INTRODUCTION

Sound is the essential way of communication in human and most living organisms. Unlike the eyes, our ears are constantly open ready to receive information from all sides and to warn us of potential dangers.(1) Audible sound is any vibratory motion at frequencies between about 20 and 20,000 Hz; normally it reaches the ear through pressure waves in air. Sound is also readily transmissible through other gases, liquids, or solids; its velocity depends on the density and the elasticity of the medium.(2)

Noise is all around us. It is an unavoidable part of our daily lives and has increasingly become a major burden on the quality of lives. Noise pollution is defined as a form of air pollution that is an audible unwanted sound that poses a threat to a person's health. (3) Noise pollution can be from simple sources such as an air-conditioner, a loud radio, human conversation, traffic, to more complex machinery such as large trucks and airplanes.(4) Noise is quite subjective because it varies depending on many different factors, including the time, the place, the conditions, as well as the emotional states and the social and cultural backgrounds of the people exposed to the noise. (5)

Noise is described in terms of loudness (intensity) and pitch (frequency) and noise exposure is measured using a logarithmic decibel (dB) scale. The Occupational Safety and Health Administration recommends hearing protection in the workplace if there is exposure to noise greater than 85 dB for 8 hours (hr) or more because of the potential of permanent hearing loss.(6) As a reference, Table (1) lists some common sources of noise.(7)

Six different factors affect human performance under the influence of noise, as follows: (8)

1. Work-day length: The longer the work-day, the more the negative effect of noise.
2. Acclimatization: The more a person is used to a particular environment; the less he or she is affected by presence of noise.
3. Motivation: The more the person is motivated, the less he or she is affected by disturbances around him or her.
4. Type of work: The nature and kind of work also plays an important role in determining the effect of noise on worker performance.
5. The aspect of work being studied: If the work demands good quality carefulness, and speed, then the job will be more affected by the presence of noise.
6. Other types of stress: The effect of noise on performance will be more if there are other types of stress present in the work environment.

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Table 1: Common sources of noise

Sound	Loudness (dB)
Whisper	30-40
Quiet Room	50
Conversation	60
Lawnmower	90
Stereo Headphones	110-120
Industrial:	
Near large gas-regulator	as high as 150
Foundry shake-out floor	as high as 128
Automobile assembly line	as high as 125
Construction and mining:	
Bulldozer	90–105
Oxygen jet drill in quarry	128
Rock drill (jumbo)	122
Transportation:	
Jet takeoff	130–140
Diesel truck	85–110
Passenger car	70–80
Subway (in car or on platform),	as high as 110
Community:	
Heavy traffic, business area, Pneumatic pavement-breaker	as high as 110 92–98
Power lawn mower	as high as 95
Household:	
Hi-fi in living room	as high as 125
Kitchen blender	90–95
Electric shaver	in use 75–90

The brain recognizes the sound level and discriminates the stress level. The brain is the key organ involved in interpreting the responding to potential stressors.[9] It reacts within split-seconds (sec) timing to instruct the rest of the body in how to adjust to the stressor by the release of cascade of hormones the brain not only turns the stress response but also turns it off and regulates the entire process.[10] Thus, brain appears to handle repeated stress over weeks (wk) by showing adaptive plasticity in which local neurotransmitters (NT) as well as functional changes.[9]

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Thus the effects of noise are not sudden or catastrophic but gradual and insidious. Hence its impact on the psychological, social well-being and our state of health has all too often been denied, or ignored. Moreover, the mechanism by which noise exposure effects general health is quite complex. The interactions between various physiological systems involved in combating noise and the different mechanisms by which noise induced stress may contribute towards the noise induced illness. (11)

I. Effects of noise in human:

In humans, noise is now recognized to cause important health problems.(12) Noise effects are divided into auditory and non-auditory changes. (13) Although the auditory effects of noise have long been studied (14), they are not responsible for most of the effects of noise on organisms.(15) Noise-associated problems mainly are associated with non-auditory perturbations.(16) These problems include both physiological (cardiovascular and endocrine) and psychological (mood, attention and memory) effects as well as sleep disturbances which can lead to psychiatric problems. (13)

I.1. Auditory health effects:

Noise is the major preventable cause of hearing loss. Noise-induced hearing loss (NIHL) can be caused by a one-time exposure to an intense impulse sound (such as gunfire), or by steady state long-term exposure with sound pressure levels (SPL) higher than 75–85 dB as in industrial settings. The characteristic pathological feature of NIHL is the loss of auditory sensory cells in the cochlea. Because these hear cells cannot regenerate in mammals, no remission can occur; prevention of NIHL is the only option to preserve hearing. WHO estimates that 10% of the world population is exposed to SPL that could potentially cause NIHL. In about half of these people, auditory damage can be attributed to exposure to intense noise.(17)

I.2. Non-auditory health effects:

I.2.1. Physiological effects of noise:

I.2.1.1. Noise and cardiovascular disease:

Both short-term laboratory studies of human beings and long-term studies of animals have provided biological mechanisms and plausibility for the theory that long term exposure to environmental noise affects the cardiovascular system and causes manifest diseases (including hypertension (HTN), ischaemic heart diseases, and stroke).(18) Acute exposure to different kinds of noise is associated with arousals of the autonomic nervous system and endocrine system; investigators have repeatedly noted that noise exposure increases systolic blood pressure (SBP) and diastolic blood pressure (DBP), changes heart rate (HR) endocrine system. Chronic exposure can cause an imbalance in an organism's homoeostasis (allostatic load), which affects metabolism and the cardiovascular system, with increases in established cardiovascular disease risk factors such as blood pressure (BP), blood lipid concentrations, blood viscosity, and blood glucose concentrations. These changes increase the risk of hypertension (HTN), arteriosclerosis, and are related to severe events, such as myocardial infarction and stroke.(19)

I.2.1.2. Endocrine responses to noise:

Exposure to high intensity noise in industry has been linked in some studies to raised levels of noradrenaline and adrenaline.[20] In one study, catecholamine secretion decreased when workers wore hearing protection against noise. Some studies, but not all, have shown raised cortisol in relation to noise. [21]

I.2.1.3. Neurotransmitters responses to noise:

Noise was reported to affect norepinephrine (NE), epinephrine, dopamine (DA), and serotonin (5-HT) in discrete regions of the rat brain indicates that noise stress can alter the brain biogenic amines.[22] Experimental studies have demonstrated ultra structural modifications in rat cardiomyocytes mainly involving mitochondria. These subcellular alterations are related to an imbalance in calcium homeostasis, which is supposed to be sustained by increased catecholamine innervations.[23]

I.2.2. Behavioural effects of noise:

I.2.2.1. Noise and sleep disturbance:

There is both objective and subjective evidence for sleep disturbance by noise.[24] Exposure to noise disturbs sleep proportional to the amount of noise experienced in terms of an increased rate of changes in sleep stages and in number of awakenings. Noise exposure during sleep may increase BP, HR and finger pulse amplitude as well as body movements. There may also be after-effects during the day following disturbed sleep; perceived sleep quality, mood and performance in terms of reaction time all decreased following sleep disturbed by road traffic noise. Levels attributable to disturbed sleep can be as low as a continuous noise greater than 30 dB or an intermittent noise that increases the amounts of awakenings per night.[25]

I.2.2.2. Noise and negative social behavior and annoyance reactions:

Noise levels have been associated with increased negative reactions such as increased agitation, exhaustion, dissatisfaction, anger, and distraction.[26] In severe forms, it could be thought to affect wellbeing and health, and because of the high number of people affected, annoyance substantially contributes to the burden of disease from environmental noise.

I.2.2.3. Noise exposure and performance:

There are many potential detrimental effects of noise pollution on task performance involving both children and adults. Cognitive task performance at school and at work has been well documented in several studies.[27] However, the task to be performed is usually described to be complex and cognitively demanding. Children exposed to noise in the home or at school may have difficulty with learning, cognitive and language development, and problem solving. Noise may impair concentration, decrease motivation; increase rates of errors and can thus lead to preventable accidents in the workplace.[28] In addition, communication may be affected leading to misinterpretation of instructions further reducing an employee's effectiveness and accuracy.

To solve a noise problem, one must find out something about what the noise is doing, where it comes from, how it travels, and what can be done about it. A straightforward approach is to examine the problem in terms of its three basic elements; that is, sound arises from a source, travels over a path, and affects a receiver or listener. The source can be one or any number of mechanical devices that radiate noise or vibratory energy. Such a situation occurs when several machines are operating at the same time. The most obvious transmission path by which noise travels is a direct line-of-sight air path between the source and the listener. Noise travels along structural paths. Noise can travel from one point to another via any one path or a combination of several paths. The receiver may be, for example, a single person, or a suburban community.(29)

The solution of a noise problem requires alteration or modification of any or all of the following three basic elements:(30)

- Modifying the source to reduce its noise output.
- Altering or controlling the transmission path and the environment to reduce the noise level reaching the listener.
- Providing the receiver with personal protective equipment modifying the source to reduce noise output involves noise-level specifications, process substitution, machines substitution, and systems design.

So study and analysis the noise types and their components (sources), and detect which component (frequency) has the major responsibility to affect the receiver will help in finding the facilities to avoid the noise danger effect on health.

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