FIELD SURVEY ON ROAD TRAFFIC NOISE AND EVALUATION OF HEARING LOSS AND RISK FACTORS QUESTIONNAIRE IN THE COMMUNITY OF KOTA BHARU, KELANTAN.

By

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LISTS OF ABREVIATIONS

NIHL - Noise-induced hearing loss

HUSM - Hospital University Science Malaysia

PTS - Permanent Threshold Shift

TTS - Temporary Threshold Shift

ABSTRACT

IN BAHASA MELAYU

Objektif :

Tujuan utama kajian ini dijalankan adalah untuk mengenalpasti tahap purata kebisingan bunyi bising di beberapa tempat di sekitar Kota Bharu dan menilai beberapa factor-faktor yang berisiko menyebabkan masalah pendengaran dan mengenengahkan inciden masalah kehilangan pendengaran yang disebabkan oleh bunyi bising terutama terhadap orang-orang yang tinggal berhampiran dengan jalanraya-jalanraya yang sibuk.

Kaedah:

Tahap kebisingan bunyi diukur menggunakan peralatan yang dipanggil 'sound level meter' di sepanjang 15 tempat sepanjang jalanraya-jalanraya yang dipilih. Kajian meliputi 16 jam dalam masa sehari. Tempat yang dipilih kemudiannya dibahagikan kepada tiga kumpulan utama. Berdasarkan kepada tahap purata kebisingan bunyi, kumpulan tersebut sekali lagi dibahagikan kepada kumpulan yang terdedah kepada bunyi bising dan kumpulan yang dikawal.

Keputusan:

Kajian menunjukkan terdapat 6 subjek dari kumpulan yang didedahkan kepada bunyi bising mengalami masalah pendengaran yang disebabkan oleh bunyi bising sementara hanya 2 subjek dari kumpulan yang dikawal mengalami masalah pendengaran yang disebabkan oleh bunyi bising.

Kesimpulan:

Tahap kebisingan persekitaran didapati di bawah tahap yang kritikal iaitu 85d BA, kecuali di beberapa tempat di mana ianya menghampiri tahap yang agak merbahaya ini.

Penilaian yang merangkumi faktor-faktor risiko yang membawa kepada masalah pendengaran didapati berkesan di dalam menjangkakan inciden kepekakan disebabkan oleh bunyi bising, terutamanya melibatkan kebisingan di tempat kerja, penyakit-penyakit sistemik dan hobi.

ABSTRACT

Objective:

The purpose of this study were to established the average traffic noise level in various places in Kota Bharu and to assess various risk factor of hearing loss and to document the incidence of noise- induced hearing loss among people living the traffic lane in Kota Bharu.

Methods :

The noise level were measured using the sound level meter at 15 sites along the traffic lane . The study was carried out for 16 hours per day. Those sites were then categorize into three main groups.Based on the average noise level the group then further divided into noise exposed group and control group. Then written questionnaire were given to both, the exposed group and control to assess the risk factors for hearing loss among them. Subsequently the pure tone audiogram were done to assess the hearing status

Results:

The study showed that 6 subjects from noise- exposed had noise –induced hearing loss pattern, while 2 subjects from control had noise- induced hearing loss pattern.

Conclusions :

The environmental noise is found to be below the critical level of 85dBA except at some places where it reaches very close to this hazardous figure. Evaluation of risks factor questionnaire is found effective in predicting the sensorineural hearing loss particularly in relation to noise exposure during employment an accident, systemic diseases and hobbies.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Noise is a non- periodic sound waves of random fluctuations of pressure of numerous unrelated frequencies and intensities. Physically noise is a complex sound that have no periodicity. Whereas, physiologically noise is a signal that bears no information and psychologically noise is a sound which irrespective of its waveform appears undesirable and unwanted. For example , a stereo set playing loud music on the first floor of a house may have a pleasant effect on someone while, it may be disturbing for another person located upstairs and trying to sleep.

Unwanted sound of various frequencies and intensities can be also called noise which carries no information; instead, it tends to interfere with one's ability to receive and interpret any useful sound.

In many cases , it is difficult to decide whether a sound carries an information or is merely a noise. Often, it is both. For example, the sound of a machine conveys information to the operator, whether it is running normally or not . But to an other person working next to him, it may be more like a noise. Noise is not just a sound rather it has some additional characteristics. Noise is a sound that is subjective , it must be heard before a value judgement is passed that the sound heard is indeed noise. However sound as noise is unwanted, irregular and erratic (random) that tends to interfere with the reception and interpretation of another sound.

Noise, whether a result of air traffic, crowded urban streets, personal stereos or high Powered machinery, rifle and shotguns , is one of America's most widespread nuisances (Clark *et al*, 1999).

Noise has been an increasing hazard in all developed and developing nations. An estimate suggest that 600 millions people have been working in environments with hazardous levels of noise (50 - 60 millions in the United States and Europe) (Alberti PW.1998).

Non industrial noise source mainly established as road traffic noise has been reported to be a perpetual cause of annoyance among community at large . A certain degree of environmental quietness is desirable in itself. People in general do not like to live in the immediate vicinity of airfield, or near the road with heavy traffic, or near other noisy places. Many residents exposed to outdoor traffic noise level consider it as unacceptable for sound sleep and amenity.

Kota Bharu, due to its increasing population, urbanization, road planning and ever rising volume of road traffic is likely to face this problem sooner or later. The land use and road planning of Kota Bharu is not well integrated . Honking tendency at many places during routine traffic jams is suggestive of frustation and annoyance.

Residential developments are in close proximity to transport corridors at many places. Appropriate buffers zones are not planned. Increasing tendency of reliance on one's own transportation, reluctance to share vehicles among family members and lack of public transportation have tremendously added to new vehicles on road .There is need to quantify the problem to protect the amenity of this town. At least, data regarding community exposure to noise must be available for any ready reference.

Type of noise

Steady – state : Continuous noise exposure in which overall levels do not vary more than +- 5 dBA.

Fluctuating : Continuous noise and overall level exceeds +- 5dBA.

Intermittent : Discontinuous noise in which the sound level may fall to non-hazardous level.

Impulsive : Transient noise that lasts less then 0.5 second.

Mechanism of Noise- induced hearing loss

There are many causes of hearing loss produced by noise and occupation, and the following classification covers most : -

a) Temporary threshold shift (TTS).

b) Permanent threshold shift (PTS).

Both of the above imply prolonged exposure to noise, which may be steady state, intermitent or a mixture of both.

In addition, there is a hearing loss caused by single intense sound sources classified as acoustic trauma , where the noise level is exceeding 140 dBA. It results in an immediate and permanent hearing loss. The organ Of Corti becomes detached from the basilar membrane, deteriorates and is replaced by scar tissue. Because the ear is damaged mechanically by impulsive sound, the maximum sound pressure level(SPL) is more important than the duration and is usually come from explosive events , such as a firecracker denoting the head (170dBA), a toy cap gun fired near the ear (155 dBA SPL) , or a shotgun, high-powered rifle, or pistol shot (160-170BA SPL).

Temporary threshold shift (TTS)

Temporary threshold shift is common occurrence following the exposure to loud music at a concert or following the exposure to firing of a gun or explosion of a firework. To such a person, sound appears muffled and often accompanied by tinnitus . In such state of TTS, if one listens to a radio or CD player, he may notice as if something wrong with his hearing that does not sound right. TTS may vary from an insignificant few d BA to profound level . After the termination of the noise, the hearing can turn to the pre-exposure level within a few minutes to several weeks (loss present for 4 weeks or more after an exposure is considered permanent). High frequency noises (2-6 KHz) are more effective in producing TTS than low frequency noises . In general , a TTS can be produced by sound levels grater than about 80 d B SPL.

The hair cells will undergo degree of anatomical and physiological changes ranging from disruptions of it's metabolic activities and losses of stereocilia rigidity which lead to " Floppy cilia" to the complete degeneration of the organ of Corti and the auditory nerve supply. Mild metabolic disruptions and "floppy cilia" can be reversible.

Permanent threshold shift

PTS results from mechanical destruction to the Organ of Corti with excessive Sound pressure waves . It occurs gradually and the frequencies at which hearing loss noted are within 3 – 6 KHz especially at 4KHz . PTS exists when the TTS does not recover completely, i.e., when hearing sensitivity does not return to its preexposure level.. Proposed mechanism for PTS due to noise are as below : -

a) Noise can cause disconnection between stereocilia of outerhair cells and the tectorial membrane , resulting in a reduction in the ability to translate the vibration from the basilar membrane. Hair cell's body suffers from metabolic exhaustion as a result of oxygen free radicals will swells up and finally leads to death of the cell (Aage , 1995).

b) Excessive noise may damage the microvascular system impeding supply of nutrients to the organ of Corti, hastening the metabolic exhaustion.

CONSEQUENCES OF NOISE EXPOSURE

1) Auditory effects of noise exposure

a) It can produce noise induced hearing loss pattern where the loss is marked at the higher frequency (2-6KHz) and usually with a sharp dip at 4KHz.

b) It can also produce tinnitus which is high pitched, continuous sound usually described as whistling.

c) Sometimes vertigo also can occur, but it is rare and it is known as Tullio phenomenon.

2) Non auditory effects of noise exposure

a)Vasoconstriction and minor changes in heart rate.

A study done by Talbott et al (1999), showed that there were significant effect of cumulative noise exposure on systolic blood pressure among occupational noise workers.

b) Slow deep breathing habit.

c) Galvanic skin resistance to electric flow

d) Brief changes in skeletal muscles tension.

e) Glandular stimulation , catecholamine release and increased basal metabolic rate.

f) Anxiety and annoyance.

In view of traffic noises, although it causes annoyance, there is little evidence from studies of psychological symptoms, psychotropic drug use, mental hospital admissions, and community studies that it causes psychiatric disorder but nevertheless may contribute to anxiety (Stansfeld et al. 1996).

Also in a study done by Stansfeld *et al.* (1996), a study of road traffic noise and psychiatric disorder, found that there is no overall association (or linear trend) between noise level and psychiatric disorder.

Despite that, some experienced sleep disturbances which include prolonged sleep latency (time from the commencement of a planned sleep and its actual onset); increased number of awakenings; increased movement time Murai *et al.*1999).

An idiosyncracy or increased sensitivity in individual to develop hearing loss may be a hereditary trait. Previous exposure to acoustic trauma may increase liability. The effect of previous middle ear disease and operations (stapedectomy) may depend on a critical sound pressure level below which the condition protects the cochlea, but above which the harmful effect of noise is accentuated. Older persons are more susceptible than younger.

Potential people to develop noise induced hearing loss are military personnels,police officers, firefighters, factory workers, construction workers, heavy industry workers, musicians and entertainment personals, industry professionals and airport workers. Although the hearing protectors were implemented, some of the workers do not know or refuse to use them. In a study done by Palausa *et al* (1995),a study done among Canadian military found that the awareness of hearing protector and its benefits among them was poor.

Besides that , people living near the noise source like traffic lane and airport have high risk of developing noise- induced hearing loss. A study done by Chen *et al* (1997) , showed that there is high prevalence of noise- induced hearing loss for those who are living near the airport . Also a study of population exposed to aircraft noise(Rosenlund *et al*, 2001), showed that there were increased prevalence of hypertension among those residing near the airport.

1.2 ANATOMY OF THE INNER EAR, ITS NEURAL PATHWAY AND PHYSIOLOGY OF HEARING

INNER EAR

The inner ear consists of the auditory and the vestibular labyrinths. The term labyrinth is used to denote the intricate maze of connecting pathways in the petrous portion of each temporal bone. The osseous labyrinth, (Figure 2.1) is the channel in the bone ; the membranous labyrinth (Figure2.2) is composed of soft tissues fluid- filled channels within the osseous labyrinth that contains the end- organ structures of hearing and vestibular systems.

The auditory labyrinth is called the cochlea and is the sensory end- organ of hearing. It consists of fluid-filled membranous channels within a spiral canal that encircles a bony central core. Here the sound waves, transformed into mechanical energy by the middle ear, set the fluid of cochlea into motion in a manner consistent with their intensity and frequency. Waves of fluid motion impinge on the membranous labyrinth and set off a chain of events that results in neural impulses being generated at VIIIth cranial nerve. The cochlea is a fluid –filled space within the temporal bone, which resembles the shape of a snail shell with 2.5 turns. Suspended within this fluid-filled space, or cochlear duct, is the membranous labyrinth, which is another fluid-filled space often referred as scala media.

The scala media separates the scala vestibuli from the scala tympani (Figure2.3). The scala vestibuli is the uppermost of the two perilymph-filled channels of the cochlear duct and terminates basally at the oval window. The scala tympani is the lowermost channel and terminates basally at the round window . Both of these channels terminate at the apical end of the cochlea at the helicotrema.

The scala media is an endolymph – filled channel that lies between the scala vestibuli and scala tympani. It is cordoned off by two membranes. Reissner's membrane serves as the cover of the scala media, separating it from the scala vestibuli. The basilar membrane serves as the base of the scala media, seperating it from scala tympani. Riding on the basilar membrane is the organ of Corti, which contains the sensory cells of hearing (Figure2.4 and 2.5). It is obvious that the microstructure of the organ of Corti is complex, containing nutrient, supporting the sensory cells.

There are two types of sensory cells, both of which are unique and very important to the function of hearing. These are termed as the outer hair cells and inner hair cells. The outer hair cells are elongated in shape and have small hairs, or cilia, attached to their top. These cilia are embedded into the tectorial membrane, which cover the organ of Corti (Figure2.6).

There are three rows of outer hair cells throughout most of the length of the cochlea. The outer hair cells are innervated mostly by efferent or motor, fibers of the nervous system.

There are about 13,000 outer hair cells in the cochlea. Inner hair cells are elongated and have an array of cilia on the top (Figure 2.7). The inner hair cells stand in a single row. The inner hair cells are innervated mostly by afferent or sensory, fibers of the nervous system.

The blood supply of the labyrinth

The blood supply comes from the labyrinthine artery which is usually a branch of the Anterior inferior cerebellar artery, although it may arise directly from the basilar or even the vertebral artery. The artery passes down the internal auditory meatus to divide into an anterior vestibular and common cochlear artery, which subsequently divides into cochlear and vestibulocochlear artery.

The anterior vestibular artery supplies the vestibular nerve, much of the utricle and parts of the semicircular ducts.

The vestibulocochlear artery, on arrival at the modiolus, in the region of the basal turn of the cochlea, divides into its terminal vestibular and cochlear branches, which take opposite directions. The vestibular branch supply the saccule, the greater part of the semicircular canals, and the basal end of the cochlea; the cochlear branch, running a spiral course around the modiolus, ends by anastomosing with the cochlear artery. The vestibular and cochlear branches both supply capillary areas in the spiral ganglion, the osseous spiral lamina, the limbus, and the spiral ligament.

In the internal auditory canal, the cochlear artery runs a spiral course around the acoustic nerve. In the cochlea, it runs a serpentine course around the modiolus, as the spiral modiolar artery, which is an end artery. Arterioles leave this artery, to run either into the spiral lamina or cross the roof of the scala vestibuli (Figure2.8). Both sets of arteries end in capillary networks either in spiral lamina or the stria vascularis on the lateral wall of the cochlear duct.

The capillaries from the lateral wall drain into venules which run under the floor of the scala tympani to empty into the modiolar veins which run spirally down the modiolus. The apical regions are drained by way of an anterior spiral vein, while the basal regions drain into the posterior spiral vein. These two branches of the spiral vein join with the anterior and posterior branches of the vestibular vein , in the region of the basal turn, to form the vein of the cochlear aqueduct- the principal vein of the cochlea- which empties into the jugular bulb.

The auditory pathway

The cochlear nerve

The fibers of the cochlear nerve are the central processes of nerve cells located in the spiral ganglion of the cochlea (Figure2.9). They enter the anterior surface of the brainstem at the lower border of the pons on the lateral side of the emerging facial nerve and are separated from it by the vestibular nerve (Figure 2.10). On entering the pons, the nerve fibers divides, one branch entering the posterior cochlear nucleus and the other branch entering the anterior cochlear nucleus.

Cochlear nuclei

The anterior and posterior cochlear nuclei are situated on the surface of the Inferior cerebellar peduncle (Figure 2.10). They receive afferent fibers from the Cochlea through the cochlear nerve. Then, the second order neuron runs medially through the pons to end in the Trapezoid body and the Olivary nucleus. Here they are relayed to the posterior nucleus of the Trapezoid body and the superior olivary nucleus on the same or the opposite side. The axons now ascend through the part of the pons and midbrain and form a tract known as the lateral Lemniscus (Figure2.10).

On reaching the midbrain, the fibers of the lateral lemniscus either terminate in the nucleus of the inferior colliculus or relayed in the medial geniculate body and pass to the auditory cortex of the cerebral hemisphere through the acoustic radiation of the internal capsule (Figure2.10).

The primary auditory cortex (area 41 and 42) includes the gyrus of Heschl on the surface of the superior temporal gyrus. The recognition and interpretation of sound on the basis of past experience takes place in the secondary auditory area.

The descending auditory pathway

Descending fibers originating in the auditory cortex and other nuclei in the auditory pathway accompany the ascending pathway. These fibers are bilateral and end on nerve cells at different levels of the auditory pathway and on the hair cells of the organ of Corti. These fibers serve as a feedback mechanism and inhibit the reception of sound, and in the process of auditory sharpening, suppressing some signals and enhancing others.

Physiology of hearing

As the sound waves travel through the outer ear, they are transformed into mechanical vibrations which then vibrate the ossicles and this stimulation is transmitted to the cochlear fluids by the in-and –out motions of the stapedial footplate at the oval window at the base of the cochlea. The oval window leads into the upper chamber(scala vestibuli). Hence, a given in-ward motion will cause the fluids to be displaced downward, pushing downward on the basilar membrane, and a given out-ward motion will displace the fluids and basilar membrane upward.

The site where this traveling wave will peak along the basilar membrane depends on the frequency of the sound.High frequencies are represented toward the base of the cochlea, and successively lower frequencies are represented closer and closer to the apex.

The traveling wave brings the stimulus to the appropriate location for a given frequency, which involves motion along the length of cochlear duct. The stereocilia in the other hand must be bent away from the modiolus in order for the hair cells to respond. In other words, the traveling wave moves along the cochlear duct (in the longitudinal direction) but the stereocilia must be bent across the duct(in the radial direction).

The stereocilia of the hair cells are actually linked to each other by transduction links (fine links running upwards from the tip ofthe shorter stereocilia on the hair cell which join the adjacent taller stereocilia of the next row) (Figure2.11). When the stereocilia are deflected in the direction of the tallest stereocilia, the links are stretched, opening ion channels in the cell membrane.When the stereocilia are deflected in the opposite direction,the tension is taken off the links, and the channels are closed .When the channels on the stereocilia are opened, ions will enter or leave the cell depending on the electrical and chemical gradient across the cell surface (Figure2.12).The resulting action potential will be generated and the impulse will be conducted via the cochlear nerve through auditory pathway.

CHAPTER 2

OBJECTIVES

OBJECTIVES

2.1 The specific objectives of this study are : -

2.1.1 To determine the average environmental traffic noise at various places in Kota Bharu and its effect on hearing of subjects exposed while at home or workplace residing along the edges of traffic lanes.

2.1.2 To assess the risk factors questionnaire in four main categories and analyze the hearing risk variables utilizing audiometric survey.

2.2 The general objectives of this study are : -

2.2.1 To determine the maximum and minimum noise values at various places in Kota Bharu.

2.1.2. To highlight the predominant noisy areas through average noise level measurement within Kota Bharu.

2.1.3 To draw the attention of local authorities on the management of ambient community noise, a possible threat to a so far peaceful environment of Kota Bharu.

2.1.4. To document the risks factors and possible diagnosis of hearing loss.

CHAPTER 3

METHODOLOGY

METHODOLOGY

3.1 The type of study

Cross sectional study.

3.2 Sample size

3.2.1. An initial pilot study was carried out from December 2000 to February 2001 to identify the problems that might be involved in the subsequent study and to provide a baseline data for statistical workup in calculating the sample size. The sample for the pilot study was taken from the U.S.M. community that has been exposed to noisy environment for many years. The subjects came from the hospital's kitchen, hospital's laundry(dobby), haematology laboratory , blood bank and endocrine laboratory. Those areas were identified as noisy workplaces according to sound level meter reading . Majority of those places showed readings > 75 d BA . From this pilot study , it was noted that 5% of them showed sensorineural hearing loss while 0.5 % showed noise-induced hearing loss pattern .Based on the findings the calculations were made for the sample size for the main study.

3.3 Inclusion criteria

3.3.1.This study involved the main three races in Malaysia which include malay, Chinese and Indian.

3.3.2. Subjects living near the traffic flow, we try to get all family members from same family, but some of them did not turn up due to personal problems.

3.3.3. People with others significant risks for sensorineural deafness also included in this study. This include those with medical illness, noisy hobbies, working in noisy environment and ear diseases.

3.4 Exclusion criteria

3.4.1. Subjects that have recently moved to the survey sites less than one year.

3.4.2. Children and elderly people.

For the children, the reason being is the inability to answer the questionnaire and invalidity of the audiogram findings. And for the elderly the risk of presbycusis were taken into account.

3.5 Sampling method : -

3.5.1. Measurement of noise level.

15 main areas within Kota Bharu were selected for the measurement of the noise level. The areas were ; -

1) Infront of Hospital University Science Malaysia (Raja Zainab road).
2) Infront of Billion supermarket.
3) Telipot residential area.
4) Kijang roundabout.
5) Infront of Naim Jaya supermarket.
6) Pasir Tumboh traffic signal.
7) Clock tower roundabout.
8) Siti Khadijah central market.

9) Telekom- SKMK.

10) Wakaf Siku traffic signal.

11) U.S.M. residential area(Pasir Tumboh).

12) J.P.J. residential area..

13) J.P.J. Panji.

14)Uda Murni residential area.

15)Kg. Dusun Raja.

3.6 Material and method

3.6.1 Sound level meter.

Sound level meter (S.L.M.) that is available in O.R.L. department was utilized for the study. S.L.M MODEL quest 1700/0 B-100 has the following specifications . Noise measurement is in A- weighted sound pressure with an instrument , model no., quest 1700/0B-100 . It is a battery operated , portable sound level meter with condenser microphone. This meter provides linear reading in a range of 20dBA - 140dBA , with weighted scale A &C and time constant being slow and fast. S.L.M. allows operating temperature of +5 c to + 35c . Microphone provides output impedance of 1700+-, sensitivity 20dBA and frequency response 30Hz – 1600Hz.

3.6.2. Pure tone audiometer

Audiometry equipment model no : Amplaid 161/C was employed in this Study in a quiet room (audiology lab.) in the department of O.R.L., H.U.S.M . All participants underwent otoscopic examination prior to the audiometric test. The audiometric test was performed by me myself.

3.6.3 Noise prevalence

1) Time of study conducted varied from 6 am- 10pm i.e.16 hours/day.
2) 16 hours period within a day was divided into 16 breaks, each one comprising of 30 minutes duration, i.e. 6:00 am to 6:30 am. A five minutes recording of noise during break was done.
   a) During each of this 5 minutes duration, a continuous recording of noise level was carried out. 20-30 recorded values were noted during each interval and average values were calculated as a representative of this 5 minutes reading.
   b) Finally, those 5 minutes interval (32 recorded) readings were averaged to indicate the prevalence of noise at any specific site under survey.
   c) The highest and lowest noise levels during the above interval (5 minutes) were determined to give the minimum and the maximum

peak level at all the sites surveyed.

3.6.4. Noisy sites

The places in Kota Bharu under survey were divided into 3 categories as following : -

1) Range of average noise level equal and less than 60dBA with an average of minimum and maximum peak values.
2) Range of average noise level in the range of 60dBA- 75dBA with an average of minimum and maximum peak values.
3) Average noise level of more than 75dBA with an average of minimum and maximum peak values.

3.7. Noise exposed and control group

The subjects in these two groups were picked up from the same area and the difference between them was the difference in distance of their residence or workplace from the main traffic lane. Subjects in control were further away from main traffic corridors.

3.8 Validity of questionnaire

At the beginning , the questionnaire was first made in malay version, then it was translated into to english and was checked by Unit Bahasa Jabatan Pendidikan P.P.S.P.,U.S.M. Then again the English version was translated back to malay version and checked by the Unit Bahasa Jabatan Pendidikan for any correction. Hence, those questionnaires were validated.

3.8.1 Questionnaire response

The questionnaire were attempted to assess the risk of hearing loss in 4 main categories : -

1) Noise exposure at employment sites.
2) Acoustic trauma
3) Medical diseases includes diabetes mellitus and hypertension.
4) Hobbies

The participants were only given questionnaire to answer if the audiometric findings showed an elevation in the hearing threshold and a conductive component of hearing loss.

CHAPTER 4

RESULTS

RESULTS

4.1 Patient characteristics

This study involved a total number of 150 subjects, 78 subjects from noise exposed and 72 subjects from control groups. The summary of gender and race is shown in table 4.1 and 4.2 respectively. Subjects ranged in age from 17 years to 54 years.

Table 4.1
The gender distribution from both groups, the noise exposed and control group.

	Noise exposed	**Control**	**Total**
Male	42	29	71
Female	36	43	79
Total	78	72	150

Table 4.2
The racial distribution among noise exposed and control group.

	Noise exposed	Control	Total
Malay	69	61	. 130
Chinese	5	5	10
Indian	4	6	10
Total	78	72	150

4.2 The distance

The mean distance in meter from main road for subjects from noise exposed and control . Levene's test for equality of variants shows the P value of 0.001 ,which is significant. The 95% Confidence Interval of difference range from -7.38to –1.83 with resulting degree of freedom of 148.Therefore the mean distance for both group suggest significant difference.