NOISE EXPOSURE AND STRESS RESPONSES IN TEXTILE INDUSTRY

TSONG JIA YAN

Thesis submitted in fulfilment of the requirements

for the award of the degree of

Bachelor of Occupational Safety and Health with Honours

Faculty of Engineering Technology

Universiti Malaysia Pahang

January 2015

ABSTRACT

Textile Industries are developing rapidly to meet the necessities of human beings by supplying the basic needs of cloth for day to day needs. With the rapid development, there are several issues that occurring in the textile industry. Noise pollution is the most often severely exposed by the workers due to the machines used in the operations and may developed stress consequence among the workers. This study was conducted in a textile industry with fifty respondents to assess the relationship between noise exposure and its effect towards stress among highly exposed and low exposed workers. Environmental and personal noise level was measured using Sound Level Meter and Personal Noise Dosimeter respectively. Stress responses were obtained from the Depression Anxiety and Stress Scale (DASS) questionnaire. It was found that there is a significant relationship ($r = 0.0864^{**}$, $p<0.05$) between personal and environmental noise levels. Besides that, there is also a significant difference ($t = -6.045$, $p<0.05$) on individual noise level between exposed and low exposed groups. However, there is no significant relationship between noise level and stress responses among the workers because of the effective periodically hearing conservation practice that applied in the textile industry.

ABSTRAK

Industri tekstil sedang mengalami pembangunan pesat untuk memenuhi keperluan manusia dengan membekalkan keperluan pakaian dari masa ke semasa. Dengan perkembangan pesat, terdapat beberapa isu-isu yang berlaku dalam industri tekstil. Pencemaran bunyi merupakan isu yang paling serius antara isu-isu yang terdedah kepada pekerja disebabkan oleh mesin-mesin yang digunakan dalam proses penghasilan yang mungkin menyebabkan impak stres dalam kalangan pekerja. Kajian ini dijalankan dalam industri tekstil dengan lima puluh responden yang dipilih untuk mengakses hubungan antara pencemaran bunyi dan impaknya terhadap stres antara kumpulan terdedah and terdedah kepada pencemaran bunyi yang lebih rendah dalam kalangan pekerja. Data bunyi yang dihasilkan daripada alam sekeliling and bunyi individu telah dikumpul dengan menggunakan Sound Level Meter dan Personal Dosimeter masing-masing. Manakala, respon stres akan diakses dengan menggunakan Depression Anxiety and Stress Scale (DASS) soal selidik. Berdasarkan kajian, walaupun wujudnya hubungan yang ketara ($r = 0.0864^{**}$, $p<0.05$) antara tahap bunyi daripada alam sekeliling dan tahap bunyi individu dan juga wujudnya hubungan yang ketara ($t = -6.045$, $p<0.05$) antara perbezaan tahap bunyi individu dalam pekerja yang terdedah dan pekerja yang terdedah kepada pencemaran bunyi yang lebih rendah. Nanum begitu, tiada hubungan yang ketara antara pencemaran bunyi dan stres yang terdedah kepada pekerja industri tekstil kerana industri tekstil tersebut telah mengamalkan amalan pemulihara pendengran yang berkesan secara berkala.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

D	Noise Dose
dB	Decibel
dBA	Decibel in A-weighting Filter
Hz	Hertz
M	Meter
n	Number of Sample
Lp	Sound Pressure Level
Leq	Equivalent continuous sound level
T	Time Period

LIST OF ABBREVIATIONS

FMA	Factory and Machinery Act
OSHA	Occupational Safety and Health Administrative
SPSS	Statistical Package for Social Science
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
PTS	Permanent Threshold Shift
TTS	Temporary Threshold Shift
SPL	Sound Pressure Level
SLM	Sound Level Meter
WHO	World Health Organization
FEA	Federal Environmental Agency
DASS	Depression Anxiety and Stress Scale

LIST OF EQUATIONS

Equation No.	Formula
2.1	$D = 100\ C/T$
2.2	$D = (C_1/T_1 + C_2/T_2 + \ldots + C_N/T_N)$
2.3	$TWA = 16.61 \log (D/100) + 85$
2.4	$Leq = 10 + \log 1/T\ (t1 \times 10^{L1/10} + t2 \times 10^{L2/10})$
3.1	$n_o = (t)\ 2\ (p)\ (q)\ /\ (d)\ 2$
3.2	$n_1 = 384 / (1+384 / \text{population})$

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

In this chapter will discuss about the background, problem statements, and research objectives. Besides that, hypothesis of this study will be develops. Next, will discuss about scopes of study, significance of study, operational definition of study and expected results.

1.1 BACKGROUND OF STUDY

Noise is one of the most important environmental factors, which affects the workers' health and efficiency (Noweir and Zytoon, 2013). Noise pollution is now considered one of the main problems in urban areas: actually noise is one of the major pollutants in both workplaces and living space (Tomei *et al.*, 2000). This is due to the increasing number of noise sources, such as the technological and industrial progress (Caciari *et al.*, 2013). Exposure to occupational noise, that is, unwanted sound, has been linked with variety of adverse effects upon well-being over and above its obvious relationship with hearing loss (Leather *et al.*, 2013).

Stress defined as the acceptance resources of an individual, social system or tissue system had been exceed or tax by any event in which environmental demand, internal demand, or both (Victoria, 1993). Stress can be caused by unpleasant or dangerous physical conditions such as crowding, noise, air pollution, or ergonomic problems (Keshavarz and Mohammadi, 2011). According to Neely (2007), workers are daily exposed to several factors such as noise, vibration and stress that can adversely affect the performance of work, for example, the sound being produce from a piece of equipment maybe be so loud and distract the worker and cannot hear an important signal, by this may lead to a higher risk for accidents and injuries.

McDonald (1989) reported a dose-response relationship among blue collar workers between occupational noise exposure and symptoms of psychological distress. Based on (Bigert *et al.*, 2004) statement, they mentioned that there 30 previous studies regarding the interaction between stress and noise exposure, the studies include various types of noise, such as occupational noise, traffic noise or aircraft noise. Psychological, physiological, behavioral stress in people can be cause by the noisy environment and influence sleep, work efficiency, performance, communication abilities (Sheeladevi *et al.*, 2006). In the blue-collar environment, noise can be a particular work stressor (Tennant, 2001).

To protect the workers, Malaysia had established regulation to govern the noise exposure that will be exposed by the workers, which is Factory and Machinery (Noise Exposure) Regulations 1989, under Factory and Machinery Act 1967.

1.2 BACKGROUND OF PROBLEM

Textile Industries are developing rapidly to meet the necessities of human beings by supplying the basic needs of cloth for day to day needs, for decoration purposes and in the world's fashion. The growth of textile industry in accelerated in the early 1970s when the country embarked on export-oriented industrialization. Malaysia's manufacturing focus has resulted in the continued growth of the textile and apparel industrial, according to Malaysian Industrial Development Authority (MIDA), the government's industrial development promotion and coordination agency. While, based on the information by Malaysian Investment Development Authority (MIDA), in 2011, the textile industry was the 10th largest export earner, contributing approximately 2.3 per cent to Malaysia's total exports of manufactured goods. Exports of textiles and textile products for the year 2011 were RM10.8 billion while imports amounted to RM6.6 billion. Currently, the textile industry employs more than 68,000 workers.

With the rapid development, there are several issues that occurring in the textile industry. Textile workers are exposed to cotton fiber, dust, noise and many hazardous chemical by this the major occupational health issues had been raised in the textile industries (Lu *et al.*, 2013). Noise pollution is often most severely exposed by the workers in textile industry (Lee, 1986). Low frequency large amplitude noise was been chronically exposed by the textile workers (Cardoso *et al.*, 2009). In the textile industry have several work stations, which are from blow room to carding, spinning, winding, warping, sizing, weaving, grey checking, desizing, bleaching and scouring, dyeing, and lastly finishing. An occupational noise survey had been carried out found that the sound levels were highest in the weaving and spinning sections (Talukdar, 2001). According to Lee (1986), ring spinning frame is one of the major noise sources in the textile industry, the noise levels is range from approximately 90dBA to 100dBA. Based on the survey, the main cause of high noise level in the weaving and spinning section are likely due to outdated old machinery, poor design and construction and crowding of the workplace (Ashraf *et al.*, 2009).

From Table 1.1, the report by (Basu, 2000), a retired General Manager from Reliance Industries Ltd, the noise level in weaving department in textile industry is 100 – 120 dBA. While for spinning department, there are four types which are ring spinning (90-100 dBA) , Schubert salzer spincomet rotor spinning (84 dBA), schlafhorst autocoro rotor spinning (85 dBA) , open end rotor spinning (100 dBA) . The rest of the work stations just around 80 dBA to 100 dBA. According to Lee (1986), ring spinning frame is one of the major noise sources in the textile industry, the noise levels is range from approximately 90 dBA to 100 dBA. Although the sound exposure level is lower, but still exceeding the limit the stated in the regulations.

Table 1.1: Noise Level in Textile Industry

Process in Textile Factory	Noise Level (dBA)
Spinning:	
Ring spinning	90-100
Schlafhorst Autocoro Rotor spinning	85
Schubert Salzer Spincomet Rotor spinning	84
Rieter M2/1 Rotor spinning	86
Two for one twister	100-110
Open End Rotor spinning	100
Weaving	100-120

Source: Basu, 2000

Based on the data from (Tahir *et al*, 2014), noise exposure levels among industries were 28% for 91-140 dBA and 72% for 86-90 dBA, it shows that all workforces were at high risk (Figure 1.1). Among the industries, occupational noise-exposed workers were known to be highest in the metal industry (2091) followed by textile (631) and food (439), textile industry is the second largest industry that expose to noise pollution (Figure 1.2).

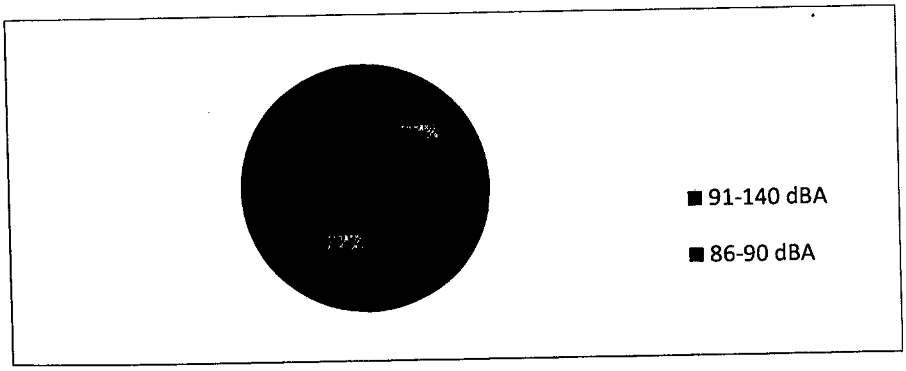

Figure 1.1: Occupational noise exposure levels among industries in Malaysia

Source: Tahir *et al*, 2014

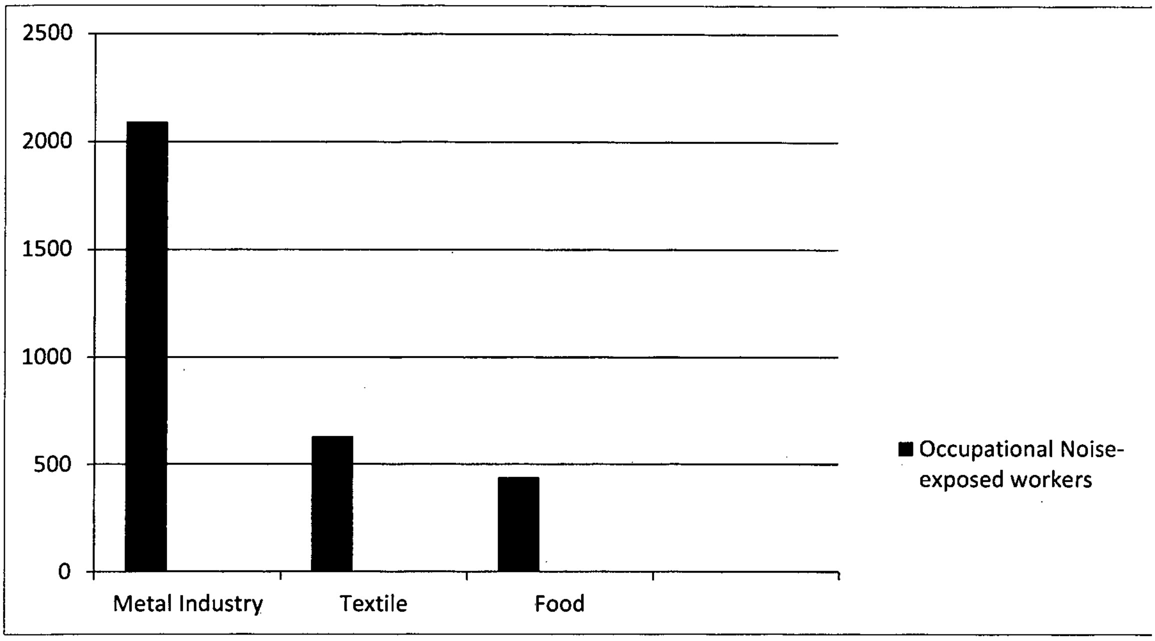

Figure 1.2: Type of industries of the occupational noise-exposed workers in Malaysia

Source: Tahir et al, 2014

"Stress" this term used today was invented by Hans Selye in 1936, who described it as non-specific response of the body to any demand for change, everyone react differently to stress and there is no specific definition of stress that everyone agree on and is highly subjective (Marisa, 2008). Stress can be caused by unpleasant or dangerous physical conditions such as crowding, noise, air pollution, or ergonomic problems (Mohammadi, 2011). If noise exposure does interact with stress, then any negative effect should be greatest under conditions of both high stress and higher noise levels (Matthews *et al.*, 1987). Occupational stress is a serious health hazard and will affect the efficiency of operation in any company; higher level of stress at work will have negative impacts on the immune system, exacerbating various medical conditions including low bowel syndrome, headache, and musculoskeletal pain (Lazuras, 2009). Nowadays, noise is a significant occupational hazard (Rachiotis, 2006). Therefore, this study is conducted to assess the noise exposure and stress responses in the textile industry.

1.3 RESEARCH QUESTIONS

1) What is the environmental noise level in various work stations in textile industry?
2) How is the correlation between environmental noise level and individual noise level?
3) How the noise exposures interact with the stress response among the workers?

1.4 RESEARCH OBJECTIVE

1.4.1 General objective

1) To assess noise exposure and its effect towards stress among workers in textile industry.

1.4.2 Specific objectives

1) To determine the environmental noise level in various work stations in textile industry.
2) To compare individual noise level between highly exposed and low exposed workers.
3) To assess the correlation between environmental noise and individual noise level.
4) To evaluate relationship between personal noise level and the stress responses among the workers.

1.5 RESEARCH HYPOTHESES

1) The personal noise level among the highly exposed workers is significantly higher than the low exposed workers.
2) There is a significant direct correlation between environmental noise and personal noise levels.
3) There is a significant relationship between personal noise level and stress responses.

1.6 SIGNIFICANCE OF STUDY

In general, this research provides information on the noise level that exposed by the workers in the textile industry and its effects towards stress among the workers. Besides that, this research also provides the information on the stress level among the workers. Specifically, this research is beneficial to the following groups:

1) Textile Industry
   The industry will have information on how much noise level that exposed by the workers among the work stations in the industry and also the information on the possible effects of noise towards the workers. Besides that, the information on the stress level that faced by the workers also will be provided. Therefore, the industry will be aware on the control of noise exposure to minimize the adverse effect and to keep workers as far as practicable from the noise hazards.

2) Workers
   The workers will have more knowledge on the effects of noise exposure and be aware to protect themselves by following the safety work practices and wear the Personal Protective Equipment (PPE) that provided by the industry.

3) Future Researchers
   This research can be serve as another source of reference for the future research studies on occupational noise exposure. More research study in this field will help to strengthen the findings and this research will be able to bring benefits to others.

1.7 SCOPE OF STUDY

A comparative cross-sectional study carried out in a textile industry located in Kuala Kangsar to assess noise exposure and stress responses among the workers. The study focused on weaving and spinning process work station that produced highest noise from the machine. Workers employed in weaving and spinning department have been classified as highly exposed groups while those in administrative office as comparative group. The monitoring were conducted using sound level meter and personal dosimeters. Questionnaire been given to know the mental and physical status of the workers towards the noise exposure exposed to them and measure their stress level.

1.8 OPERATIONAL DEFINITION OF VARIABLES

1) Noise

   Noise is generated from technological and industrial progress in textile industry. The main sources of the noise for technological and industrial progress include weaving and spinning work station.

2) Stress

   According to Herroro (2012), stress is defined as a "complex phenomenon involving stimuli, responses, and psychological processes that mediate between them, it assumes that the stat of the organism is characterized by overexertion. Stress level will be measured by using questionnaire, DASS.

3) Personal Noise Exposure

   A measure of the total noise 'dose' received by the workers during the working day, expressed in decibels (dBA) measured by using personal dosimeter within hearing zone.

4) Environmental Noise Exposure

   WHO defines environmental noise as "unwanted or harmful outdoor sound created by human activities, including noise from road, rail, airports and from industrial sites". It is measure by sound level meter. The reading will be record by A-weighted decibels (dBA).

5) Physical Stressors

   Physical stress is suffering by the body as a result of a stressful situation. Physical stressors include pollution, excessive noise, physical injury, lack of rest, drug use, and excessive dieting or exercise.

6) Psychosocial Stressors

Psychological stress is what you feel when you are under pressure or having difficulty coping with a situation or stimulus. Psychosocial stress is the result of a cognitive appraisal of what is at stake and what can be done about it. Source of psychological stress can be any situation that produces an emotional response, whether it is an actual experience or one that you perceive to be real.

7) Physical Symptoms

Physical symptoms are a perception, feeling, or even belies about the state of our body (Pennebaker, 1982). The symptoms included anxiety and tension, uncontrollable worrying, insomnia and headache.

8) Psychosocial symptoms

Human emotions and the context of change in the life-pattern of an individual referred as psychosocial symptoms. Difficulty in sleeping, loss of appetite or excessive appetite, fatigue, and aches and pains included as physical symptoms.

9) Behavioral symptoms

Behavior is an action or reaction to the environment or to internal thoughts and emotions. Behavioral symptoms include overeating or not eating, increased or decreased sleeping and increased drinking or smoking.

1.9 CONCEPTUAL FRAMEWORK

Figure 1.3 demonstrated the conceptual framework for this research which intended to study the noise exposure and stress responses in textile industry. The subjects were based on the workers that exposed to the excessive noise. The environmental and personal noise level was measured by using sound level meter and personal dosimeter. While the stress responses were assessed by using questionnaire. Besides, it contributed the idea on the effect that results from the excessive noise exposure. The effects were categorized into auditory and non-auditory effect. The main effect that study in this research is stress responses that occurred among the workers.

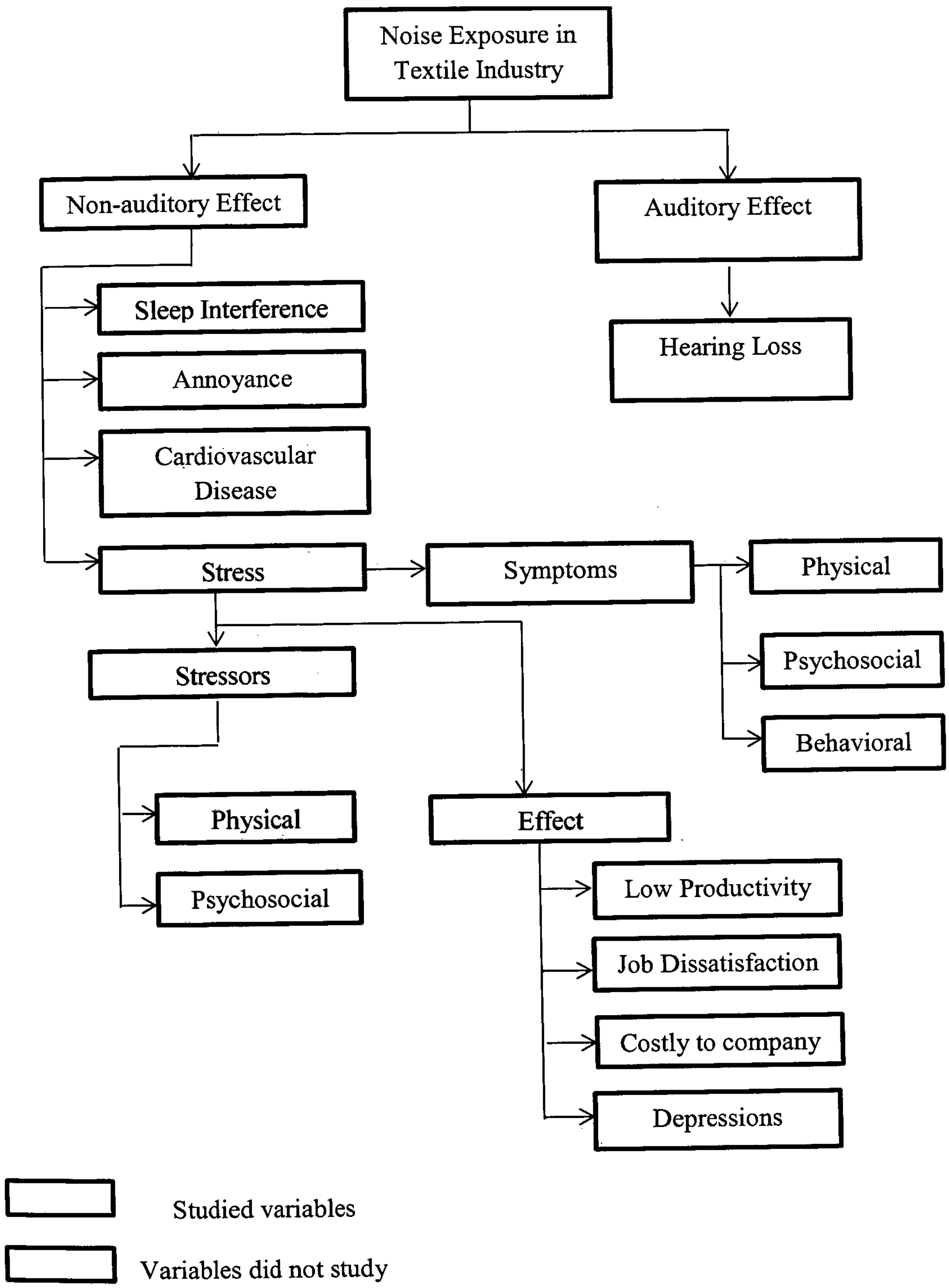

Figure 1.3: Effects results from the excessive noise exposure

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter will discuss on the background of noise, the human perception of noise, how the human auditory system is and how human ears detect sound, the characteristics of sound, the effect of noise, background of stress, the correlation of noise and stress, and lastly the noise source in the textile industry.

2.1 BACKGROUND OF NOISE

Sound is a pressure variation, wave that travels through air and is detected by the human ear while noise is excessive or unwanted sound which potentially results in annoyance and hearing loss that can be from occupational or non-occupational sources (Breysse and Lees, 2006). According to Hansen (2010), sound or noise is the result of pressure variations, or oscillations, in an elastic medium generated by a vibrating surface, or turbulent fluid flow. Sound propagates in the form of longitudinal as opposed to transverse waves, involving a succession of compressions and rarefactions in the elastic medium. When a sound wave propagates in air which is the medium considered in this document, the oscillations in pressure are above and below the ambient atmospheric pressure. A sound wave which consists of a pure tone only is characterized by the amplitude of pressure changes, the wavelength, the frequency and the period.

Human exhibit great ability to utilize sounds to recognize and monitor events in their environment (Pastore *et al.*, 2008). In hearing, human tend to systemize sounds into auditory objects or stream and apply the principles of categorizing to separate those components that are interested in from others (Department of Physics, 2002). Human hearing depends on the competence of the ear and the neural system to perceive and process variation in sound pressure. Frequency is sense by human as pitch. While, what human can hear is the sound intensity and generally only a specific range of sound, usually from 20 Hertz to 20000 Hertz. The factors that go into a sound are its intensity, frequency and overtones.

2.2 CHARACTERISTICS OF SOUND

2.2.1 Sound Wave

Propagation, transmission, and reception of waves in some medium, most commonly air is defined as sound (Brauer, 2006). A sound wave is produced when the areas of compression and rarefaction travel in a medium; sound wave is the pattern of fluctuation in the air pressure over a specific distance or time, is the pattern of changes in air pressure (Talty, 2005). The pattern is shown in Figure 2.1. Sound wave may vary in intensity and frequency, sound intensity measure the loudness of the sound while the sound frequency determines the pitch (Wentz, 1998).