOAE = distortion product otoacoustic emission

HL = hearing loss

NIHL = noise induced hearing loss

PTA = pure tone audiometry

PTS = permanent threshold shift

TTS = temporarily threshold shift

ISO = International Organization for Standardization

NIOSH = National Institute of Occupational Safety and Health

ABSTRACT

Introduction:

Grass trimming workers work every day in a noisy environment as they carry the grass trimming machine on their back, such daily exposure for many years may contribute to noise induced hearing loss.

Objective:

To assess the hearing status of the grass trimming workers in KB and the nearby areas and to determine the prevalence of noise induced hearing loss among them.

Methodology:

This was a descriptive cross sectional study.The source population were from grass trimming worker works under USM Health Campus, Majlis Perbandaran Kota Bharu (MPKB) , Majlis Daerah Pasir Puteh, Bachok, Ketereh and Tumpat. The data was collected at HUSM /ORL-HNS outpatient clinic to fill the Proforma , otoscopic examination and hearing tests. Hearing tests consist of pure tone audiometry, tympanogram and distortion product otoacoustic emission.

Results:

A total of 77 grass trimming workers participate in this study. All of them were male with age range from 20-53 years old with majority of them fall in age group of 40-50years old. Two of the subjects were excluded as they have history of working in noisy job before and for at least 10 years.

None of them use any protecting hearing device. Duration of work of grass trimmers were in between 1 to 33 years. The daily work was 4-5 hours with time of rest in between we found that 62 out 75 grass (82.7%) trimming worker have noise induced hearing loss with characteristic notch at 6 kHz , 4 kHz and 3 kHz. The noise induced hearing loss occurred in workers exposed to noise as early as two years in this job. The intensity of the noise from the machine is in between 91.3 to 100.7dB in a fluctuant manner. The left ear was the predominant side that was affected by hearing loss .All of the subjects was having mild hearing loss.

Conclusion:

The study showed that grass trimming job have occupational hazards of noise induced hearing loss. It occurs with one to two years working without any hearing protection device .The dip at 6kHz is a significant early sign for noise exposure. We strongly recommend that all the workers use the hearing protection device while doing grass trimming.

ABSTRAK

Pengenalan:

Pemotong rumput bekerja tiap tiap hari di suasana yang bising semasa mereka menjalankan kerjanya dan membawa mesin pemotong rumput atas bahunya. Pendedahan kepada kebisingan seperti ini pada tiap tiap hari bagi beberapa tahun boleh menyumbang kepada kehilangan pendengaran yang disebabkan oleh kebisingan ia itu dan "acquired noise induced hearing loss".

Objektif:

Tujuan kajian ini adalah untuk mengkaji status pendengaran pemotong rumput di dan untuk menentukan tahap kehilangan pendengaran yang disebabkan oleh kebisingan mesin potong rumput dikalangan pekerja-pekerja ini.

Methodologi:

Kajian ini merupakan kajian " cross sectional" yang diskriptif di mana sumber pupulas adalah terdiri daripada pemotong rumput yang bekerja di Kampus Kesihatan Universiti Sains Malaysia, Majlis Perbandaran Kota Bharu (MPKB) , Majlis Daerah Pasir Puteh, Bachok, Ketereh dan Tumpat. Data bagi kajian ini telah dikutip daripada pekerja perkerja ini setelah mereka dijemput untuk hadir di Unit Otorlaryngologi, Hospital Universiti Sains Malaysia sebagai pesakit luar untuk ditemuduga dan menjalankan pemeriksaan otoscopi dan pendengaran. Pemeriksaan ini telah dijalani setelah mendapat kebenaran bertulis dari mereka. Pemeriksaan pendengaran telah meliputi "audiometric nada tulia", timpanogram and distortion product otoacoustic emission".

Keputusan:

Sejumlah 77 pemotong rumput telah mengambil bahagian dalam kajian ini. Kesemua mereka adalah lelaki dan umur mereka adalah dalam lingkungan 20-53 tahun dengan majoritinya dalam kumpulan umur 40-50 tahun. Daripada kumpulan ini, 2 orang pekerja telah dikecualikan daripada kajian ini kerana mempunyai sejanah kerana mereka telah menjalankan kerja kerja yang melibatkan kebisingan bagi sekurang kurangnya 10 tahun.

Adalah didapati bahawa semua pekerja pekerja yang telah ditemuduga bagi kajian ini langsung tidak menggunakkan alat alat perlindungan yang boleh melindung mereka daripada kebisingan. Mereka juga telah bekerja sebagai pemotong rumput di antara 1 hingga 33 tahun. Pekerjaan harian mereka adalah bagi tempoh 4 hingga 5 jam dengan waktu rehat. Dari kajian ini, adalah didapati bahawa 62 daripada 75 pemotong rumput (82.7%) telah mengalami kehilangan pendengaran yang disebabkan oleh kebisingan mesin pemotong rumput . “Characteristic notch” telah didapati pada

6 kHz%, 4 kHz% dan pada 3 kHz%. Adalah didapati bahawa kehilangan pendengaran telah mula berlaku 2 tahun setelee menjalankan kerja ini. Tahap intensity kebisingan daripada mesin mesin pemotong rumput ini adalah diantara 91.3 ke 100.7dB. Dalam kebanyakkan kes, bahagian telinga kiri adalah yang mengalami kekurangan pendengaran.

Kesimpulan:

Kajian kami telah menunjukkan bahawa kerja kerja pemotongan rumput yang menggunakan mesin mesin yang mengeluarkan decibel yang tinggi boleh menyebabkan kehilangan pendengaran (noise induced hearing loss) . Keadaan kehilangan ini boleh berlaku se awal awalnya dalam tempoh 1-2 tahun sekiranya mereka tidak menggunakan sebarang alat perlindungan. Tahap 6 kHz adalah merupakan satu tahap yang significant sebagai tanda awal bagi pendedahan kepada kebisingan tinggi (early sign for noise exposure). Dengan itu kami ingin mengesyurkan secara tegasnya bahawa pekerja pekerja seperti ini haruslah menggunakkan alat perlindungan pendengaran semasa menjalankan kerja kerja pemotongan rumput.

1 INTRODUCTION

1.1 Noise induced hearing loss (NIHL)

Noise induced hearing loss (NIHL) or occupational hearing loss is defined:

As a permanent sensory neural hearing, loss results from accumulative repetitive noise exposure of high amplitude (Bauer *et al.*, 1991).

1.2 Prevalence of NIHL:

This problem is highly prevalent among industrial community where the workers exposed to variable degrees of noise. It is the second most common form and cause of hearing loss after the age related hearing loss or presbycusis (Nandi and Dhatrak, 2008). According to the data recorded by the National Institute for Deafness and Communication Disorders (NIDCD), the American Speech, Language and Hearing Association (ASHA), and the Occupational Safety and Health Administration (OSHA) more than 30–40 million Americans are exposed to hazardous sound or noise levels on a regular basis. NIHL affects approximately 10–15 million people, of all age groups in USA. NIHL is a major occupational disease, a significant cause of disability and a major cost to society (Lynch and Kil, 2005). NIHL is the second most reported occupational disease and injury in the USA (Hong, 2005).

1.3 Overview of grass trimming in Malaysia

Grass trimming is one of the commonest jobs carried out in almost all states in Malaysia. It is mainly a male-dominated occupation. The rate of growth of grass in a Malaysia, which is fast and consistent as a tropical area, had made this job in a great demand in order to maintain the neatness and to keep the beauty nature of the landscapes. Using grass-trimming machine is the best way for cutting long grass along the roadside and general agricultural land because of different levels and difficult angles that the grass can grow that make the use of lawn mower not practical because the design of these machines is for use on the ground.

1.4 Description of grass trimming machine

Grass-trimming machine is a motorized cutter powered by petrol engine carried on the back by the workers and fixed with belts as in Figure 1-1, showing one of the grass trimming workers doing his job. This makes the grass-trimming workers exposed to a noisy job and has the risk of noise induced hearing loss (NIHL).

Noise produced by these machines are of two sources the one is the motor of the machine and the other is the sound result from the plastic string that break out the plants rather than cutting them (Mallick, 2009)

Figure 1-1: Grass trimming.

The machine consists of three main parts: the motor powered by petrol, the drive shaft that transfer the motor movement to the head and the plastic string which fixed to the rotating head which cut the grass, and this inexpensive PVC string frequently changed during cutting as it may damaged, as shown in Figure 1-2.

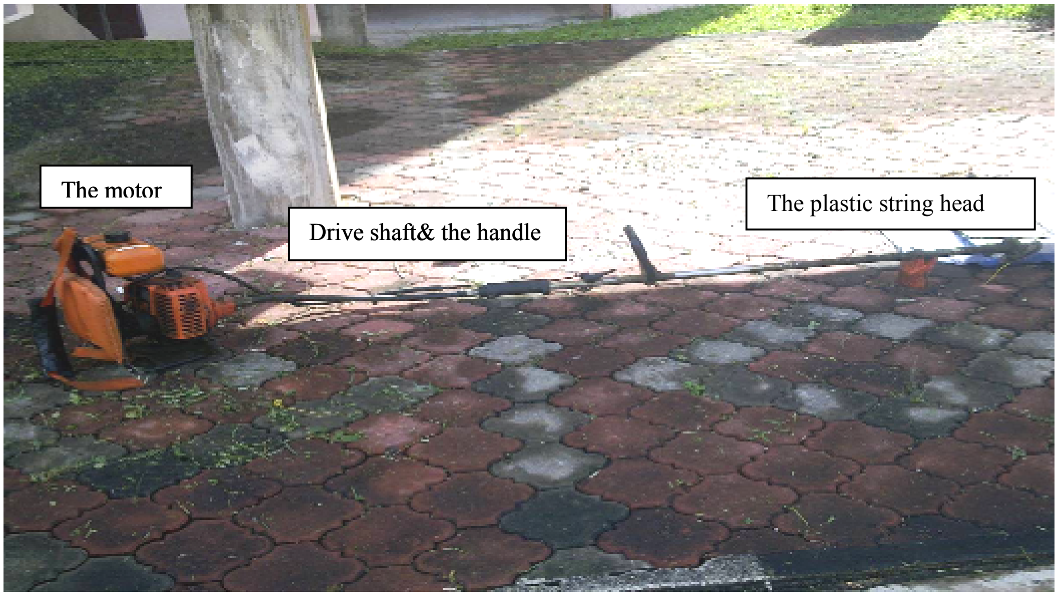

Figure 1-2: Grass trimming machine parts.

1.5 Grass trimming workers

Most of these workers are contract workers; they give less attention to their health status. Inadequate knowledge about the occupational noise exposure or their educational level may be the cause.

The approximate number of workers recruited on this job in Malaysia reaches to more than 20,000 workers as work force of this industry (Zulquernain Mallick 2009).

2 Literature review

NIHL is an irreversible sensorineural hearing loss, thus the only way to avoid that is to diagnose the prevalence in every noisy job and to take primary precautions against it (Celik *et al.*, 1998). Continuous or repeated exposure to high-level noise more than 85 dB will cause a permanent damage to the outer hair cells of cochlea (Henderson and Hamernik, 1995). Although the noise level may have a broad frequency spectrum, the hearing loss usually started at 4 to 6 kHz .This is due to the reflecting enhancement of sound energy in this frequency from the natural resonance of the ear canal (Leikin *et al.*, 2000).

In USA a study carried on the construction workers, the level of noise for one working day (7 hours) was between 90-130dB, their mean age was 43years old and their employment mean time was 18.1 year. After 14 hours free of noise exposure pure tone audiometry (PTA) done for those workers, 60% of them have an audiometric notch at the high frequency areas at 4 and 6 kHz while 38.5% show hearing defect at 0.5,1,2 and 3 kHz (Hong, 2005) .

According to ex-study by Tunay and Melemez(2008) , the noise level produced by chainsaw was between 90-105dB, their mean age was 38 years , time of exposure was 7 hours for each day in addition to that they did not use any kind of hearing protective devices. This study determined three factors affecting the prevalence of NIHL: the amplitude of noise, the time of exposure and the age of worker. The study high light that those workers have a characteristics bilateral symmetrical " v " shape dip or notch at 4 kHz with average of 42 dB hearing loss (Tunay and Melemez, 2008).

Celik *et al* , (1998) , had conducted a similar study on workers employed in a hydroelectric power station. The noise level measured in two places, the resting place was 75-85 dB while at the working place near the electrical maintenance services and turbines machines the noise level was 95-110dB. He divided them into three groups based on their time of employment, 10 years and below, 11-20 years and more than 20 years. Out of 126 persons tested for hearing loss 71 have evident of NIHL at 4 and 6 kHz bilaterally. Another point, which related to deceleration of noise-induced shift over time, most of the threshold shift that was found after 20 years is already started within 10 years of noise exposure.

The study concluded that the hearing losses developed within the first decade of noise exposure and associated with slight progress in the following years (Celik *et al.*, 1998).

Hearing loss is classified into six broad categories on the basis of hearing threshold: 0–20 dB is considered normal average, 21–45 dB reflects a mild hearing loss, 46–60 dB reflects a moderate hearing loss, 61–75 dB reflects a moderately severe hearing loss, 76–90 dB reflects a severe hearing loss, and greater than 90 dB indicates profound deafness. (Ali Dehqan *et al.,* 2011)

2.1 Anatomy and physiology of the inner ear

2.1.1 Fluid Compartments

The inner ear labyrinth is divided into two chambers, filled with fluid one inside the other, Figure 2-1. The fluid in the two chambers differs on term of the kind of salt that each contains. The fluid in the outer or bony chamber is rich with a sodium salt solution called perilymph, which resembles cerebrospinal fluid while the inner or membranous chamber is rich with a high potassium salt solution called endolymph, which resembles intracellular fluid. The potassium actively pumped into the membranous chamber to maintain the difference in the sodium and potassium concentrations. The difference in the chemical composition between perilymph and endolymph provides the electrochemical energy that powers the activities of the sensory cells (K.Lalwani, 2008).

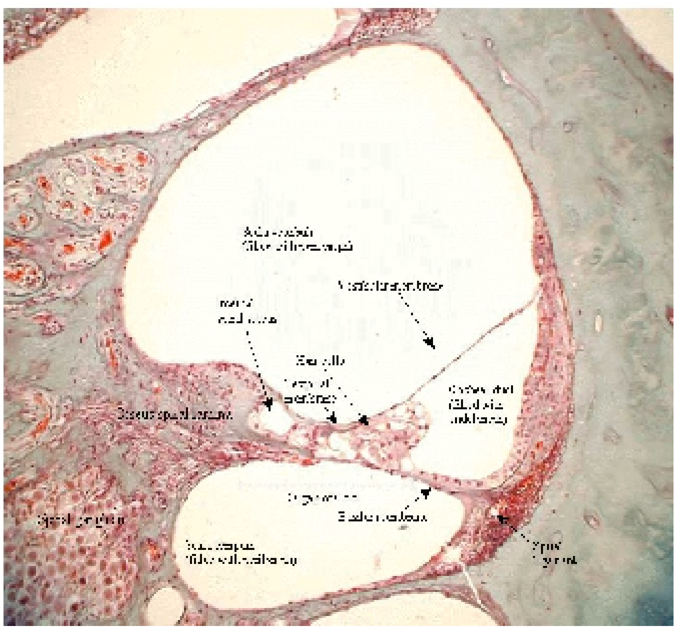

Figure 2-1:Cross section into cochlea showing the internal anatomy of membranous labyrinth. (Adapted from http://www.biology.clc.uc.edu/.../Histology_Ear.htm)

2.1.2 Hair Cell Function

Hair cells are the sensory receptor cells of hearing and balance of the inner ear, Figure 2-2. The hair cells name comes from the fact that they have about 100 stereocilia at their apical end. Individual stereo cilia are composed of a filamentous actin cytoskeleton. Hair cells have unique and specialized mechanoreceptors that convert the mechanical stimuli associated with hearing and balance into neural information to be transmitted to the brain. The conversion of one form of energy to another is called transduction. The stereocilia of each hair cell are arranged in a special geometry. This arrangement is not uniform and polarized because the stereocilia are arranged in rows of short, intermediate, and tall stereo cilia. A single kinocilium is located adjacent to the tallest row. It has the arrangement of 9 by 2 microtubule organization similar to motile cilia found elsewhere in the body. The kinocilium roll is thought to establish the morphologic polarization of the stereocilia bundle and is not required for mechanoelectrical transduction. It is present in embryonic cochlear hair cells but is resorbed by the time cochlear hair cells mature. There is a gradual progression from the shortest row to the tallest row. This arrangement of the bundle from short to tall rows is related to the functional consequences of bending the bundle on the cell's membrane potential (K.Lalwani, 2008).

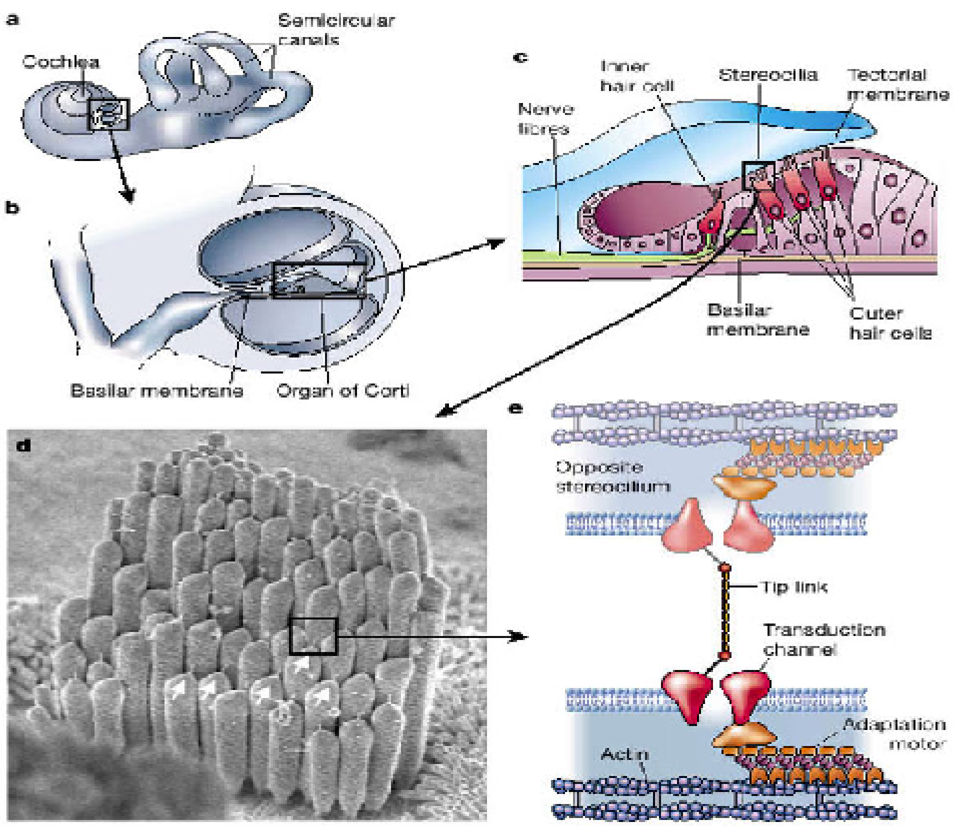

Figure 2-2: The OHCs and its roll in transduction.

Adapted from http://Molecular basis of mechanosensory transduction Peter G. Gillespie and Richard G. Walker.

The mechanoelectrical transduction channels that are in the wall of the stereocilia are attached to adjacent stereocilia by “tip links” (Figure 2-3). The deflection of the stereocilia toward the tallest row causes shearing between the stereocilia, which causes the tip links to pull on the transduction channels, opening them. Deflection in the opposite direction releases the tension of the tip link, causing the transduction channels to close. Bending the bundle toward the direction of the tallest row leads to entry of K+ and Ca^{+2} ions into the hair cell through channels that open at the tips of the stereocilia.

This causes the hair cell to depolarize. Bending the bundle in the opposite direction promotes channel closure and results in hair cell hyperpolarization.

Within the stereociliary bundle, there is movement of the bundle back and forward parallel with the axis of symmetry through the kinocilium. Movement in this direction produces a maximal receptor potential (change in intracellular voltage) (K.Lalwani, 2008).

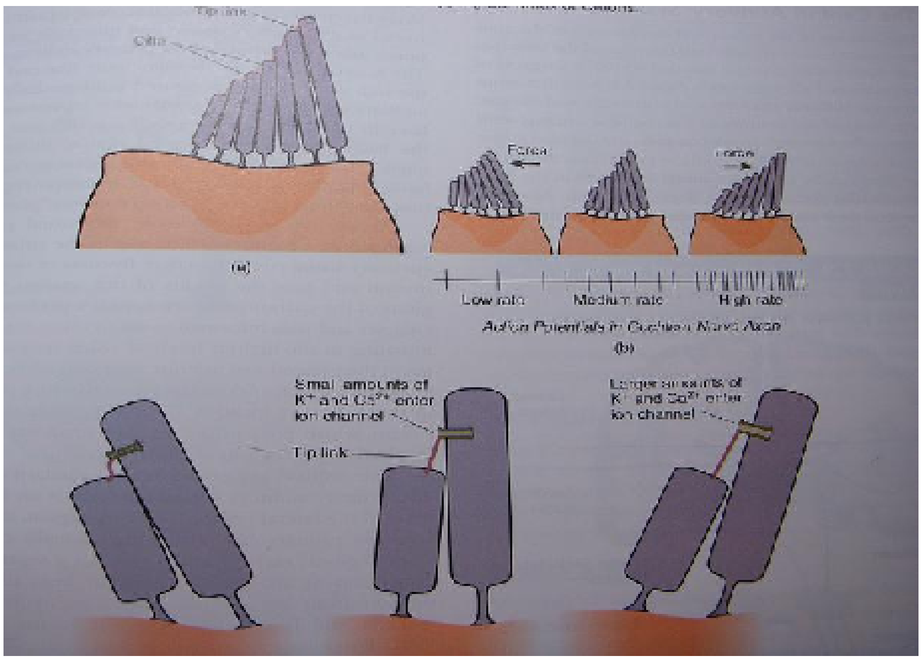

Figure 2-3 : The ionic channels of the hair cells.

(Adapted from http://www. Transduction in hair cells of the inner ear: fig. 7.8)

Hair cells have synapses located at their basal part. Whenever the hair cell is mechanically stimulated, it releases a chemical that modulates the electric activity of the afferent neurons (Figure 2-4). This neurotransmitter release is controlled by changes in the membrane potential of the hair cell in response to bending its stereocilia bundle. Efferent synapses at the termination of the fibers originating deep in the brainstem are also present. The neural signals from the brain accompanied by these efferent fibers modulate the gain (amplification) of the hair cells they innervate (K.Lalwani, 2008).

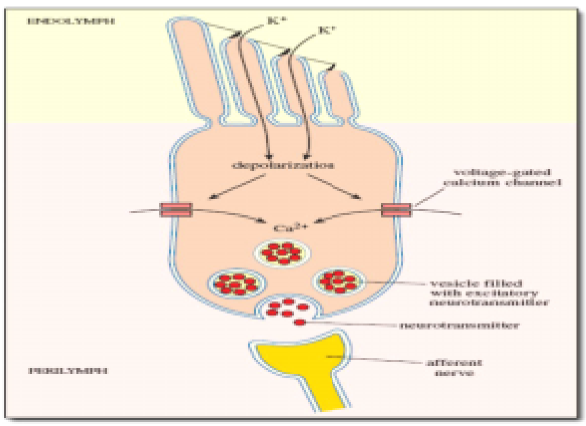

Figure 2-4: The depolarization of the hair cells with influx of Ca^{+2} .

(Adapted from http// labspace.open.ac.uk/…/view.php?id=432278)

2.1.3 The Auditory Pathway

2.1.3.1 Cochlear Nerve

It is the branch of the auditory nerve which transmits the auditory information from the cochlea to the brain. Cell bodies located in the cochlear nerve ganglion. Each contains ~50,000 afferent axons 95% thick and myelinated axons forming synapses with the inner hair cells; the inner hair cells are very important for normal hearing, 5% thin and unmyelinated axons forming synapses with the outer hair cells; The outer hair cells are effectors cells, play a role in altering the mechanical characteristics of the basilar membrane so that influencing the effects of sound vibrations on the inner hair cells also contains efferent axons. The source is the superior olivary complex .The efferent fibers constitute the olivocochlear bundle making synapses directly on outer hair cells and on the dendrites that serve the inner hair cells. The neurotransmitter at the afferent synapse is glutamate, and that at the efferent synapses is acetylcholine, which has an inhibitory effect on the hair cell (K.Lalwani, 2008).

2.1.3.2 The central auditory system

Pathway for hearing process from external ear to the auditory cortex:

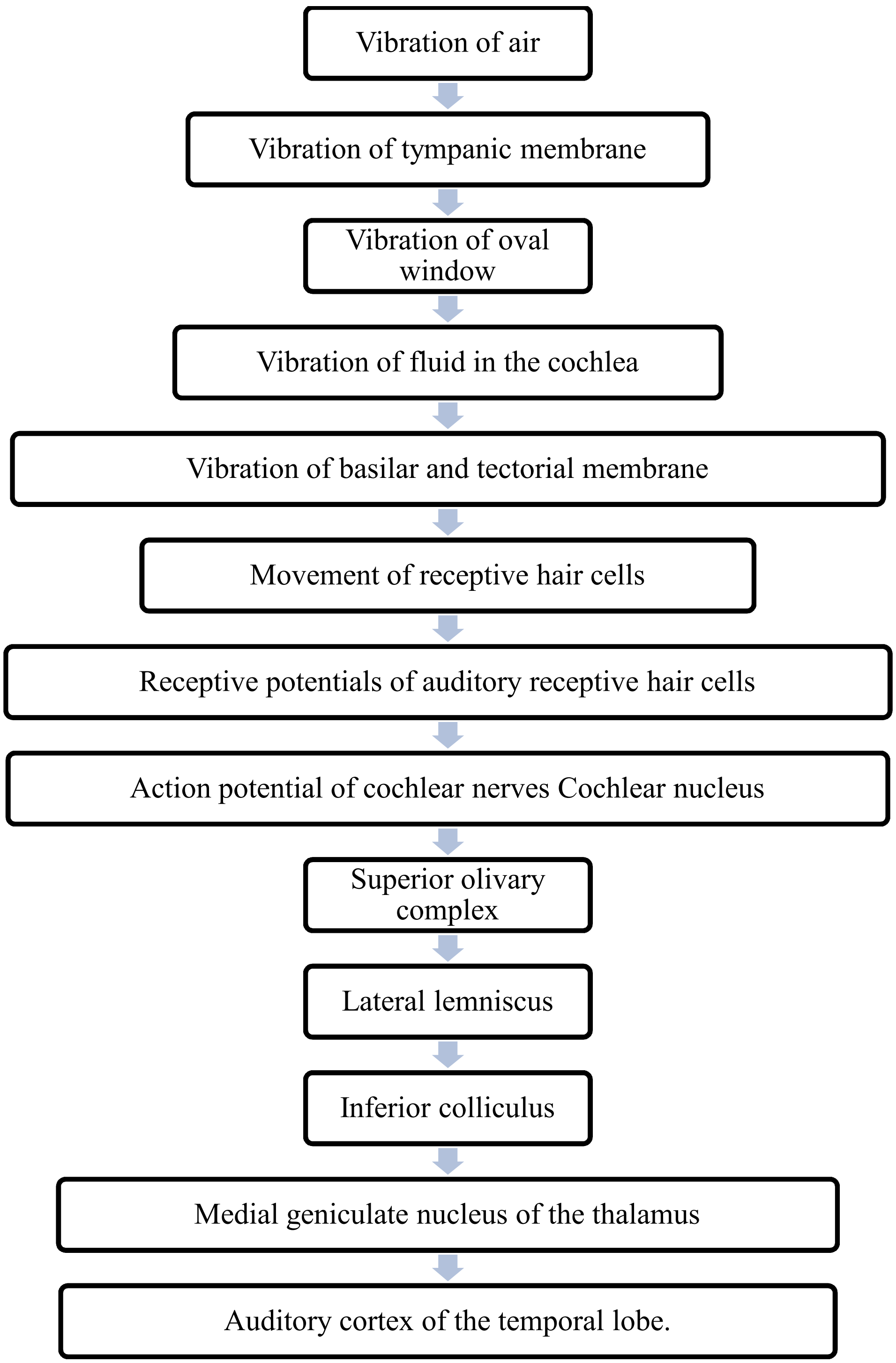

Figure 2-5: Diagrammatic pathway of the hearing from external ear to the brain

Each hemisphere receives information from both ears contralaterally; auditory information is relayed to the cerebellum and reticular formation as well as show in Figure 2-5 (K.Lalwani, 2008).

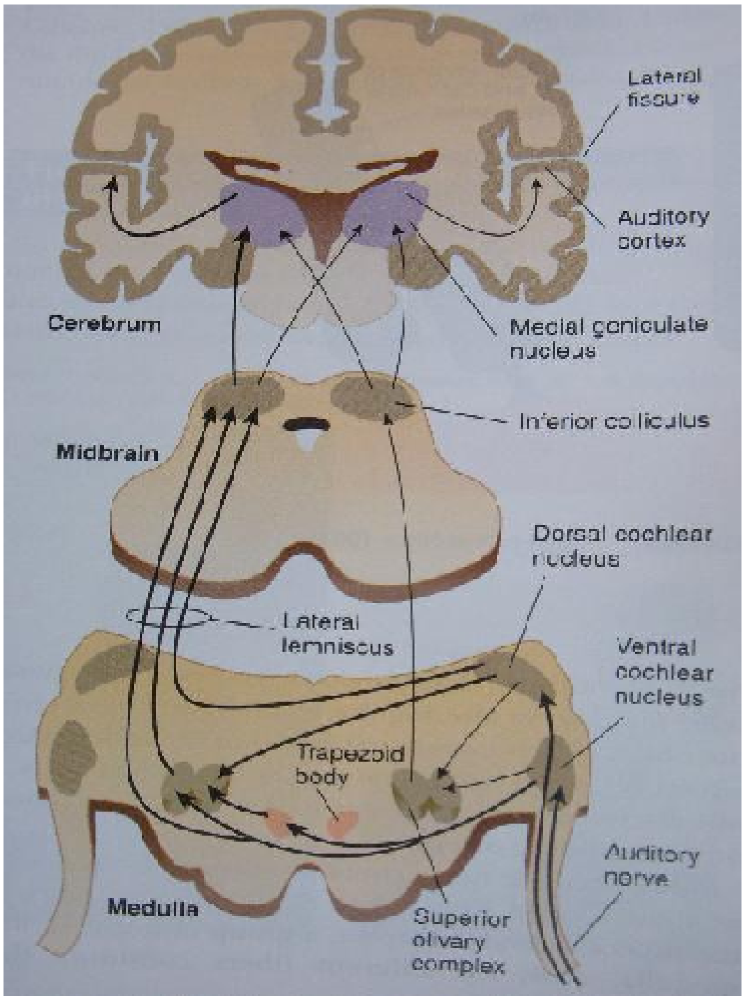

Figure 2-6: Pathway of the auditory system.

(Adapted from http//:www. physiology of behavior.com , Neil, 10th edit., Pearson)

2.2 Pathophysiology of NIHL:

In response to sound waves passing through the cochlea, auditory hair cells in the organ of Corti depolarize following the opening of mechanotransduction channels caused by the physical deflection of the stereocilia on their apical surface. The organ of Corti contains mainly two types of auditory hair cell: inner and outer hair cells (IHC and OHC, respectively). OHCs are built into three rows and are usually the first hair cells affected. Healthy OHCs reacts in response to acoustic stimulation, resulting in an increase in sensitivity (or gain) of ~40–50 dB (active cochlear amplification) (Wu *et al.*, 2004). Mitochondria are the most and the first affected intracellular organelles in models of NIHL. IHCs are mainly sensory in nature and are heavily innervated by the eighth cranial (auditory) nerve.

The quantity and quality of hair cell damage depends on the frequency, intensity and duration of the noise exposure. Above a specific limit of intensity level, OHCs show signs of metabolic exhaustion with the accumulation of reactive oxygen and reactive nitrogen species (ROS and RNS, respectively). When the damage of OHCs is permanent or it is lost, the threshold sensitivity of the IHC increases or it became less excitable (loss of active cochlear amplification) and it is often recorded as a threshold shift or as hearing loss (Lynch and Kil, 2005).

In an early stage, noise only can lead to a temporary hearing threshold shift (TTS), which usually disappears in the time following noise exposure. Different regeneration mechanisms are issued in literature, e.g. regeneration of the hair bundle which occurred within about 48 h after noise exposure (Schneider *et al.*, 2002).

The recovery of thresholds to normal status was associated with a recovery of OHC receptor currents which may be accelerated by the presentation of non-traumatic sounds during the recovery period (Patuzzi, 2002). On the other hand a rapid recovery mechanism due to a short-lived disruption of the synapses between the inner hair cells and the primary afferent neurons within the first five minutes after noise exposure was demonstrated by (Patuzzi, 1998). Permanent hearing threshold shift (PTS) is known to occur little by little over time as a cumulative process and as a result of gradually increasing irreversible damage to the cochlear sensory cells. For that reason, it is an important concern for industrial hearing conservation programs is the early detection of NIHL. The most sensitive and vulnerable to noise overexposure cellular structure of the inner ear is the outer hair cells (OHCs) (Linss *et al.*, 2005, Zhang and Zwislocki, 1995). The common audiometric tests that used to assess overall hearing capability are not able to detect the precise changes in OHC function. Thus, noise-induced OHC impairment may remain obscured or undetected due to potential retro-cochlear compensation mechanisms, which may postpone the awareness of subtle changes in hearing capability (Muller *et al.*, 2005). Over the past decade, more progress has been made in our understanding of the cellular and biochemical basis of NIHL. Acute exposure to loud noise affects many structural elements in auditory hair cells, including cell membrane and intracellular biochemical pathways (Kopke *et al.*, 1999). These changes can provoke the formation of free radicals (in particular ROS and RNS) that overwhelm resident detoxification and antioxidant mechanisms (Yamane *et al.*, 1995). On other hand many studies have shown a greater susceptibility to NIHL in animals and humans with dietary magnesium (Mg) deficiency (Gunther *et al.*, 1989).

According to that low Mg might contribute to a loss of membrane potential, resulting in altered or decreased sensorineural function.

A major intracellular antioxidant pathway that can defense the auditory hair cells and detoxify free radicals and attenuate ROS and/or RNS involves the tripeptide glutathione (GSH) (Meister, 1991). Loud noise can decrease GSH and increase the level of oxidized glutathione in the inner ear (Yamasoba *et al.*, 1998) leaving it prone to ROS- and/or RNS mediated cell damage. There is another intracellular compound that interacts with GSH; it is the glutathione peroxidase (GPx), which catalyzes the ability of GSH to act as an antioxidant. However, GPx activity also decreases following noise exposure (Ohlemiller *et al.*, 1999).

The combined effect of increased ROS and/or RNS and depleted antioxidant capacity can lead to cell injury or death. Some of the most damaging ROS and/or RNS are those that able to oxidize lipids such as hydroxynonenal (4-HNE) and peroxynitrite ($ONOO^{-1}$). These free radicals break out lipids and damage membrane-bound organelles such as mitochondria and nuclei. The excess of ROS and/or RNS resulting from elevated hair cell metabolic activity during intense noise exposure could overcome the antioxidant buffering capacity of the cell, leading to permanent loss or injury of hair cells (Ohinata *et al.*, 2003, Yamashita *et al.*, 2004).

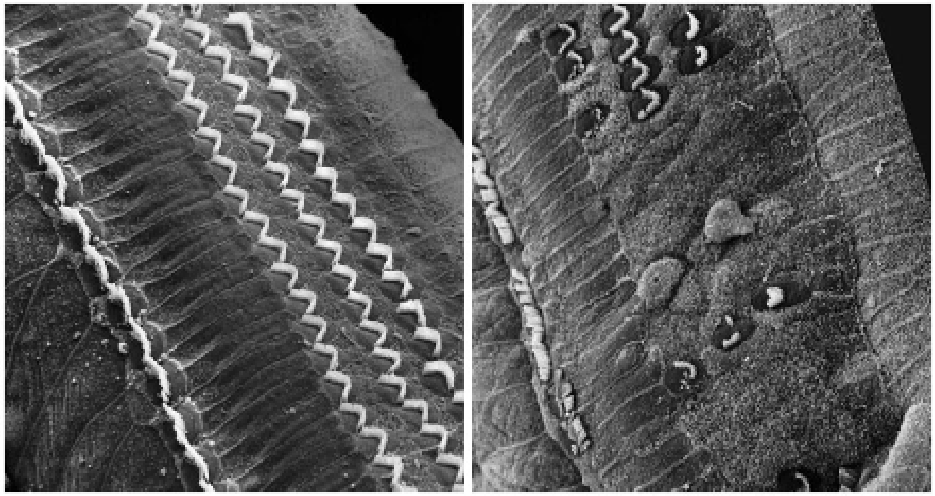

Figure 2-7: Microscopically viewed cochlear hair cells before noise exposure and after noise exposure.

(Adapted from http://neuro.bcm.edu/groveslab/?m=static&id=21)

2.3 Diagnosis of NIHL:

The principal characteristics of occupational noise-induced hearing loss according to the American Colleges of Occupational and Environmental Medicine (2003) are as follows:

1. It is always sensorineural, affecting mainly the hair cells in the inner ear.

2. Ideally most noise exposures are symmetrical; so that the hearing loss is typically bilateral.

3. Typically, the first sign of NIHL is a “notching” of the audiogram at 3000, 4000, or 6000 Hz, with recovery at 8000 Hz.

The exact location of the notch depends on many factors including the frequency of the damaging noise and the length of the ear canal (individual variation).So that, in early noise-induced hearing loss, the average hearing thresholds at low frequency areas (500, 1000, and 2000 Hz) are better than the average at 3000, 4000, and 6000, and the hearing level at 8000 Hz is usually better than the deepest part of the “notch” as in Figure 2-7. This “notching” differ from the age-related hearing loss (presbycusis) , which also produces high frequency hearing loss, but in a down-sloping pattern without recovery at 8000 Hz.

4. Noise exposure alone usually does not produce a profound hearing loss; however individuals with superimposed age-related losses may have that.

5. The greatest rate of hearing loss due to chronic noise exposure is during the first 10-15 years of exposure, and decreases as the hearing threshold increases. While in contrast to that, age-related hearing loss accelerates over time.

6. Hearing loss due to noise does not progress, and there is scientific evidence indicates that previously noise-exposed ears are not more sensitive to future noise exposure and the NIHL stopped once the exposure to noise is discontinued.

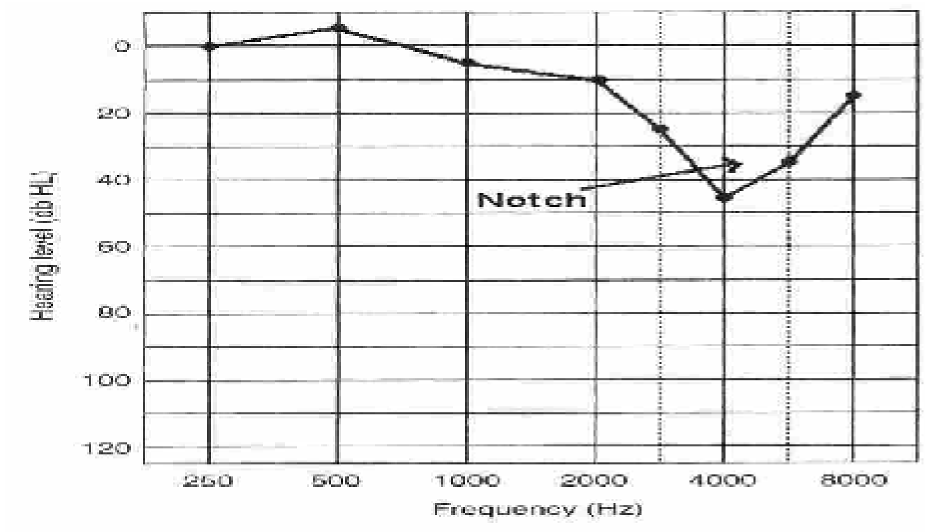

Figure 2-8: High frequency notch in the audiogram, typical sign of NIHL
(adapted from http://www.google.com, Coles *et al.*, 2000)

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Charactristc 4 kHz notch have several explanations but the most accepted explanations for that are three as fallowing :

1. The greater senstivity of the human ears to the frequencies between 1and 5 kHz which may be related to to the transmission charactristcs of outer and middle ear (Pierson *et al.*, 1994).

2. Following the exposure of intense sounds with the presence of PTS or TTS the maximum basilar membrane vibration shifts by about half of an octave upon loss of active cochlear mechanisim ,it means that 1kHz pure tone will be percieved as 1.5 kHz (Tunay and Melemez, 2008).

3. The role of acoustic refelx in attenuating the intense sound transmission below 2 kHz (Tunay and Melemez, 2008).

2.4 Saftey parametres and NIHL prevention

According to Occupational Safety and Health Administration OSHA regulated the exposure to noise as duration with sound pressure level (SPL) measured in dB , it states that every 5 dB increase in sound pressure level requires a 50% reduction in exposure time and it also recommends that no one should be exposed to more than 140 dB of sound even for brief periods (Lynch and Kil, 2005), while the National Institute For Occupational Safety And Health (NIOSH) guidelines stated that in terms of maximum time one could safely be exposed to different time –weighted averages (TWAS) of sound pressure on daily basis as showen in Table 2-1 below:

Table 2-1: (NIOSH) guide lines of TWAS decibel levels maximum exposure.

Sound intensity (dB)	Maximum time
85	8 hours
88	4hours
91	2hours
94	1hour
97	30mins
100	15mins
103	7.5mins
106	3.75min.s

As we mention that the NIHL is more marked at high freqeuncies from 3 to 6 kHz with charactristc noth at 4 kHz, the effect of that is loss of consonant discrimination such as *s, f, d, sh, k, t, d,* although these are not responsible for the acaustic power of speech they are very essential for the intellegibility of speech ,so the problem with NIHL is not hearing the speech but the exact understanding of the speech .

Many industries have adopted hearing conservation programs which may have different components :

- Assessment of noise levels : can be obtained by sound pressure meters
- Engineering controls
- Using the personal hearing protection device .
- Serial audiograms for the workers to assess the hearing status in high risk group.

Prevention of noise induced hearing loss (NIHL) has been addressed by providing wearable hearing protection device (HPD) and reducing noise emission. For many occupations this has been insufficient when the noise level exceeds 130-140dB (Lynch and Kil, 2005).

Although Hearing Protection Devices (HPD) are theoretically defined as a short-term solution, due to some economics and applicability issues, they are commonly employed as the only measure against noise exposure. On the other hand, it is also well known that unless workers wear HPD continuously, its efficiency will be very low (Arezes and Miguel, 2005).

According to (Fernandes, 2003) the average levels of acoustic attenuation of the HPDs, depending on the type and modele of HPDs was range between 19-29dB as showen in Table 2-2:

Table 2-2: The average levels of acoustics attenuation of the four HPDs.

Type of HPDs	Model	Noise Reduction Ratio
Earplug type HPD (silicon)	Pomp Plus	21 dB
Earplug type HPD (foam)	3M 1100	29 dB
Earmuff type HPD	Novel I	19 dB
Earmuff type HPD	Silent I (Air Safety)	29 dB

On the contrary the levels effect`ive to the ear were between 80 and 89 dB with the earmuff providing the highest energy attenuation, and between 92 and 102 dB with the earmuff providing the lowest energy attenuation (Starck *et al.*, 2002).

For all we mention about the possibility of NIHL to occur in those who work in grass trimming which is very common job in Malaysia and the irreversibility of this hearing loss so we aim to do a precise research to avoid the occupational hazards of this job. If we prove that there is hearing loss caused by the grass-trimming machine we can advise the workers to wear a protective ear muffles or ear plugs otherwise they will have a permanent NIHL.

3 Methodology:

3.1 OBJECTIVES:

3.1.1 General

To assess the hearing status of grass trimming workers in KB and the nearby areas.

3.1.2 Specific:

1. To determine the noise spectrum of the petrol engine machine used in grass-trimming.
2. To determine the "prevalence" of noise induced hearing loss among the grass-trimming workers.
3. To determine the "association" between the noise exposure by the grass-trimming job and NIHL.

3.2 STUDY DESIGN:

This was a descriptive cross sectional study. The source population was from grass trimming workers working in Kelantan (HUSM, MPKB, Majlis Daerah Pasir Puteh, Majlis Daerah Bachok, Majlis Daerah Ketereh, Majlis Daerah Tumpat) .The data was collected as a sample size calculated according to statistical measures for each specific objective. All the workers were invited to HUSM/ORL-HNS outpatient clinic to achieve all the tests needed for our study.