A STUDY OF BASELINE AUDIOGRAMS OF THAI FIRST YEAR BACHELOR DEGREE STUDENTS

NIPAPORN CHAROENRIT

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A STUDY OF BASELINE AUDIOGRAMS OF THAI FIRST YEAR BACHELOR DEGREE STUDENTS

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ABSTRACT

This study aimed to determine the baseline audiograms of Thai students in the southern part of Thailand. There were 1,500 students from four universities who attended the study; ie: Walailak University, Nakornsrithammarat Rajabhat University, Suratthanee Rajabhat University and Phuket Rajabhat University. Those students comprised 478 males and 1,022 females.

The average age of subjects was 19.45 years. The background of hearing loss was an average of 11.52 dB for the left ear and 12.30 dB for the right. The baseline audiogram for 500, 1000, and 2000 Hz for males was 12.58 dB for the left ear and 12.90 dB for right ear . The study determined the baseline of female as 11.65 dB for the left ear and 12.28 dB for right. The baseline audiogram for females was better than that of males and the baseline audiogram NIOSH Criteria Document was less than those of Thai students. It was also found that the baselines of hearing between male and female students were significantly different ($p < 0.05$). The difference of hearing between the left and right ear was also significantly different ($p < 0.05$). The correlation between the baseline of hearing and the distance from road to house on the left and right ear showed a significant difference ($p < 0.05$). The activities of noise exposure events were also in order as follows: riding a motorcycle, telephoning, listening to music by earphones, singers and musicians, and at discothèque. The relationship of the baseline of hearing level and noise exposure activities held significant differences ($p < 0.05$).

KEY WORDS: HEARING LOSS / BASELINE AUDIOGRAM / HEARING

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การศึกษาระดับการได้ยินของนักศึกษาในระดับอุดมศึกษาในภาคใต้
(A STUDY OF BASELINE AUDIOGRAMS OF THAI FIRST YEAR BACHELOR DEGREE STUDENTS)

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บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อประเมินหาระดับการได้ยินของนักศึกษาในระดับอุดมศึกษาในภาคใต้ ซึ่งมีอายุในช่วง 17 – 22 ปี จำนวนตัวอย่างที่ศึกษาในครั้งนี้มีจำนวน 1,500 คน ซึ่งซึ่งคัดเลือกกลุ่มตัวอย่างจากนักศึกษาชั้นปีที่หนึ่ง จากมหาวิทยาลัยวลัยลักษณ์ มหาวิทยาลัยราชภัฏนครศรีธรรมราช มหาวิทยาลัยราชภัฏสุราษฎร์ธานี มหาวิทยาลัยราชภัฏภูเก็ต

กลุ่มตัวอย่าง เป็นเพศชาย 478 คน เพศหญิง 1,022 คน อายุเฉลี่ยของกลุ่มตัวอย่าง 19.45 ปี ค่าเฉลี่ยการได้ยินของหูข้างซ้าย 11.52 เดซิเบล และค่าเฉลี่ยการได้ยินของหูข้างขวา 12.30 เดซิเบล จากการศึกษาระดับการได้ยินที่ความถี่ 500 1000 2000 เฮิร์ต พบว่า กลุ่มตัวอย่างเพศชายหูข้างซ้ายมีระดับการได้ยิน 12.58 เดซิเบล หูข้างขวามีระดับการได้ยิน 12.90 เดซิเบล สำหรับกลุ่มตัวอย่างเพศหญิง หูข้างซ้ายมีระดับการได้ยิน 11.65 เดซิเบล หูข้างขวามีระดับการได้ยิน 12.28 เดซิเบล ซึ่งเพศชายมีระดับการได้ยินสูงกว่าในเพศหญิงและเมื่อนำค่าระดับการได้ยินของกลุ่มตัวอย่างเปรียบเทียบกับเกณฑ์ระดับการได้ยินของ NIOSH Criteria Document ที่ช่วงอายุ17 – 22 ปีพบว่าระดับการได้ยินของกลุ่มตัวอย่างสูงกว่าเกณฑ์ที่กำหนดไว้ทั้งเพศชายและเพศหญิง

จากการทดสอบข้อมูลทางสถิติพบว่า ระดับการได้ยินของเพศชายและเพศหญิงมีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) ระดับการได้ยินของหูข้างซ้ายและหูข้างขวามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) และความสัมพันธ์ของระดับการได้ยินกับระยะระหว่างบ้านกับถนนมีความสัมพันธ์กันอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$) กิจกรรมที่เกี่ยวข้องกับการสัมผัสเสียงดังของกลุ่มตัวอย่างประกอบด้วย กิจกรรม การขับขี่จักรยานยนต์ การพูดคุยโทรศัพท์ การใช้หูฟังวิทยุ การร้องเพลงและเล่นดนตรี การเที่ยวดิสโก้เทค ซึ่งกิจกรรมเหล่านี้ควรหลีกเลี่ยงเพราะมีความสัมพันธ์กับระดับการสูญเสียได้ยินอย่างมีนัยสำคัญทางสถิติ ($p < 0.05$)

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CHAPTER I
INTRODUCTION

1. Background and rationale

Sound is important to the human. It was useful for communication, relaxing, pleasing, etc. At the mean time, the high sound level is the greatest hazard to human ears. Useless sound can be called noise. The effects of noise on hearing are compounded by factors such as intensity, frequency and duration. It is difficult to isolate a single effect from others.

The WHO suggested that noise can affect human health and well-being in a number of ways, including annoyance reaction, sleep disturbance, interference with communication, performance effects and effects on social behaviors and hearing loss. Noise is likely to continue as a major issue well into the next century, both in developed and in developing countries (1).

Ward WD. (1980) (2) studied the noise induced hearing damage. People who experienced high noise levels (especially around airports or along road/rail corridors) differ from one who was less noise exposure, in terms of increasing number of headaches, reliance on sedatives and sleeping pills, mental hospital admission rates and greater susceptibility to minor accidents.

In developing countries, children and young people comprise a larger share of the population than in developed countries. The general health condition is also worse. Hearing loss due to ear infections in childhood is more prevalent and affects the overall number of hearing impairment. In 1995 the UN World Health Organization, WHO, estimated that more than 25 million people in Southeast Asia suffers from disabling hearing loss. In Thailand, data indicated that approximately 13.5% of the population suffers from hearing loss. Xinhua News Agency (2002)(3)(In China a comprehensive survey showed that 3.3 percent of the population suffers from hearing loss. However, the prevalence of ear disorders has caused a relatively high incidence of hearing loss in Chinese children.

In many lesser developed areas of some countries such as Malaysia, India, Pakistan and Saudi Arabia, the knowledge and awareness of hearing loss is low. For example, surveys from India, Thailand and Pakistan indicated that hearing loss among children spreads widely in rural areas because of the prevalence of dangerous infectious diseases. In China, Pakistan and Saudi Arabia, some of the hearing loss may be caused by genetic effects related to marriages between close relatives. Hearing disabilities in Thailand are a common problem. A large-scale study including nearly 7,500 people from different regions of Thailand found that on average13.6 per cent suffer from different degrees of hearing loss. Great regional variations occurred with 25.2 percent in southern Thailand experiencing hearing loss and only about 6 per cent in Bangkok. Another study among more than 12,000 school children found differences between rural and urban children. Hearing problems were more common in rural areas with 6 per cent of the school children suffering from hearing loss while in Bangkok only 3.6 per cent suffered from it. The variations between cities and rural areas might result from a greater occurrence of middle ear problems such as otitis media and impacted cerumen among the rural population. Concentrating specifically on sensorineural hearing loss, a study involving more than 32,000 people found that 4.3 per cent of the population suffered from this kind of hearing loss. Generally, the overall prevalence of sensorineural hearing loss in Thailand is estimated to range from 3.5 to 5 per cent.(1)

The contents from many researches specified that there were a lot of people in the Southeast Asia facing hearing problems including children and young people in the southern part of Thailand. Those young Thais have experienced hearing loss problem. That may lead to the difficulty of living and the quality of life. This study aims to find the baseline data hearing level in southern part of Thailand. Expectantly, that can bring about the concerns of the hearing for Thai student.

2. Objectives

2.1 To study baseline data of hearing level among the Thai students in southern part of Thailand

2.2 To study the difference between baseline data of hearing level and gender.

2.3 To compare between NIOSH Criteria baseline audiogram and baseline audiogram of Thai student

2.4 To determine the difference between baseline data of hearing level between the left and the right ears

2.5 To find out the correlation between baseline data of hearing level and distance between road to house

2.6 To study the correlation between baselines data of hearing level and the sound exposure of subjects

3. Research Hypotheses

3.1 The baseline data of students' hearing level in each University are not different

3.2 The baseline data of hearing in male are different from one in female.

3.3 The hearing level between the NIOSH Criteria baseline audiogram is different from the Thai student

3.4 Hearing level in left ear is different from hearing level in the right ear.

3.5 The distances between road to house are not correlative with baseline of hearing level.

3.6 Noise exposure activities behavior is not correlation with baseline of hearing level.

4. Scope of this study

The scope of this study is to evaluate baseline hearing loss in the Thai students who are the first year students in bachelor degree program in the southern part of Thailand. The subjects of the study were from four universities which were Walailak

University, Nakornsrithammarat Rajphat University, Suratthanee Rajphat University and Phuket Rajphat University.

The Subjects, 1,500 persons, were selected by proposive sampling. They were in good health. They had no problem of hearing and were not over 25 years of age.

5. Variable

5.1 Independent Variables

5.1.1 Area

5.1.2 Gender

5.1.3 Left ears and right ears

5.1.4 The distance between road and house

5.1.5 Noise exposure activity

5.2 Dependent Variables

5.2.1 Baseline of hearing level

5.3 Control Variables

5.3.1 Subject's age: 17 to 25 years old (the first year students in bachelor degree program)

5.3.2 Subject' s hearing threshold less than 25 dB HL at 0.5,1,2,3,4,6, and 8 KHz

5.3.3 Health status

During the audiometric measurement, the subjects had to be in good health condition, and without any inflicting of diseases and abnormalities.

5.3.4 Ear diseases

Subjects must not have any ear problems histories such as pains, ear drainages, ear diseases or excessive wax build–up, otitis, fullness sensation, tinnitus

5.3.5 Medication affecting hearing threshold

During the measurement, subjects must not take any medications which might affect their hearing. The medications includes diuretics drug, antiseptic drug (streptomycin, kanamycin, neomycin), anti inframmatory, antimalarials, and antineoplastic agents.

6. Definitions

6.1 dB is the noise level measurement

6.2 Baseline audiometric test is the first audiometric test performed satisfactorily on a worker while employed by his/her current employer.

6.3 Abnormal baseline audiogram is an audiogram produced from a baseline audiometric test in which the hearing threshold, in either ear, averages 25 dB or more at 500 to 6000 Hz.

6.4 Periodic audiometric test is any audiometric test conducted after the baseline audiometric test for comparison with the baseline audiometric test and/or the last periodic audiometric test.

6.5 Early warning audiogram is an audiogram produced from a periodic audiometric test, which shows a drop of 15 dB or more, in either ear, at 2000 to 6000 Hz when compared to the worker's baseline audiometric test or to one of the worker's periodic audiometric tests.

6.6 Abnormal audiogram is an audiogram produced from a periodic audiometric test which shows a drop, in either ear, of 15 dB or more at any two adjacent frequencies, or a drop of 25 dB or more at any one frequency, from 500 to 6000 Hz when compared to the worker's baseline audiometric test or to one of the worker's periodic audiometric tests.

6.7 Hearing level is the amount, (in decibels), by which the threshold of audibility for an ear differs from a standard audiometric threshold.

6.8 Audiogram is a graph or table obtained from an audiometric examination showing hearing level as a function of frequency.

6.9 Baseline audiogram is an audiogram obtained from an audiometric examination that is preceded by a period of at least 14 hours of quiet.

6.10 Acoustical calibration is a procedure by which an audiometer is checked to determine if it is producing the correct intensity level of pure tones, at specified frequencies, and that the signals are free from distortion and unwanted sounds.

6.11 ANSI is an abbreviation for the American National Standards Institute; a standards making body.

6.12 Annual audiogram is an audiogram performed yearly following a baseline audiogram.

6.13 Audiologist is a professional specializing in the study and rehabilitation of hearing, who is certified by the American Speech-Language-Hearing Association or 1icensed by a state board of examiners.

6.14 Audiometer is an electro acoustical generator of pure tones at selected hearing frequencies and of calibrated output used for the purpose of determining an individual's threshold of hearing.

6.15 Biological calibration is an audiometer calibration that tests the audiometer's output using an adult with known normal hearing who has not been exposed to noise and has no history of ear disease.

6.16 Calibrate is to check noise measurement equipment and audiometric testing equipment for accuracy and uniformity.

6.17 Hertz (Hz) is a unit of frequency; synonymous term for cycles per second.

6.18 Background noise may be defined as background sound that is apparent in the room, stemming from many possible sources such as the heating, ventilations, and air-conditioning (HVAC) system, other equipment in the room, exterior sources such as traffic or airplane noise, or neighboring spaces.

7. Expected outcomes and benefits

7.1 To know the baseline data of hearing level in Thai people who are 17 – 22 years of age in southern part of Thailand.

7.2 To identify the difference between baseline audiogram NIOSH Criteria Document and baseline data of hearing level for Thai people who are 17 – 22 years old in southern part of Thailand

7.3 To be aware of the baseline data for prevent hearing loss in Thai students

CHAPTER II
LITERATURE REVIEW

1. Sound and the ear (4,5)

Sound consists of vibrations of air in the form of waves. The ear is able to pick up these vibrations and convert them into electrical signals that are sent to the brain. In the brain, these signals are translated into meaningful information, such as language or music with qualities like volume and pitch. The volume of sound is measured in decibels (dB).

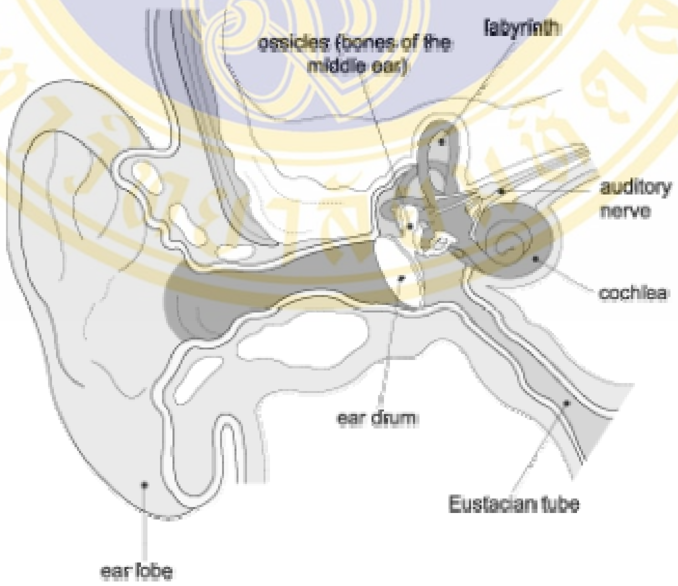


Figure 2 – 1 Cross section of the ear

The ear consists of three parts: the outer ear, middle ear and inner ear. Please see the diagram, over the page. The outer ear is the visible part of the ear on either side of the head and includes the ear canals that go into the head. The fleshy parts of the outer ear act as "collectors" of sound waves, which then travel down the ear canal to the eardrum. This is a membrane of tissue that separates the outer ear from the middle ear.The sound waves cause the eardrum to vibrate. This vibration is passed on to the middle ear, which consists of three small bones called the "ossicles", which amplify and conduct the vibrations of the eardrum to the inner ear.The inner ear consists of an organ called the cochlea, which is shaped like a snail's shell. The cochlea contains tiny cells called hair cells, which move in response to the vibrations passed from the ossicles. The movement of these hair cells generates an electrical signal that is transmitted to the brain.

2. Physiological Effects (6)

Noise can elicit many different physiological responses. However, no clear evidence indicates that the continue activitation of these responses leads to irreversible changes and permanent health effects. It is important, therefore, to consider not only the moreover effects of noise such as hearing loss and the making of speech, but also the more subtle effects which noise can produce. These nonauditory effects can be merely transitory or, in some cases long lasting. They can take place without conscious knowledge of there occurrence.

2.1 Pain.

There are two general types of aural pain or discomfort. The first type is caused by the stretching of the tympanic membrane tissues in response to large amplitude sound waves. Although there is a fairly wide range of wide rang of individual variability, especially for high-frequency stimuli, the threshold of pain for normal ears is approximately 135-140 dB SPL.This pain threshold is essentially independent of frequency, and it can affect people with a hearing loss as those with normal hearing since it is not a function of the ear’s sensori-neural system.

A second type of aural discomfort occurs as a result of abnormal function in the cochlea or inner ear. Frequency, noise induced hearing losses are accompanied by a condition called auditory recruitment, which is defined as an abnormal increase in loudness perception. In some cases, the condition is severe, and it can lead to considerably lower thresholds of aural discomfort or pain. Consequently, sound level of only moderate intensity can occasionally be quite uncomfortable to individuals experiencing auditory recruitment.

2.2 Startle reflex.

Noise induce orienting reflexes serve to locate the source of a sudden sound and, in combination with the startle reflex, prepare the individual to take appropriate action in the event danger is present. Apart from possibly increasing the chance of an accident in some situations, there are no clear indications that the effects harmful since these effects are of short duration and do not causes long – time body changes.

2.3 Effect on sleep.

Noise can interfere with sleep; the problem of relating noise exposure level to quality of sleep is, however, difficult. Even noise of a very moderate level can change the patterns of sleep, but the determination of the significance of these changes is still an open question. Noise exposure may cause fatigue, irritability, or insomnia in some individuals but the quantitative evidence in this regard is unclear. No firm relationship between noise and these factors can be established at this time.

2.4 Stress.

Noise exposure can be presumed to cause general stress by itself or in conjunction with other stressors. Neither the relationship between noise exposure and stress nor the threshold noise level or duration at which stress may appear has been resolved.

Short and infrequent periods of stress are usually harmless if there is an opportunity for the body to recuperate within a brief period after exposure. Long-term stress, however, poses a potential danger to the health of an individual; this attitude is based on extensive experimental work on animal Major factors that have not yet been resolved are (a) the point at which a noise becomes a stressing agent in man, and (b) what amount of exposure is necessary to cause long-lasting or permanent physiological changes.

The concept that stress is universally bad unhealthy is misleading. At certain times, some stressing agents and stressful situations might be construed as necessary (such as alerting, orienting, or motivating). Thus, although it is plausible that noise can be detrimental as a stressing agent, there is insufficient data to state unequivocally that noise as a stressing agent, there is insufficient data to state unequivocally that noise as a stressor is sufficiently severe to cause serious troublesome reactions.

3. Effects on social contacts (7)

Unlike the blind and the crippled, hearing impaired individuals give no outward indication of disability. Mostly people are likely to confuse imperfect hearing with imperfect intelligence. This hurts the hard-of-hearing person's feelings; this and similar attitude make for a strained relationship between a speaker and a listener. As a result, the hard-of-hearing person frequently limits his social contacts, which often leads to moods of frustration, insecurity, and even aggression

The hard-of-hearing person misses "small talk", the low frequency sound. The person does not get the flavor of a conversation. This eventually makes him feel shut off from the normal hearing world around him and makes him a prey to discouragement and hopelessness. Until a person loses some hearing, he can hardly realize how important it is to hear the small background sounds around him, and how much these sound help him to feel alive.

Hearing loss today is far more handicapping than it was before television, radio, and the telephone began to play such a major role in education, leisure, and the business word. Today the inability to understand speech on a telephone would be a major handicap for the vast majority of people. The loss of the ability to perceive high tones to musician or even to an audio high fidelity fan also is handicapping. The hearing loss of tomorrow will have a different handicapping effect from the hearing loss of today.

4. Causes of hearing loss (8)

There are many possible causes of hearing loss. These can be divided into two basic types, called conductive and sensorineural hearing loss.

4.1 Conductive hearing loss is caused by anything that interferes with the transmission of sound from the outer to the inner ear. Possible causes include: middle ear infections (otitis media) ,collection of fluid in the middle ear ("glue ear" in children),blockage of the outer ear (by wax) ,damage to the eardrum by infection or an injury ,otosclerosis, a condition in which the ossicles of the middle ear become immobile because of growth of the surrounding bone ,rarely rheumatoid arthritis affects the joints between the ossicles.

4.2 Sensor neural hearing loss is due to damage to the pathway for sound impulses from the hair cells of the inner ear to the auditory nerve and the brain. Possible causes include: age-related hearing loss - the decline in hearing that many people experience as they get older ,acoustic trauma (injury caused by loud noise) to the hair cells ,viral infections of the inner ear (may be caused by viruses such as mumps or easles) ,certain drugs, such as aspirin, quinine and some antibiotics, which can affect the hair cells ,an acoustic neuroma, a benign (non-cancerous) tumors affecting the auditory nerve ,viral infections of the auditory nerve (such as mumps and rubella) ,infections or inflammation of the brain or brain covering meningitis ,multiple sclerosis ,a brain tumour ,a stroke

Adult may have difficulty hearing sound pitched higher than 12,000 Hz. Speech frequencies are in the rang of 20 Hz to 2000 Hz. Needless to say ,the process of hearing as related to the work environment is considerably more detailed. These details have been left to others

5. A side effect of medication

The action of some medications can cause hearing loss, as well as aggravate existing hearing problems. Doctors refer to these as ototoxic drugs. The effects of such drugs, which can range from mild to severe, depend on the dose and the length of time you take them. Heredity may also play a role.

Hearing problems caused by some ototoxic drugs go away when you stop taking the medication. Drugs that are known to cause permanent hearing loss are usually given only when no other alternative exists for treating a life-threatening disease.

About 200 drugs are considered ototoxic. If you and your doctor decide that it's in your best interest to take an ototoxic drug, an audiologist will likely test your hearing before, after and while you take the medication. Your physician will closely monitor test results to help decide how long you can continue the drug or when to change the dosage. If you have existing hearing problems, be sure to let your doctor know. This can help you avoid unnecessary exposure to ototoxic drugs.

Table 2-1 Examples of ototoxic medications

Class of drugs	Specific examples	Effects on hearing
Salicylates	Aspirin Salsalate (Disalcid)	Hearing loss may occur at high doses but usually is reversible.
Quinoline-related drugs	Chloroquine (Aralen) Quinine (Quinamm)	Hearing loss may occur at high doses or with prolonged therapy but usually is reversible when the drug is discontinued.
Loop diuretics (a specific type of water pill)	Bumetanide (Bumex) Furosemide (Lasix) Ethacrynic acid (Edecrin)	Can cause temporary or permanent hearing loss. If these drugs are given with other ototoxic drugs, the risk of permanent damage may increase.
Amino glycosides	Amikacin (Amikin) Gentamicin (Garamycin)	Risk of hearing loss increases with longer duration of use and at higher doses. Damage may be permanent.

6. Degree of hearing loss (9)

Although the type of hearing loss is important, of equal important is the degree of the impairment. Because the critical range for hearing speech is 500 through 200 Hz, most professionals focus on this range of hearing when describing the extent of a hearing loss. An I individual's hearing loss for speech can be estimated by taking an arithmetic average of the threshold for pure tone, as seen on the audiogram, for the three test frequencies of 500, and 2000 Hz.

Table 2-2 Classification of degree of hearing loss

Degree	Average Hearing Level for 500, 1000, and 2000 Hz In the better ear		Ability to Understand Speech
	At Least (dB)	Less than (dB)	
None	-	25	No difficulty
Slight	25	40	Difficulty with faint Speech
Mild	40	55	Frequent difficult with Faint speech
Moderate	55	70	Frequent difficult with Loud speech
Severs	70	90	Can hear only shouted or Amplified speech
Profound	90	-	Very limited usable hearing

7. NIOSH recommendations and AAOO-AMA guide. (10)

7.1 NIOSH recommendations

7.1.1 NIOSH recommendations criteria document for occupational exposure to noise recommended a slightly different definition of hearing impairment. NIOSH stated that hearing level at 1000, 2000, and 3000 Hz exceeds 25 dB ANSI 1969. The principal reasons given by NIOSH for this definition are as follow:

1. The basic of hearing impairment should not be limited to only the ability to understand speech.

2. The ability to hear sentence and repeat them correctly in quite is not satisfactory evidence of adequate hearing for speech communication under everyday conditions.

3. The abiliy to understand speech under everyday condition is best predicted on the basis of the average hearing level at 1000, 2000, and 3000 Hz.

4. The point at which the average hearing level at 1000,2000, and 3000 Hz begin to have a detrimental effect on the ability to understand speech is 25 dB ANSI 1969.

7.1.2 The method for correcting initial baseline audiograms for age. Age corrections to initial baseline audiograms shall be made in the following manner. For each audiometric test frequency

Table 2 – 3 Age corrections values to be use for age correction of initial baseline audiograms for males

Age (year)	Audiometric Test Frequency (Hz)					
	500	1000	2000	3000	4000	6000
20 or younger	10	5	3	4	5	8
21	10	5	3	4	5	8
22	10	5	3	4	5	8
23	10	5	3	4	6	9
24	10	5	3	5	6	9
25	11	5	3	5	7	10
26	11	5	4	5	7	10
27	11	5	4	6	7	11
28	11	6	4	6	8	11
29	11	6	4	6	8	12
30	11	6	4	6	9	12
31	12	6	4	7	9	13
32	12	6	5	7	10	14
33	12	6	5	7	10	14
34	12	6	5	8	11	15
35	12	7	5	8	11	15
36	12	7	5	9	12	16
37	13	7	6	9	12	17
38	13	7	6	9	13	17
39	13	7	6	10	14	18
40	13	7	6	10	14	19
41	13	7	6	11	15	20
42	14	7	7	11	16	20
43	14	8	7	12	16	21
44	14	8	7	12	17	22
45	14	8	7	13	18	23

Table 2 – 3 Age corrections values to be used for age correction of initial baseline audiograms for males (continued)

Age (year)	Audiometric Test Frequency (Hz)					
	500	1000	2000	3000	4000	6000
46	14	8	8	13	19	24
47	14	8	8	14	19	24
48	15	9	8	14	20	25
49	15	9	9	15	21	26
50	15	9	9	16	22	27
51	15	9	9	16	23	28
52	15	9	10	17	24	29
53	16	9	10	18	25	30
54	16	10	10	18	26	31
55	16	10	11	19	27	32
56	16	10	11	20	28	34
57	16	10	11	21	29	35
58	17	10	12	22	31	36
59	17	11	12	22	32	37
60 or older	17	11	13	23	33	38

Table 2 – 4 Age corrections values to be used for age correction of initial baseline audiograms for females

Age (year)	Audiometric Test Frequency (Hz)					
	500	1000	2000	3000	4000	6000
20 or younger	15	7	4	3	3	6
21	16	7	4	4	3	6
22	16	7	4	4	4	6
23	16	7	5	4	4	7
24	16	7	5	4	4	7
25	16	8	5	4	4	7
26	16	8	5	5	4	8
27	17	8	5	5	5	8
28	17	8	5	5	5	8
29	17	8	5	5	5	9
30	17	8	6	5	5	9
31	17	8	6	6	5	9
32	17	8	6	6	6	10
33	18	9	6	6	6	10
34	18	9	6	6	6	10
35	18	9	6	7	7	11
36	18	9	7	7	7	11
37	18	9	7	7	7	12
38	18	10	7	7	7	12
39	19	10	7	8	8	12
40	19	10	7	8	8	13
41	19	10	8	8	8	13
42	19	10	8	9	9	13
43	19	11	8	9	9	14
44	20	11	8	9	9	14
45	20	11	8	10	10	15

Table 2 – 4 Age corrections values to be used for age correction of initial baseline audiograms for females (continued)

Age (year)	Audiometric Test Frequen14cy (Hz)					
	500	1000	2000	3000	4000	6000
46	20	11	9	10	10	15
47	20	11	9	10	11	16
48	20	12	9	11	11	16
49	21	12	9	11	11	16
51	21	12	10	12	12	17
52	21	12	10	12	13	18
53	21	13	10	13	13	18
54	21	13	11	13	14	19
55	22	13	11	14	14	19
56	22	13	11	14	15	20
57	22	13	11	15	15	20
58	22	14	12	15	16	21
59	22	14	12	16	16	21

7.2 AAOO-AMA guide.

The committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology, after year of studying the various method and procedures used to determine hearing damage, issued a report that was published by the American Medical association as the ‘‘ Guide for the Evaluation of hearing Impairment’’. It recommended that the average hearing level for the pure tones at 500 Hz, 1000 Hz, and 2000 Hz be used as an indirect measure of the probable ability to hear everyday speech. It recommended that the average hearing level for the pure tones at 500 Hz, 1000 Hz and 2000 Hz is 25 ANSI 1996 (15 dB ASA 1951) or less, the AMA Guide stated that usually no impairment exists the ability to hear everyday speech under everyday conditions.

8. Constantly quiet test environment (10,11,12,13)

The first requirement for accurate industrial eudiometry is to have the background noise in the test booth or room at or below the appropriate values specified in ANSI S3.1-1960 (R1971) as shown in Table 2 – 5

Table 2 – 5 Maximum background noise audiometer rooms

	Octave – band Center Frequencies (Hz)					
	500	1000	2000	4000	6000	8000
Band Sound Level (dB)	40	40	47	57	62	67

9. Background noise levels (10,11)

An Engineering noise survey of the proposed test area should be made with an octave band analyzer. The ambient background noise level present in the area proposed for the location of the booth will determine the acoustical characteristics of the booth necessary to obtain a satisfactory audiometric testing environment. The maximum allowable noise levels inside the audiometric test booth are listed in ANSI S3.1 – 1960 (R1971), Criteria for Background Noise in Audiometer Rooms. A safety factor of 10 dB should be used when specifying maximum background level as shown in Table 2 – 6

Table 2 – 6 Sample calculation using audiometric booth attenuation data

Preferred Center Test Frequency (Hz)	Octave Band				
	500	1000	2000	4000	6000
Maximum allowable band sound level ANSI S3.1 – 1960 (dB)	40	40	47	57	62
Attenuation (dB) of audiometric booth (data supplied by manufacture)	46	53	58	61	63
Maximum allowable ambient background levels (dB) outside ANSI S3.1 - 1960	86	93	105	118	125
Safety factor (-dB)	-10	-10	-10	-10	-10
Suggested maximum allowable background noise levels (dB) outside this particular audiometric test booth	76	83	95	108	115

Frequently, the ambient noise level in the audiometric test area fluctuate; therefore, the use of a safety factor of at least 10 dB is a good practice (11) , and its use will ensure long term adequacy of the audiometric testing facility. However, the audiometer earphones be mounted inside earmuffs to replace an audiometric testing room. The characteristics of some earmuffs may not be sufficient to meet ANSI standards when use in some areas, and could yield unreliable results. Earphone to ear coupling may vary depending on how well the earmuffs fit each individual.

10. Audiometric booth (10,13)

Audiometric rooms are designed for use for earphone audiometric testing. An audiometric booth is not a sound proof room but is used where there is a need to reduce surrounding noise to a very low level and prevent any echo or boom within the booth. This is done by reducing external noise to the same proportion as the noise within the booth.

10.1 Features include:

10.1.1 Noise reduction

10.1.2 Automatic door closures

10.1.3 Ventilation

10.1.4 Double glazed windows

10.1.5 Lighting - Power

10.1.6 Painting

10.1.7 Internal fitment

10.1.8 Special lining

10.1.9 Carpeted floor

10.2 Applications

10.2.1 Factories

10.2.2 Doctors Surgeries

10.2.3 Hospitals

10.3 Construction

Booths are generally constructed of galvanized mild steel and lined with acoustic fiberglass faced with acoustic galvanized perforated metal. The floor would be of similar construction to the walls, with suitable structural support as required. Anti-vibration mounts are fitted to minimized the amount of vibration reaching the unit. A single door sealed with molded rubber strips and heavy hinges and can be opened from inside or outside. A double glazed window would be fitted to one wall. Positive ventilation is by means of a fan and discharged via an attenuated outlet.

Figure 2–2 An audiometric test booth with double doors and wall provides considerable attenuation

11. The Audiometer (14)

An audiometer is a frequency compensated, audio-signal generator. It produced pure tones at various frequencies and intensities for use in measuring hearing sensitivity. The purpose of such hearing test is not only to identify existing hearing impairments, but more importantly, to monitor the effectiveness of hearing protection programs. In contrast to a clinical setting, where a variety of a audiometric tests are under taken, hearing tests in industry are limited to pure tone air – conduction audiometry. The audiometer was developed to provide electronically a stimular to that generated by the tuning fork. In one respect the audiometer is superior to the tuning fork, in that, intensities can be controlled much more accurately; therefore, the results can be more carefully quantified.

The wide-range audiometer produces signals in the major portion of the human auditory range. It includes a pair of air-conduction earphones, a bone vibrator, a tone switch, and facilities for masking the opposite ear during testing. The wide-rang audiometer is intended for use primarily in clinical and diagnostic applications.

The limited-range audiometer is more restricted than a wide-range audiometer audiometer in its range of frequency and of sound pressure level. It produces pure tone at 500, 1000,2000,3000,4000, and 6000 Hz, at intensity levels from 10 dB to 70 dB standard reference threshold level. The limited-range audiometer is intended for measuring the hearing threshold levels of adult populations typical of those found in industry. Vaccuum tubes were used in the early audiometer and were continued in exclusives use until the recent development of solid-state circuitry, which is now basic in the newer audiometer design. If fully tran warm-up period. They may be turned on and off as needed. Transistorized audiometers are more stable and more reliable than vacuum tube instruments.

Most audiometric technicians are well aware of the importance of a properly serviced and calibrated instrument; however, the technician, although trained and qualified to make basic audiometric measurements, may not be aware of the problems with an audiometer than can affect the test results.

An audiometer is an electronic device, and like any other electronic device, it can deteriorate over a period of time. The day-to-day change may go unnoticed unless the user is swearing of certain problems that can exist. Some guidelines and procedures to aid the operator in determining.

Figurure 2-3 Demonstration of the audio metric calibration set - up

12. Audiometric Testing – Results (15)

12.1 Reportable Hearing Loss:

12.1.1 This is a hearing loss relative to the worker's baseline audiogram (or upward revised baseline).

12.1.2 It is a 25 db average change for the worse in either ear at 2000, 3000, and 4000 hertz.

12.1.3 This hearing loss must be reported on the MSHA Accident form 7000-1

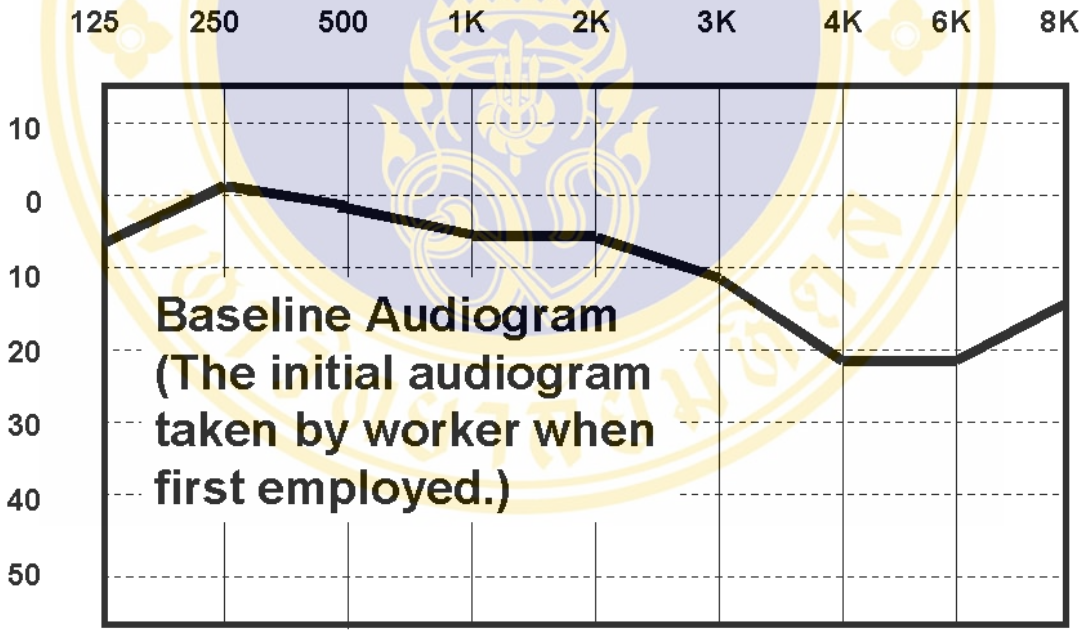
12.2 Standard Threshold Shift:

12.2.1 This is a hearing loss relative to the baseline audiogram

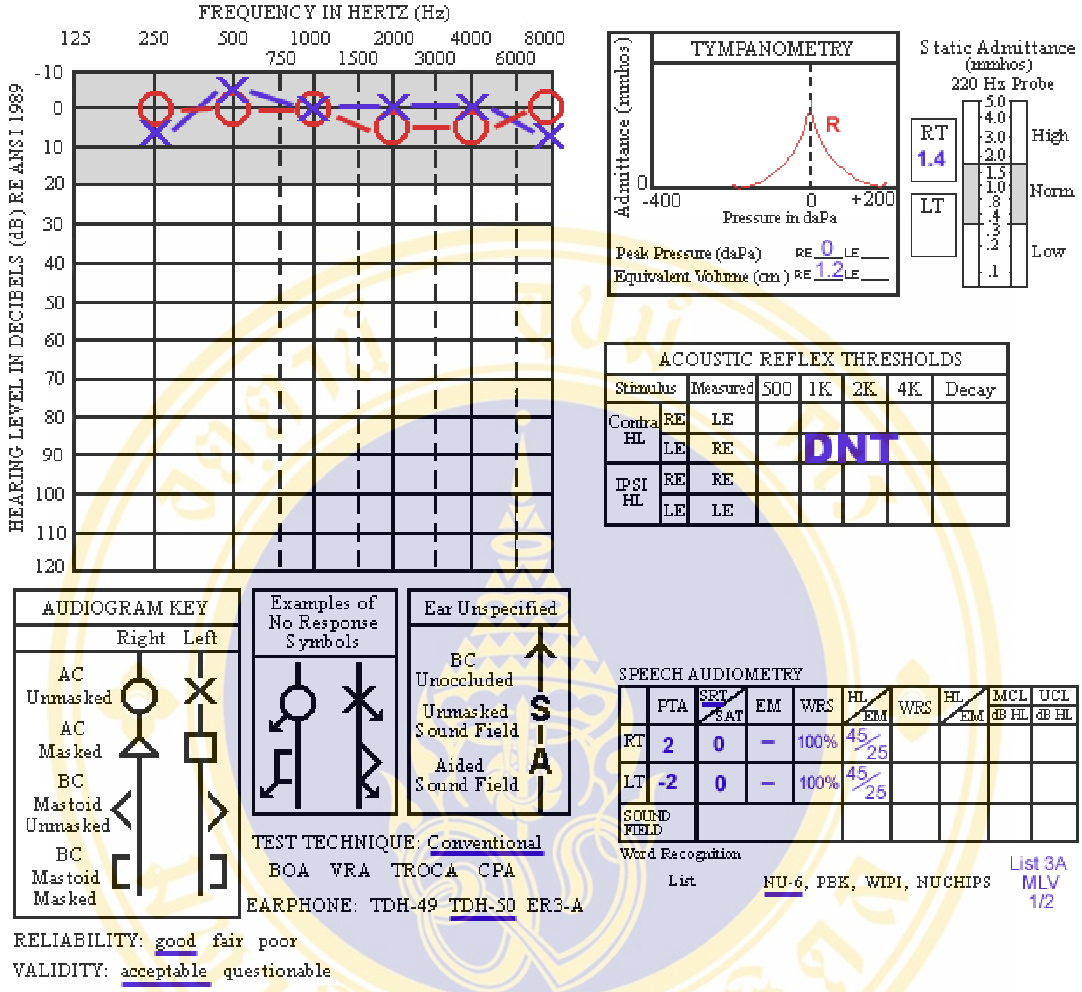
(or upward revised baseline)

12.2.2 It is a 10 db average change for the worse in either ear at 2000, 3000, and 4000 hertz.

12.2.3 An employee shown to have a Standard Threshold Shift (STS) must be retrained and offered hearing protection by the company if the audiologist determines the STS to be work related. The company must review the effectiveness of engineering and administrative noise controls.



Figurure 2 - 4 Baseline audiogram



Figurure 2 - 5 Audiogram for a patient with normal hearing

13. Calibration check. (16)

1. Pass:+5 dB of baseline at 500 –4000 Hertz (Hz)and +10 dB at 6000 Hz.Mark (X) this column if periodic biological calibration check is within +5 dB of baseline at 500 -4000 Hz and + 10 dB at 6000 Hz (e.g., if baseline of 15 dB has been established at 1000 Hz in right ear, any of the following hearing threshold levels obtained on periodic check would require no action:10,15,or 20 dB).

2. Fail :greater than +5 dB of Baseline at 500 -4000 Hz and +10 dB at 6000 Hz.Mark this column if periodic biological calibration check is greater than +5 dB of baseline at 500 - 4000 Hz and +10 dB at 6000 Hz (e.g., if baseline of 15 dB has been established at 1000 Hz in right ear, any threshold levels of 5 dB or less or 25 dB or greater would require action). This discrepancy must be accounted for or audiometer should receive an electro acoustic calibration.

14. Hearing threshold level of test (16)

A. Baseline. After listener has demonstrated test-retest reliability (i.e., if test results of several pre-tests are consistently within +5 dB of each other), enter hearing threshold levels of last test results in increments of 5 dB (e.g., 0,5,10,15, etc.).

B. Periodic Biological Calibration Checks. Enter hearing threshold levels in increments of 5 dB. Use a separate line for each calibration check

15. Problem audiograms (16)

Examples of problem audiograms are: Audiograms that show large differences in hearing thresholds between the two ears, audiograms that show unusual hearing loss configurations that are atypical of noise-induced hearing loss, and audiograms with thresholds that are not repeatable.

Survey of noise level from vehicles that traveled in BMR and vicinity in 1998 reported that non-fixed route buses was the major noise source in these areas, 76 % of exceeded standard noise was generated by them. Meanwhile, only 10% was produced by trucks, 7% came from motorcycles and 1% was released from benzene automobiles (noise level from vehicle exhaust pipe shall not exceed 100 dB (A)). Therefore, in 2000, the non-fixed route buses are the important targets that their emitted noise are going to Baseline audiograms

The sensori – neural hearing loss that results from noise exposure is similar to losses cause by other, less apparent factors. It is, therefore, difficult in any particular case without a baseline preemployment audiogram to state what part of the employee's hearing loss can be attributed to state what part of the employee's hearing loss can be attributed to conditions at his present place of employment, and what part existed prior to being hired by his current employer.

The same problem presents itself where the employee has worked for numerous employers where each place of employment might have contributed to the final hearing loss. Which employer then is to be held responsible for the hearing loss found at the time of the claim. Several legislatures have settled this problem by enacting statutes which hold the last employer responsible for the entire hearing loss unless by competent audiometric evidence it can be established what the employee's baseline hearing level was at the beginning of employment.

Rules and statutes have alerted industry to the need for pre employment hearing tests to establish baseline audiograms. Additional audiograms should be taken at periodic intervals on workers exposed to hazardous noise, in order to be able to document the employees 'hearing ability through their years of employment.

The ambient noise in BMR, vicinity and regions has been monitored since 1996. The data show that the noise level from every roadside monitoring station was exceeded the noise standards (equivalent sound level 24 hours (Leq 24 hr.) shall not exceed 70 dB (A)). Particularly, some stations recorded the equivalent sound level 1 hour (Leq 1 hr.) exceeded 70 dB (A) hourly in a whole day, everyday. As a result, this noise level might effect a hearing ability of people who live near the roads

16. Research Cited

The WHO suggests that (1,17) noise can affect human health and well-being in a number of ways, including annoyance reaction, sleeps disturbance, interference with communication, performance effects, and effects on social behaviour and hearing loss. Noise can cause annoyance and frustration as a result of interference, interruption and distraction. Activity disturbance is regarded as an important indicator of the community impact of noise. The AEC national noise survey assessed two major disturbances, for example, to listening activities and sleep: 41% of respondents reported experiencing disturbance to listening activities and 42% to sleep

Kryter,K.D. (1970)(6) the research into the effects of noise on human health indicates a variety of health effects. People experiencing high noise levels (especially around airports or along road/rail corridors) differ from those with less noise expo sure in terms of: increased number of headaches, greater susceptibility to minor accidents, increased reliance on sedatives and sleeping pills, increased mental hospital admission rates Exposure to noise is also associated with a range of possible physical effects including: colds, changes in blood pressure, other cardiovascular changes, increased general medical practice attendance, problems with the digestive system and general fatigue Street Traffic Of all the sources of noise pollution, street traffic is the most prevalent and perhaps damaging source of noise pollution. Indeed, Sharp and Donovan (1979) confirm that "more people are exposed to noise from motor vehicles than any other single source of noise. Though this claim is now 20 years old, the prevalence of street traffic has certainly grown since then, and thus the impacts of traffic noise are still a major factor in human society.

Bugliarello, Alexandre, Barnes, & Wakstein, (1976) Engines exhaust systems, tires interacting with the road, and horns, generate noise that is emitted by street traffic. Of these, tires contribute most predominantly to the noise emitted by automobiles, both in the effects on passengers within a vehicle and in the contribution to roadside noise, especially in American-made cars. The other components of traffic noise are significant contributors nonetheless. Exhaust and engine noise, for example, have been implicated more even more prevalent than tire noise in some cases, especially in Japanese and European-made cars. Further, noise produced during acceleration can be as much as 20 dB greater than that produced at cruising speed. Motorcycles are another source of traffic noise, and they present a unique situation. First, unlike cars, trucks, and buses, tire noise contributes rather insignificantly to the overall amount of noise produced by motorcycles (Sharp & Donovan, 1979). Thus, the type of engine, acceleration, and other issues that are relevant to the engine system rather than the tires become more important when considering motorcycles as a noise source. Second, unlike passengers in cars, trucks, and buses, the rider of a motorcycle is not shielded by an enclosed compartment from the noise produced by their vehicle. Third, motorcycles can be particularly noisy; whereas cars generally produce noise levels in the range of 67-75 dB, motorcycle noise generally ranges from 72-83 dB, but can reach levels as high as 120 dB immediately behind the cycle.

The Central Pollution Control Board of India also specifies noise limits for vehicles and some domestic appliances and construction equipment as follows:

Table 2 – 7 Noise limits for vehicles and some domestic appliances and construction equipment

Equipment	Noise Limit (dBA)
Small motorbike or scooter	80
Passenger Car	82
Small Bus or Commercial Vehicle	85
Medium Bus or Commercial Vehicle	89
Large Bus or Commercial Vehicle	91
Domestic Air Conditioner	68
Refrigerator	46
Domestic Generator	85
Compactors (rollers), Front Loaders, Concrete Mixers, Cranes (moveable)	75

Davis (1995)(18) show about study of hearing for 20 % of the adult population had an average hearing threshold level of 25 db or greater in the better ear. The major factor that determined both prevalence and the distribution of hearing thresholds was age. At the higher percentiles the effect of age was greater than at the lower percentiles, but in general the effect was monotonic and the rate of decrease of hearing impairment appeared to greater for those over 50-55 years than for those younger than 50 years.

Hans M.Borchgrevink, Kristian Tambs, Howard J. Hoffman (1996 – 1998)(19) As supplement to a general health screening examination, they conducted a pure tone audiometry study in 1996 – 1998 on adult (>20 years) in 17 of 23 municipalities in Nord Trondelag, Norway, with questionnaires on occupational and leisure noise exposure, medical history, and symptoms of hearing impairment, and familial or genetic influences on hearing. Audiometric data were collected from 62 % (n = 50,733) of 81,600 unscreened invite subjects (age – rang 20 – 101 years,meam =50.2 year, SD=17.0 years) .Test – retest correlations 0.25- 8 kHz among 99 randomly drawn subjects examined twice were (right – ear) .88 -.91 - .96 - .98 -.97 - .95 -.97 and (left – ear) .68 -.79 -.94 -.97 -.98 -.97 -.97 , respectively. Mean thresholds show negligible male – female differences < 1kHz,but were poorer in males from > 3 kHz,with maximal gender differences of around 20 dB at 3 – 4 kHz for subjects aged 55 – 74 years. Mean > 10 dB hearing loss at 6kHz were register for both genders in the youngest age group 20 – 24 years, indicating noise – related socio – acusis – could also refect too restrictive 6 kHz reference thresholds.

Kahari (2002)(20) hearing in musicians and the many times high sound level cause by musician is a topic of current public and scientific interest. A newly released thesis from Goteborg University stressed the impoetance of including, tinnitus, hyperacusis distortion and diplacusis besides sensor neural hearing loss in the assessment of hearing disorders. This is especially vital among musicians who are dependent on a very well functioning auditory system and where tinnitus, hyperacusis, distortion and diplacusis are considered to be and even greater handicap than a slight to moderate high tone loss. The thesis showed also on a high prevalence of hearing disorders among the rock / jazz musicians studied (74%).

E Toppilla, J Starck, Pyykko (2000)(21) a randomized study was performed on 30 females (age 20 – 30 years) on the efficacy of AO to prevent discotheque – induced. Otologic examination and baseline hearing measure were made in a field clinic, adjacent to the discotheque.The subject alternately receive placebo or 400 mg N – acetylcysteine before exposure .Subject were in the discotheque for four hours.Exposure was monitored with apersonal noise dosimeter .Between leaving the discotheque and subsequent audiological examination,the subjects listened to music with headphones,at 93 dB (A) .Clinical audiometry was performed at 1k,2k,4k,8kHz and 0.5k,starting with the left ear.Transient otoacoustic emissions were measured from right ear with and without contralateral inhibition.The dosimetry showed personal exposure level of 92-94 dB (A) .The control subjects showed an average of hearing for 8.3 (left – Ear) and 10 (right) dB (A) at 4 kHz ,and between 0-3 dB at other frequencies.

Frank, Tom (2001) (22) Objective: The first purpose of this study was to determine high-frequency (8 to 16 kHz) thresholds for standardizing reference equivalent threshold sound pressure levels (RETSPLs) for a Sennheiser HDA 200 earphone. The second and perhaps more important purpose of this study was to determine whether repeated high-frequency thresholds using a senheiser HDA 200 earphone had a lower intrasubject threshold variability than the ASHA 1994 significant threshold shift criteria for ototoxicity. design: high-frequency thresholds (8 to 16 kHz) were obtained for 100 (50 male, 50 female) normally hearing (0.25 to 8 kHz) young adults (mean age of 21.2 yr) in four separate test sessions using a Sennheiser HDA 200 earphone. The mean and median high-frequency thresholds were similar for each test session and increased as frequency increased. At each frequency, the high-frequency thresholds were not significantly ($p > 0.05$) different for gender, test ear, or test session. The median thresholds at each frequency were similar to the 1998 interim ISO RETSPLs; however, large standard deviations and wide threshold distributions indicated very high intersubject threshold variability, especially at 14 and 16 kHz. Threshold repeatability was determined by finding the threshold differences between each possible test session comparison ($N = 6$). About 98% of all of the threshold differences were within a clinically acceptable range of +/-10 dB from 8 to 14 kHz. The threshold differences between each subject's second, third, and fourth minus their first test session were also found to determine whether intrasubject threshold variability was less than the ASHA 1994 criteria for determining a significant threshold shift due to ototoxicity. The results indicated a false-positive rate of 0% for a threshold shift ≥20 dB at any frequency and a false-positive rate of 2% for a threshold shift >10 dB at two consecutive frequencies.

H. Silverstein, R. Wolfson, S. Roasemberg, (1992) the perception of sound the processing of sound and the understanding of sound each takes place in different regions of the auditory systems. For this reason clinical tests were designed for testing parts of the system that are suspected to be involved in various aspects of function. For instance, sound detection (inner ear) sound processing (inner ear, afferent cranial nerve VIII and brain stem) and analysis (brain stem and cortex). Most tests used are non invasive (tests do not permanently alter the system) and are repeatable. Loudness of sound is measured in decibels (dB) which are a logarithmic comparison of two intensities. Hearing loss >20dB is considered significant.

CHAPTER III
MATERIALS AND METHOD

1. Population and sample group

This study was a cross–sectional study that aimed to find the baseline of hearing level. This study was conducted on 1,500subjects selected from university students in the south. The subjects were both male and female with age rang of 17 – 25 years old. The hearing level threshold levels of the subjects were less than 25 dB at all frequencies as measured by a standard audiometer. A pre–selection interview was conducted to identify subjects with the following conditions:

1.1 They were the students in the first year of bachelor degree program.

1.2 Their hearing level threshold are less than 25 dB HL at 0.5,1,2,3,4,6, and 8 KHz.

1.3 Their health status are in decent condition without inflicting any diseases or abnormalities.

1.4 They had no histories of any ear problems such as pains, drainage, ear diseases or excessive wax build–up, otitis, fullness sensation, tinnitus, etc.

1.5 They were not in medication treatments, which may affect hearing level, this includes diuretics drug, antiseptic drug (streptomycin, kanamycin, neomycin)

2. Instrumentation

The instruments used in this studies were listed as follows:

2.1 Audiometer. Model No. RA500 Serial No.961813

2.2 Audiometric test booth

2.3 Sound level meter Model NA – 61 Serial No.66250822

2.4 Octave band filter Model Nx – 02 A Serial No.11251082

2.5 Sound level calibration Model Nc – 73

2.6 The audiometric form

2.7 The interview data sheet from Division of Occupational Health, Division of Occupational Health, Ministry of Public Health. Comprised of four parts, ie. Characteristic of subject, sound exposure history, health history and activity sound exposure.

3. Data Collection

3.1 Preparation before testing

3.1.1 The subjects who attended this study must not expose to high noise levels such as environmental noise for 14 hours prior to the test.

3.1.2 Each subject had check in order to ensure their qualification for the test.

3.2 Instruction for the subjects

3.2.1 Appropriately position a seat for each subject. The subjects must be turned to the opposite side of audiometer and/or in the position that they could not see the audiometer.

3.2.2 Clearly explain the protocols of audiometric testing to the subjects.

3.2.3 Notify the subjects that they would hear a series of tones with different loudness and frequency

3.2.4 The subjects had to respond by pressing the button every time they hear a tone.

3.2.5 Any unclear questions from the subjects must be answered before starting the test.

3.3 Operations of Instrument

3.3.1 Warmed up the audiometer before using

3.3.2 Performed a functional check

3.3.3 The researcher made sure that noises in the test area was not excessive (refer to ANSI S3.1 – 1969 criteria for permissible ambient noise during audiometric testing)

3.3.4 Turned on the audiometer and checked its operation carefully

3.3.5 Obtained adequate supplies of responses record result sheet

3.4 The test protocols

3.4.1 Preparatory phase

Carefully placed the headphones on the subject and made sure that the diagram of the headphone was directly over the ear canal (red on right ear, blue on left ear).

3.4.2 Test phase

After finished preparatory phase, the subject is ready for the test phase. In this illustrative example, a hearing level level of 10 dB was increased when the subject did not respond.

3.4.2.1 Start testing at 1000 Hz. First on the left ear, in case the better ear was not known.

3.4.2.2 Adjusted the intensity or hearing level control to a dial reading of 10 dB with the tone on. In case there was no responding, the increasing of the hearing level level would be operated until getting the response from the subject.

3.4.2.3 Left the pure tone sound at the hearing level point on for one to two seconds to prevent the mistake of subjects' hearing level.

3.4.2.4 Start to decrease 30 dB, and left the tone on again for one to two second. Checked the responding.

3.4.2.5 If the subject still responds, the intensity level of 10 dB will be decreased, and left the tone on again for one to two second. Continue decreasing the level of the tone in step of 10 dB until the intensity level was reached where the subject fails to respond.

3.4.2.6 Started increasing the intensity or hearing level of the tone by 5 dB, left the signal on for one to two seconds. If the subject still did not respond, another 5 dB would be increased. The same process would be repeated until the subject did respond.

3.4.2.7 Recording the hearing level of the subject. That would be the base line of hearing level.

4. Data Analysis

The data was analyzed by using the following statistics.

4.1 Descriptive Statistics

To describe the characteristics of subjects and all measurements by using Percentage, Average.

4.2 Analysis Statistics

4.2.1 To portray the similarities and differences between the hearing level in students from each selected university by ANOVA

4.2.2 To depict the relationships between the baseline of hearing level and gender by Independent T-test

4.2.3 To describe the relationships between the hearing level of the left ear and one of the right ear by pair of T-test

4.2.4 To explain the relationships of the baseline of hearing level and the distance between the road and subjects' houses by correlation

4.2.5 To describe the relationships between baseline of hearing level and noise exposure activity by correlation

CHAPTER IV
RESULTS

The result of this study was presented in six parts as follows:

Part 1 The characteristics of subjects and background noise.

Part 2 The similarities and differences between the hearing level in students from each selected university by ANOVA.

Part 3 The relationships between the baseline of hearing level and gender by Independent t-test.

Part 4 The relationships between the hearing level of the left ear and one of the right ear by pair T-test.

Part 5 The relationships between baseline of hearing level and the distance from the road to subjects' houses by correlation.

Part 6 The relationships Baseline of hearing level with noise exposure activity by correlation.

Part 1 The characteristics of subjects and background noise.

The subjects were selected from four universities in the southern part of Thailand. The number of subjects were first expected to be 1,575 persons in the age of 17 to 25 years old, however, the final subjects after checking the qualification were 1,500 subjects of the age between 17 to 22 years old. The percentage of male subjects were 48.52 , 19.80 , 24.89 , 43.30 in Walailak University , Nakhonsrithammarat Rajaphat University, Suratthanee Rajaphat University and Phuket Rajaphat University, The percentage of female subjects were 51.47 , 80.20 , 75.11 , 56.70 in Walailak University , Nakhonsithammarat Rajaphat University, Suratthanee Rajaphat University and Phuket Rajaphat University qualified subjects comprised of 478 males and 1,022 females. After the selection and finalized the number, they were trained for audiometric testing. (as Shown in Table 4 – 1)

Table 4 – 1 The number and percentage of subjects separately by gender and university

Universities	Subjects were complete (persons)					
	Male	%	Female	%	Total	%
Walailak University	99	48.52	105	51.47	204	100
Nakhonsithammarat Rajaphat University	80	19.80	324	80.20	404	100
Suratthanee Rajaphat University	118	24.89	356	75.11	474	100
Phuket Rajaphat University	181	43.30	237	56.70	418	100
Total	478	31.86	1,022	68.14	1,500	100

The result of background noise outside booth was measurement in each university as shown in Table 4- 2

Table 4- 2 The background noise outside the booth was measurement in each university

Area	Octave band frequency (Hz)				
	500	1000	2000	4000	6000
Walailak University	63.00	76.60	74.60	79.00	79.00
Nakhonsithammarat Rajaphat University	72.00	80.25	70.00	75.00	77.00
Suratthanee Rajaphat University	76.00	77.22	76.64	75.00	78.00
Phuket Rajaphat University	74.00	79.00	77.26	80.00	82.00

The numbers of subjects were 1,500 persons including 31.86 % of male and 68.14 % of female. The range of subjects' ages was 17 – 22 years old. There were three different distances from the road to the subjects' houses ie.1- 50 metres, 50 – 100 metres and 100 – 150 metres. The numbers of percentage were 23.00, 64.80 and 12.20 followed by distance. 98.78 % of students case studies' houses were not neighbored by the noise sources and 1.22 % were near the noise sources. 99.87 % of the case study students were never experienced and exposed to high level noise while only 0.13 % had experienced and exposed to it. (Show in table 4 – 3)

Table 4 – 3 The number of subjects and percentage classified by gender , the distance between the road to house, and noise exposure history.

Characteristic	Number of subject (n)	Percentage (%)
Gender		
Male	478	31.86
Female	1,022	68.14
Age		
17 – 18	95	6.32
19 – 20	1,314	87.60
21– 22	91	6.08
The distance between the road to houses		
1-50 Meters	345	23.00
51-100 Meters	972	64.80
101-150 Meters	183	12.20
Source of noise		
Source	19	1.22
Non source	1,481	98.78
Noise exposure history.		
Exposure	2	0.13
Non exposure	1,498	99.87

Part 2 The comparison of H/L between the students from each selected university by ANOVA

The minimum of left-ear and right-ear hearing level was 2 dB and the maximum was 25 dB. The mean of left-ear hearing level was 11.52 dB and the one of right hearing level was 12.30 dB. The mean of left hearing level in each universities were 12.18, 12.05, 10.64, 12.75, in Walailak University, Nakhonsrithammarat Rajaphat University, Suratthanee Rajaphat University and Phuket Rajaphat University. The mean of right hearing level in each universities, were 2.88, 1.94, 3.00, 1.85 in Walailak University , Nakhonsrithammarat Rajaphat University, Suratthanee Rajaphat University and Phuket Rajaphat University .(Show in table 4 – 4)

Table 4 – 4 The baselines of H/L of the subjects in each Universities

Universities	Baseline of hearing level (dB)					
	Minimum		Maximum		Mean	
	Left	Right	Left	Right	Left	Right
Walailak University	2	3	25	25	12.59	12.88
Nakhonsrithammarat Rajabhat University	4	2	23	23	10.76	11.94
Suratthanee Rajabhat University	2	2	20	23	11.52	13.00
Phuket Rajabhat University	3	3	25	25	11.77	11.85
Total	2	2	25	25	11.52	12.30

The ANOVA was used to show the hearing level of subjects in each university. significant difference was found at the test p – value < 0.01

By using LSD testing, the mean of subjects' left-ear hearing level at Walailak University different with Nakhonsithammarat Rajabhat University , Suratthanee Rajabhat University,and Phuket Rajabhat University.The mean of subjects' left-ear hearing level at Nakhonsithammarat Rajabhat University,Suratthanee Rajabhat University, and Phuket Rajabhat University were not different which the significant p – value < 0.05 (Show in table 4- 5).

Table 4 – 5 The comparison between of hearing level and left ears

Ear	University	n	Mean	Sd	df	F	p
Left ear	WU.	204	12.59	4.39	3 , 1496	4.35	0.05
	N.RP	404	10.76	6.74			
	S.RU.	474	11.52	3.69			
	P.RU.	418	11.77	4.98			

WU. ≠ N.RP. , WU. ≠ S.RU. , WU. ≠ P.RU

N.RP. = S.RU. = P.RU.

The mean of subjects' right -ear hearing level at Walailak University different from Nakhonsrithammarat Rajabhat University and Suratthanee Rajabhat University, Walailak University were not different with Phuket Rajabhat University ,Nakhonsrithammarat Rajabhat University were not different with Suratthanee Rajabhat University, which the significant p – value < 0.05 (Show in table 4- 6).

Table 4 – 6 The comparison between of hearing level and right ears

Ear	University	n	Mean	Sd	df	F	p
Left ear	WU.	204	12.88	3.85	3 , 1496	4.35	0.05
	N.RP	404	11.94	5.89			
	S.RU.	474	13.00	3.71			
	P.RU.	418	11.85	3.37			

WU. ≠ N.RP.   , WU. ≠ S.RU.

WU. = P.RU.   , N.RP. = S.RU.

Part 3 The relationships between the baseline of hearing level and gender by Independent t-test

The independent t-test between baseline of hearing level and gender was significantly different of p – value < 0.05 (Show in table 4 –7)

Table 4 – 7 The comparisons baseline of hearing level and gender

Ears	Gender	n	Mean	S	t	df	P
Left	Male	478	11.97	5.73	2.25	1,498	0.025
	Female	1,022	11.31	5.19			
Right	Male	478	12.84	4.67	3.23	1,498	0.001
	Female	1,022	12.05	4.37			

Part 4 The relationships between the hearing level of the left ear and one of the right ear by pair t-test

The pair t-test was used to show the differences of hearing level between left and right ear. Significant difference was found at the test p – value < 0.05. (Show in table 4 –8)

Table 4 – 8 The comparisons baseline of hearing level on left and right ear.

Ear	Mean	S	d	S_d	t	df	P
Left ear	11.53	5.41	0.14	0.144	-5.37	1499	<0.0001
Right ear	12.30	4.48					

n = 1,556

Part 5 The relationships between baseline of hearing level and the distance between road to house

The relationship between baseline of hearing level and the distance from road to house on left and right ear. Significant difference was found at the test p – value < 0.05.(Show in table 4 – 9)

Table 4 – 9 The partial correlation between baseline of hearing level and distance of road far away from house

The relation between baseline of hearing level	r	p
Left hearing level	1.00	< 0.001
Right hearing level	0.36	< 0.001

n =1,556

Part 6 The Relationship between the baseline of hearing level and noise exposure activities by correlation

The average of time while experiencing sound exposure activities was shown from maximum to minimum orderly. The averages of time foe noise exposure activities were also in order as follows: rode motorcycle, Used mobile phone, earphone listen to the music, singer, musician, and discothèque. After evaluate of the correlation of baseline of hearing level and sound exposure activities, the significant differences was found at the test p – value < 0.05. (Show in table 4 –10)

The table 4 – 10 The frequency of noise exposure activity and time

Activities	The average of time for noise expose activities			The correlation	
	Minute / day	Time / week	Time / month	r	p
Rode motorcycle	39.67	5	20	.081	0.001
Discothèque	15	1	4	.141	< 0.001
earphone	19.83	2	8	.082	0.001
Gunning	0	0	0	-	-
Telephoning	33.26	6-7	25	.128	0.013
Racing	0	0	0	-	-
Listen to music	16.68	2	8	.270	< 0.001
Singer, Musician	20.00	1	4	.233	0.012

CHAPTER V
DISCUSSION

There were seven parts of discussion. Part 1 was the discussion of study design. Parts 2 to 7 were the discussion of results

Discussion of study design

Part 1 Systematic errors

1. Personal error: measurement on subjective data might have errors from personal variation. However, there was only interviewer who measured and analyzed all the data. That could help minimizing the mistake that might occur.

2. Method error: The error could occur from the data collection and the analytical method. The method was cross sectional study. The subject was selected by specification, the first year students in bachelor degree program. There were two steps for study. The first step was to interview students to select the qualified subjects. The second step was to apply the audiometer test to subjects. The audiometer test used in the audiometer booth that was less than 40 dB background noises. The strength of cross sectional study was easy, rapid and financially safe. The weakness was the number of subjects less than what the researcher expected.

3. Instrument Error: suction noise of the ventilation system in the audiometric booth was low, but the air temperature was high. These for their responses were possibly not totally accurate .

Discussion of result

Part 2 The characteristics of subjects and background noise measurements.

The subjects in the study represented by people of 17 – 22 years of age in the southern of Thailand. The characteristics of subjects from four Universities were not different in age, sound exposure and health status. The mean of subjects' age was

19.45 years old. The mean of left-ear hearing was 11.52 dB and the mean of right-ear hearing was 12.30 dB

The measurement of background noise was not over than the maximum allowable ambient background level (dB) outside the booth was to comply with ANSI S3.1 – 1960 as shown in Table 5-1

Table 5 – 1 Sample calculation using outside audiometric booth attenuation data

Preferred Center Test Frequency (Hz)	Octave Band				
	500	1000	2000	4000	6000
Maximum allowable ambient background levels (dB) outside ANSI S3.1 – 1960	76	83	95	108	115
For this study at, Walailakl university	63	76.6	74.6	79	79
Nakhonsrithammarat Rajphat University	72	80.2	70	75	77
Suratthanee Rajphat University	74	72.2	76.6	75	78
Phuket Rajphat University	74	79	77.2	80	82

Table 5 – 2 Sample calculation using inside audiometric booth attenuation data

Preferred Center Test Frequency (Hz)	Octave Band				
	500	1000	2000	4000	6000
Maximum allowable band sound level ANSI S3.1 – 1960 (dB) inside audiometric booth	40	40	47	57	62
For this study at, Walailakl university	35	37	40	39	37
Nakhonsrithammarat Rajphat University	37	38	35	36	38
Suratthanee Rajphat University	39	37	40	40	37
Phuket Rajphat University	36	36	39	40	40

Part 3 The similarities and differences between the hearing in students from each selected university

The hearing of the subjects in Nakhonsrithammarat Rajbhat University were different from other universities. They were in final examination weeks, therefore they had no class as while performing the audiometry testing. As a result, they were exposed to less noise than subjects from other Universities.

Part 4 The relationships between the baseline of hearing and gender

The baseline audiogram average hearing level from the study for 500, 1000, and 2000 Hz of male was 12.58 dB A for left ear and 12.90 dB for right ear. That of female was 11.65 dB for left ear and 12.28 dB A for right ear. The baseline audiogram average of male higher than those of female.

The baseline audiogram average hearing Level for 500, 1000, and 2000 Hz of NIOSH Criteria Document (10) for 17 – 22 years old for male was 10,5,3 dB for Left ear and 16,7,4 dB for Right ear follow by frequency. The baseline audiogram NIOSH Criteria Document was less than those of Thai students, as shown in table 5 – 3

Table 5-3 The comparisons of baseline of hearing average frequency of 500, 1000, and 2000 Hz between audiogram NIOSH Criteria Document and the Thai student

Gender	Baseline audiogram NIOSH Criteria Document (dB)			Baseline audiogram of Thai student (dB)		
	Audiometric Test Frequencies (Hz)			Audiometric Test Frequencies (Hz)		
	500	1000	2000	500	1000	2000
Male	10	5	3	14.18 (14.95)	12.18 (12.57)	10.29 (11.17)
Female	16	7	4	12.84 (13.71)	11.30 (11.58)	10.34 (11.09)

Remark: ( ) Hearing level of right ear

The main cause of baseline audiogram NIOSH criteria document was less than those of Thai students because the subjects were exposed to sound in the classroom before the audiogram testing. This cause was the limited for the study because the student had class, so they could not avoid from sound exposed.

From the interviews, Hans M.Borchgrevink, Kristian Tambs, Howard J. Hoffman (1996 – 1998)(19) found that Mean > 10 dB hearing were register for both genders in the youngest age group 20 – 24 years

Part 5 The relationships between the hearing of the left ear and that of the right ear

The hearings of left ears were better than right ear. From the interviews, most of student has right skillful, so the right ear expose noise more than left ear. The study of W. A. Yost, D. W. Nielsen (24) was the sound waves cause the eardrum to vibrate. This vibration is passed on to the middle ear, which consists of three small bones called the "ossicles", which amplify and conduct the vibrations of the eardrum to the inner ear. At the point of three small bones was importance because they expose sound waves difference, so the hearing of left – ear and right – ear was difference.

Part 6 The relationships of the baseline of hearing and the distance from the road to subjects' houses

The distances from the roads to subjects' houses were in relation with baseline of hearing. Those results were the same as the study of Bugliarello, Alexandre, Barnes, & Wakstein, (1976)(27) which found that the ambient noises in vicinity and regions has been monitored since 1996. The data showed that the noise level from every roadside monitoring station exceeded the noise standards (equivalent sound level 24 hours (Leq 24 hr.) shall not exceed 70 dB. Particularly, some stations recorded the equivalent sound level 1 hour (Leq 1 hr.) exceeded 70 dB hourly in a whole day, everyday. As a result, this noise level might affect a hearing ability of people who live near the roads

Part 7 The relationship between the baseline of hearing and noise exposure activity by correlation

There were six sound exposures that were in relation with Baseline of hearing. The mean of time to made sound exposure activities was followed by time. The mean of time maximum to minimum about sound exposure activities were rode motorcycle noise, telephonening, earphone listen to the music, singer and musician, and discothèque. Sharp and Donovan (1979)(28) confirmed “more people are exposed to noise from motor vehicles than any other single source of noise. Though this claim is now 20 years old, the prevalence of street traffic has certainly grown since then, and thus the impact of traffic noise is still a major factor in human society.”

Kahari (2002)(20) hearing in musicians and the many times high sound level cause by musician is a topic of current public and scientific interest. A newly released thesis from Goteborg University stressed the importance of including, tinnitus, hyperacusis distortion and diplacusis besides sensor neural hearing loss in the assessment of hearing disorders. This is especially vital among musicians who are dependent on a very well functioning auditory system and where tinnitus, hyperacusis, distortion and diplacusis are considered to be and even greater handicap than a slight to moderate high tone loss. The thesis showed also on a high prevalence of hearing disorders among the rock / jazz musicians studied (74%).

It is not uncommon among concertgoers to leave a concert unable to hear. In most cases their hearing returns shortly. Unfortunately, permanent hearing loss from loud concerts is becoming increasingly common. The situation can be even more serious for musicians, because they suffer more frequent and prolonged exposure to loud music than most people. It can also be more devastating for a musician to lose his hearing, because his livelihood and passion often leave with his hearing.Sound levels at concerts can be in the range of 120 to 140 db, well beyond the 100 db normally recognized as the threshold at which short-duration exposure can cause hearing loss. The loss is caused by damage to fragile tissue strands within the cochlea. These strands are called hair cells and resemble tiny hairs. They move with the fluid in the cochlea to stimulate the electrical impulses in the auditory nerve. The hair cells become damaged in the presence of loud noise.

CHAPTER VI
CONCLUSION

The results of this research study showed that the mean of subject's age was 19.45 years old. The mean of hearing was 11.52 dB for left ear and 12.30 dB. the for right ear. The baseline audiogram average hearing level from the study for 500, 1000, and 2000 Hz of male was 14.18, 12.18,10.29 dB A for left ear and 14.95, 12.57, 11.17dB A for right ear. Those of female was 12.84, 11.30, 10.34 dB A for left ear and 13.71, 11.58, 11.09 dB A for right ear. According to the test hypothesis (Ho) it can be concluded that.

1. The hearing of subjects in Suratthanee Rajbhat University were different from other university ($p < 0.05$).
2. The subjects were 17 – 22 years old. Who has baseline audiogram average hearing Level for 500, 1000, and 2000 Hz from the baseline audiogram NIOSH Criteria Document was less than baseline audiogram of Thai student .The hearing of male higher than female ($p < 0.05$).
3. The hearing of right ear was higher than left ears.
4. The distance of road to house relationed with Baseline of hearing ($p < 0.05$).
5. The top to topless mean of activities were rode motorcycle, earphone, listen to the music, singer and musician, and discotec.

Recommendations

This study can be the starter for the further study concerning the baseline data of hearing. In order to study for further development, the recommendation as follows could bring into an account.

1. Appropriately maintain the ventilation system in the booth meanwhile the minimizing of background noise should be considered.

2. The background noise from the out side and the inside of the booth should be controlled and/or under the standard of ANSI S3.1

3. The baseline data of hearing in other ages should be considered.

4. For the future study, the audiometry testing should be done in the morning because the subjects would have enough rest and would not expose

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APPENDIX

Mathematics of sample size for this study

Sample size was figured by formula

$$n = \frac{N Z_{a/2}^{2}\, p\,(1-p)}{e^{2}\,(N-1) + Z_{a/2}^{2}\, p\,(1-p)}$$

n = Sample size

N = Population

a = Confidence

P = Proportion

e = Error

The method to evaluated the sample size

The researcher was set the (a) 95 %, the (e) not over than 0.01 and the other variable were :

1. (N) = 9,984 persons. They were the students in bachelor degree, first year for four universities in south of Thailand
2. (P) = 90/100 or 0.9 It was the rate of normal hearing of students in a university.
3. (a) = 0.05 ($Z_{0.025/2}$ = 1.96)
4. (e) = 0.014

Apply the variable in the formula:

$$n = \frac{\{9{,}984\ (1.96)^{2}(0.9)\ (0.1)\}}{\{(0.014)^{2}(9983) + (1.96)^{2}(0.9)\ (0.1)\}}$$

n = 1,501 persons

Sample size was 1,501 persons

Table A: The number of students in the first year of bachelor degree program in each university in southern of Thailand

University	The students in the first year of Bachelor degree program (persons)
Walailak University	1,358
Nakornsrithammarat Rajabhat University	2,693
Suratthanee Rajabhat University	3,152
Pukhet Rajabhat University	2,781
Total	9,984

The ratio of sample size in each university

1. Walailak University $= \dfrac{(1{,}501)\ (1{,}358)}{(9{,}984)}$

   $=$ 204 persons

   The sample size of Walailak University was 204 persons

2. Nakornsrithammarat Rajabhat University $= \dfrac{(1{,}501)\ (2{,}693)}{(9{,}984)}$

   $=$ 404 persons

   The sample size of Nakornsrithammarat Rajabhat University was 404 persons

3. Suratthanee Rajabhat University $= \dfrac{(1{,}501)\ (3{,}152)}{(9{,}984)}$

   $=$ 474 persons

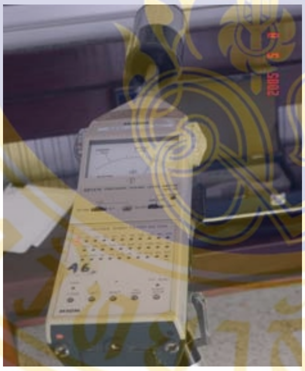
The sample size of Suratthanee Rajabhat University was 474 persons

4. Pukhet Rajabhat University $= \dfrac{(1{,}501)\,(2{,}781)}{(9{,}984)}$

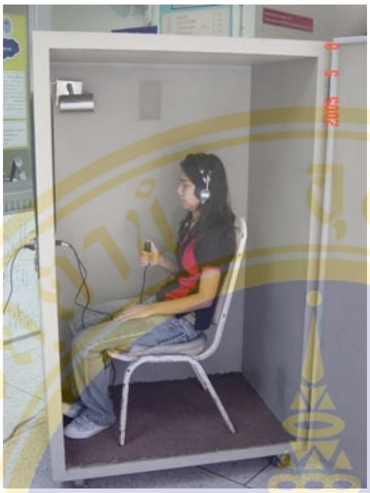
$= 418$

The sample size of Pukhet Rajabhat University was 418 persons

The material and activities for the study

No.	The picture of material	The particular of picture
1.		**Audiometric booth**
2.		**Sound level meter calibration** **Sound level meter** **Octave band**
3.		**Audiometric calibration**

No.	The picture of material	The particular of picture
4.		**The calibration of sound level meter**
5.		**The background noise testing for outside audiometric booth**
6.		**The background noise testing for inside audiometric booth**

No.	The picture of material	The particular of picture
7.		**Audiometric testing**

แบบสัมภาษณ์

ส่วนที่1 ข้อมูลทั่วไปและสภาพแวดล้อม

ข้อมูล
1.1 เพศ ☐ ชาย ☐ หญิง
1.2 อายุ..................... ปี
1.3 (วัน / เดือน / ปีเกิด ..../.........../..........
1.4 สถานภาพสมรส ☐ โสด ☐ คู่
1.5 แผนกที่ศึกษา (ช่างอุตสาหกรรม แผนก...)
1.6 ลักษณะของบ้านพักอาศัย ☐ บ้านเดี่ยว ☐ บ้านทาวน์เฮาส์ ☐ อาคารพาณิชย์ ☐ อื่นๆ ระบุ..
1.6 สภาวะแวดล้อมของบ้านพักอาศัย
☐ บ้านอยู่ติดถนน ☐ บ้านตั้งอยู่ระยะห่างถนน 1-50 เมตร
☐ บ้านตั้งอยู่ระยะห่างถนน 60-100 เมตร ☐ อื่นๆระบุ..
1.7 มีแหล่งกำเนิดเสียงดังใกล้บ้านหรือไม่
☐ ไม่มี ☐ มี ระบุประเภทแหล่งกำเนิดเสียง..
ระยะห่างจากบ้าน.............................. เมตร

ส่วนที่ 2 ประวัติการปฏิบัติงาน

2.1 ประวัติการปฏิบัติงานที่สัมผัสเสียงดังตั้งแต่อดีตถึงปัจจุบัน

ข้อมูล
2.1 เคยฝึกปฏิบัติงานที่สัมผัสเสียงดังในแผนก หรือในโรงงานบ้างหรือไม่
☐ ไม่เคย ☐ เคย โปรดระบุรายละเอียดข้อ 2.2

2.2รายละเอียดในการทำงานสัมผัสเสียงดัง

ชื่อ/ที่ตั้งสถานที่ทำงาน	แผนก / ลักษณะงาน	ระยะเวลา	การสัมผัสเสียงดัง		การใช้อุปกรณ์ป้องกัน	
			ใช้	ไม่ใช้	ใช้	ไม่ใช้

3. ประวัติส่วนบุคคล / การเจ็บป่วย

ข้อมูล	
3.1 ท่านเคยได้รับการตรวจสุขภาพหูหรือไม่	
☐ ไม่เคย	☐ เคย
3.2 ท่านเริ่มรู้ว่ามีปัญหาเกี่ยวกับหู การได้ยินผิดปกติ และโรคเกี่ยวกับหูหรือไม่	
☐ ไม่มี	☐ มี
3.3 ถ้ามีอาการผิดปกติ เป็นหูข้างใด และเป็นมานานเท่าใด	
☐ หูซ้าย เป็นนาน........... ปี	☐ หูขวา เป็นนาน............ ปี
3.4 เมื่อเกิดอาการผิดปกติ ท่านได้รับการรักษาจากแพทย์หรือไม่	
☐ ไม่ได้รักษา	☐ รักษา โดย.....
	☐ พบแพทย์
	☐ ซื้อยากินเอง
3.5 ในครอบครัวของท่านมีญาติพี่น้องที่หูเสีย หรือพูดไม่ชัดหรือไม่	
☐ ไม่มี	☐ มี ระบุ
3.6 การรับฟังเสียงในปัจจุบัน	
☐ ปกติ	☐ ไม่ดีนัก
☐ แย่ปานกลาง	☐ แย่มาก
3.7 ลักษณะเสียงที่ได้ยินในปัจจุบัน	
☐ ได้ยินชัดเจนคงที่	☐ ได้ยินบ้างไม่ได้ยินบ้าง

ข้อมูล	
3.8 ท่านรับเสียงได้ดีเมื่ออยู่ในสถานที่ที่มีลักษณะใด	
☐ เงียบ	☐ บริเวณที่มีเสียงจอแจ
3.9 ท่านใช้หูรับฟังเสียงโทรศัพท์ได้ดีหรือไม่	
หูซ้าย ☐ ไม่ดี	☐ ดี
หูขวา ☐ ไม่ดี	☐ ดี
3.10 เมื่อท่านได้ยินเสียงเรียก ท่านทราบทิศทางหรือไม่	
☐ ไม่ทราบ	☐ ทราบ
3.11 ท่านเกิดความลำบากในการรับฟังเสียงหรือไม่	
☐ ไม่ลำบาก	☐ ลำบาก ระบุ.....................
3.12 ท่านเคยได้ยินเสียงปืน ระเบิด หรือเสียงดังมากจนหูอื้อบ้างหรือไม่	
☐ ไม่เคย	☐ เคย จาก............................
3.13 เคยมีอาการต่อไปนี้หรือไม่ (ระบุได้มากกว่า 1 ข้อ)	
1. ปวดหู	
☐ ไม่เคย	☐ เคย ระบุหูข้าง................
2. มีของเหลวหรือหนองไหลออกมาจากหู	
☐ ไม่เคย	☐ เคย ระบุหูข้าง................
3. มีเสียงรบกวนหรือเสียงแว่วในหู	
☐ ไม่เคย	☐ เคย ระบุหูข้าง................
4. ลักษณะเสียงรบกวน	
☐ เสียงสูง	☐ เสียงต่ำระบุ
ระบุระยะเวลา.........นาที	ระบุระยะเวลา..........นาที
5. ปวดท้องเมื่อได้ยินเสียงดัง	
☐ ไม่เคย	☐ เคย
6. วิงเวียนศีรษะ คลื่นไส้	
☐ ไม่เคย	☐ เคย
7. ลักษณะการวิงเวียน	
☐ บ้านไม่หมุน	☐ บ้านหมุน

ข้อมูล

8.มีอาการอาเจียนร่วมด้วยหรือไม่

☐ ไม่มี ☐ มี

3.14 เคยเป็นโรคต่อไปนี้หรือไม่

☐ ไม่เคย ☐ เคย ระบุ.......

☐ หูน้ำหนวก ☐ เบาหวาน

☐ คางทูม ☐ หัด

☐ วัณโรค ☐ ฝีที่หลังกกหู

☐ ซิฟิลิส ☐ มาลาเรีย

☐ โรคทางสมอง ☐ งูสวัด

☐ แพ้อากาศ ฝุ่น ละออง ไซนัส

☐ คอเจ็บ เป็นหวัดบ่อยๆ

☐ อุบัติเหตุที่หู หรือ ศีรษะ

3.15 เคยใช้ยาปฏิชีวนะหรือไม่ (ยาเจนต้ามัยซิน กานามัยซิน สเตปโตมัยซิน ทั้งยากินและฉีด)

☐ ไม่เคย ☐ เคย ระบุ.......

3.16 เคยใช้ยาอื่นหรือไม่ (ยาเบาหวาน ยาควินิน)

☐ ไม่เคย ☐ เคย ระบุ.......

3.17 ท่านสูบบุหรี่หรือไม่

☐ ไม่สูบ ☐ สูบ

ปัจจุบันสูบวันละ.........................มวน

ติดต่อกันมา.................................ปี

เคยสูบแต่เลิกมา ....ปี

4. พฤติกรรมและการความคิดเห็น

ข้อมูล
4.1 พฤติกรรมต่อไปนี้ท่านทำบ่อยแค่ไหน (เลือกได้มากกว่า 1 ข้อ)

ลำดับที่	กิจกรรม	จำนวนนาที / วัน	จำนวนครั้ง / สัปดาห์	จำนวนครั้ง / เดือน
1	ขับรถจักรยานยนต์			
2	เที่ยวดิสโก้เทค			
3	ใช้หูฟังวิทยุเทป			
4	ยิงปืน			
5	คุยโทรศัพท์			
5	ขับรถแข่ง			
6	ฟังดนตรีเสียงดัง			
7	เล่นดนตรี , นักร้อง			
8	อื่นๆที่เกี่ยวกับเสียงดัง ระบุ.........................			

แบบบันทึกการตรวจสมรรถภาพการได้ยิน

1. ชื่อ – สกุล

....

2. ครั้งสุดท้ายที่ได้รับเสียงดังนานกี่ชั่วโมงก่อนการตรวจ

☐ 0 – 8 ชม. ☐ 9 – 14 ชม. ☐ มากกว่า 15 ชม.

ผลการทดสอบสมรรถภาพการได้ยิน	ระดับการได้ยิน	
	ข้างซ้าย	ข้างขวา
ความถี่ 250 Hz ความถี่ 500 Hz ความถี่ 1000 Hz ความถี่ 2000 Hz		
ผลเฉลี่ยของการตรวจสมรรถภาพการได้ยินที่ระดับ 500,1000,2000 Hz		
ความถี่ 4000Hz ความถี่ 6000 Hz ความถี่ 8000 Hz		

ข้อสรุปผลการตรวจสมรรถภาพการได้ยิน

1. ผลการตรวจสมรรถภาพการได้ยินเฉลี่ยในช่วงความถี่ 500 – 2000 Hz

	หูซ้าย	หูขวา
1. หูปกติ (ไม่เกิน 25 dB HL)	☐	☐
2. หูตึงเล็กน้อย (26 – 40 dB HL)	☐	☐
3. หูตึงปานกลาง (41 – 55 dB HL)	☐	☐
4. หูตึงปานกลางค่อนข้างรุนแรง (56 – 70 dB HL)	☐	☐
5. หูตึงอย่างรุนแรง (71 – 90 dB HL)	☐	☐
6. หูตึงระดับรุนแรง > 90 dB HL	☐	☐

BIOGRAPHY

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