

A Potential Source of Hearing Impairment; Headphones

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Abstract-Technological expansions have been observed in recent years for portable devices with hi-fi audio playback capability such as MP4 players, multimedia phones and hand-held game consoles. Usually these devices are used with headphones; therefore the noise levels of different headphones are of particular relevance. Despite of its several benefits, noise levels can be quite high and may cause hearing impairment. In this research, different headphones were selected to check noise levels at varying volumes. It was found in majority of cases that noise levels ranged from 75dB to 85 dB; surpassing the NEQ's & OSHA standard values.

Keywords-Headphones, Noise Level

I. INTRODUCTION

Human beings are much more dependent on sense of hearing in daily life. Ear is one of our most important organ. A good hearing ability is a great blessing. One of the cause of hearing loss is noise pollution i.e. noise from traffic, industries, blasts, vehicle horns, excessive use of loudspeakers and loud music. When a person is exposed to a high energy sound; whose pressure level and exposure time is more than the threshold limits; it affects the hearing ability. A lot of work is still needed to be carried out as noise pollution which is damaging for mankind [i].

Construction workers have to experience a loud construction noise which damages their hearing sense that's why most of the construction workers response to high pitches of voice [ii]. Noise has damaging and drastic effects on military personals as well e.g. due to frequent combat operations [iii]. Now a days, people are used to listen music while doing any activity i.e. while travelling they listen music, while studying background music is of great interest. Headphones are mostly used for this purpose. Headphones may be used with both fixed devices such as CD, DVD players, computers and portable devices such as mobile phones, mp3 player etc. Headphones are connected to their source either via wire or infrared transmission link such as Bluetooth. No doubt it has created so much convenience for the people that they can listen anything

of their interest without disturbing others, but it is also a fact that there are many problems related to their use. Major problem is hearing loss. Hearing loss is a painless and continuous process. To which people normally don't pay much attention. Process of listening involves striking of sound waves with our eardrum which produce vibrations which in turn make three tiny bone to vibrate which transfers these vibrations to cochlea which sends sound to our brain in the form of electrical signals where they are perceived as music, dialogue, car horn or whatever the form of sound (original sound). When a source emits a sound it scatters all around in every direction. While listening, any transmission without headphone, only some of the sound waves enter in our ears and therefore energy level becomes less while this is not the case with headphones. During usage of headphones; the full sound without scattering enters in our ears hence energy level in this case increases and can damage cochlea [iv]. According to statistical reports, earphones are more damaging to ears than a loud speaker because the sound emitted by headphones has high energy level than a loud speaker. In terms of noise exposure, most dangerous intensity levels are of aircrafts (130 dBA), snow-mobiles (120 dBA), and rock concrete (110dBA). The population risk in NIHL (Noise induced hearing loss) was determined by using samples of persons who were open to the elements of noise without hearing safety. A safe listening level depends on how loud (intensity) as well as the duration of exposure [v]. The damage possibility criterion describes the maximum sound levels and duration of exposure, with time intensity ratios that would suggest risk for NIHL (Noise induced hearing loss) for different duration of experience [vi]. A loud sound higher than 120 dB can damage our eardrum and tiny bones in inner ears. However, personal media players don't exceed 90 dB [vii]. Heart attacks are highly associated with noise such as noise from headphones. According to a European heart journal high level of noise can be a reason of heart attack, high level of noise can also cause blood pressure. A research performed in University of Michigan reported that blood pressure is highly affected by noise exposure. A high level of noise can also cause heart attack. Tumors are another risk which

is associated with loud noise of headphones. Exposure to the high loud sound increases the risk of developing a tumor that could result in hearing loss. Tumor is slow growing and effects on cranial nerve which senses sound [viii]. Earphones may transfer an excess dose of sound having low loudness but of high energy level. Medical specialists suggest that some people have hearing problem in their 30s and 40s. Many of them was first headphone users who then suffer from a disease called tinnitus i.e. an internal ringing or even the sound of whooshing or buzzing in the ears [ix]. Listening through headphones at a high volume for extended periods of time can result in lifelong hearing loss for children and teens. Most MP3 players today can produce sounds up to 120 decibels, equivalent to a sound level at a rock concert [x]. At that level, hearing loss can occur after only about an hour and 15 minutes. The type of hearing loss due to headphone use is typically gradual, cumulative and without obvious warning signs, so to avoid these things we have to take some measures so that we may be able to save our sense of hearing for long time [xi]. In this study, the most commonly used headphones were tested to check

checked whether they are safe to use or not.

METHODOLOGY

The most commonly used headphones were purchased from market to check their noise level. The specifications of all of these were different from one another. These headphones were then categorized as Category 1 & Category 2. Category 1 consist of headphones in which volume is varied at four different levels i.e 50%, 100%, 150% & 200% (specifications listed in Table 1); whereas in Category 2 headphone having three (03) volume ranges i.e 60%, 80% & 100% were used for analysis (specifications listed in Table II). The headphones were then connected with and electronic device to provide power. Headphones were then operated at varying volume percentages. Noise meter was held close to the speakers of headphones. For a particular volume level; the sampling time was 5 min whereas reading was taken after every 10 sec. The average value was taken for a particular volume level. The volume level was then varied and same procedure was followed.

TABLE I
CATEGORY 1 TYPE OF HEADPHONES ALONG WITH COMPANY NAME & SPECIFICATIONS

Headphone Types	Company Name and Specifications	Characteristics
A	Hp headsets Model:H2500	Reduces Background Noise and Mostly Used in web chats and Internet Calls.
B	HiFi headsets Model:PHPW2	Wireless Headphones, can be used with TV,mp3, Radio etc Sensitivity up to 105dB
C	Samsung Wave Headphones Model: Wave 2(wave series)	Smart phone headphones, available in the form of ear buds.
D	China Mobile Headphones Model: JK-I9000(for Samsung I9000)	Mic headphones, frequency reponse range 20Hz to 20kHz
E	Audionic High Quality Headsets Model: Studio 4	Stereo Ear buds with Mic and volume controller. Powerful and Rich Bass. Frequency response range from 20Hz to 20kHz

TABLE II
CATEGORY 2 TYPE OF HEADPHONES ALONG WITH COMPANY NAME & SPECIFICATIONS

Headphone Types	Company Name and Specifications	Characteristics
F	Audionic Low Quality Headsets Model: SD 650	MP3 headsets, Can be used with PC, Has noise cancelling ability.
G	EON Headsets Model:A40 pro	High quality stereo sound, can be used with PC and Play stations and gamers.
H	Samsung Galaxy Headphones Model :HS130(S5830ACE series)	Three differently sized ear buds with Woofers effects.
I	Sony Mobile Headphones Model : MH-750	Stereo sound effect, ear buds and can be used in all smart phones of Sony.
J	Poineer Headsets Model : LOOP SE-MJ31-E	DJ style ear cups, can be used with ipod and iphones also. High sound capacity up to 105dB

RESULTS

Bar charts were used for different type of headphones for which the noise level was measured at varying volumes.

For Type A headphones, measured noise levels are shown in Fig. 1 maximum noise level for Type A was reported at a volume of 200% i.e. 79.1 dB. At 50, 100 & 150% volumes, noise levels are 63, 69.6 and 73.1 dB respectively which were well within the range.

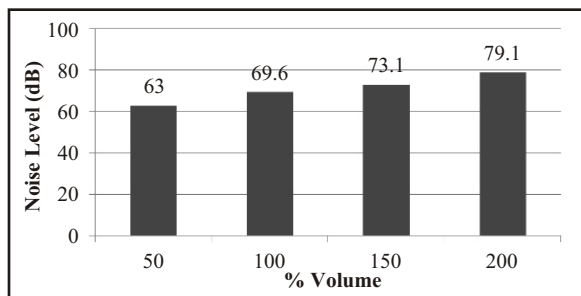


Fig. 1. Noise level (dB) at different volume percentage for Type A Headphones

Noise level measured for Type B headphones are shown in Fig. 2 at a volume of 150 and 200%, noise levels were exceeding the suitable audible range i.e 82.6 and 88.2 dB respectively. However at 100 % volume the noise level was 75.8 dB, a little higher than 75 dB.

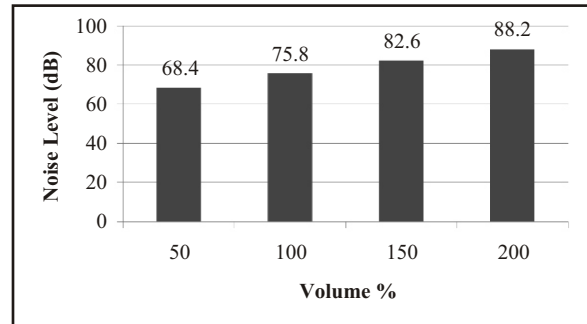


Fig. 2. Noise level (dB) at different Volume percentage for Type B Headphones

Noise level measured for Type C headphones are shown in Fig. 3 at 150 and 200% of volume, noise levels were extremely high and exceeding the suitable audible range i.e 86.9 and 91.3 dB, respectively. However, at 100 % volume the noise level was 75.7 dB.

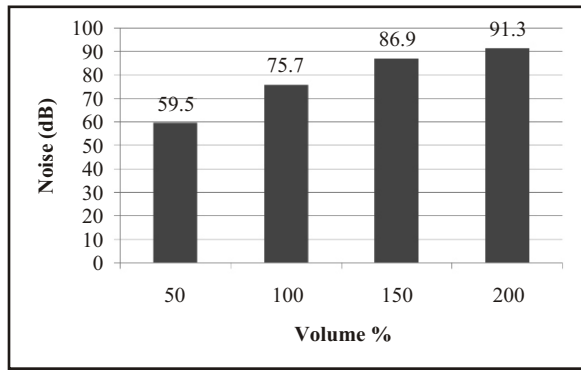


Fig. 3. Noise level (dB) at different Volume percentage for Type C Headphones

At 50, 100 and 150 % volume, noise levels were 62.7, 68.3 and 78.8 dB for Type D headphones as shown in Fig. 4. Noise levels were within permissible limits except for 150 % of volume.

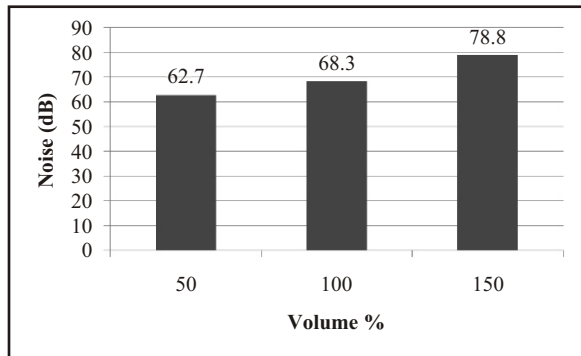


Fig. 4. Noise level (dB) at different Volume percentage for Type D Headphones

At 50, 100, 150 and 200 % volume, noise levels were 53.4, 71.1, 79.8 and 84.3 dB for Type E headphones as shown in Fig. 5. Noise levels were within permissible limits except for 150 and 200 % of volume.

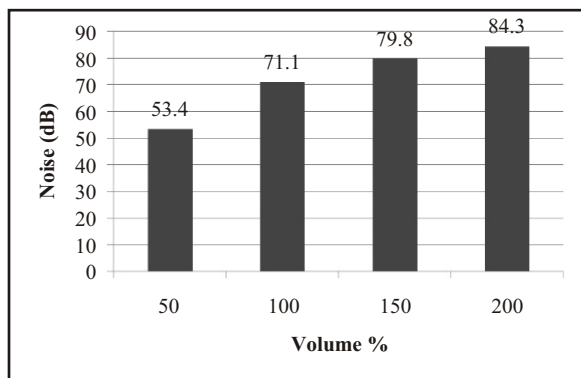


Fig. 5. Noise level (dB) at different Volume percentage for Type E Headphones

At a volume of 60, 80 and 100 %, noise levels were 78.8, 86.2 and 93.5 dB respectively for Type F headphones thus exceeding the permissible limits as shown in Fig. 6.

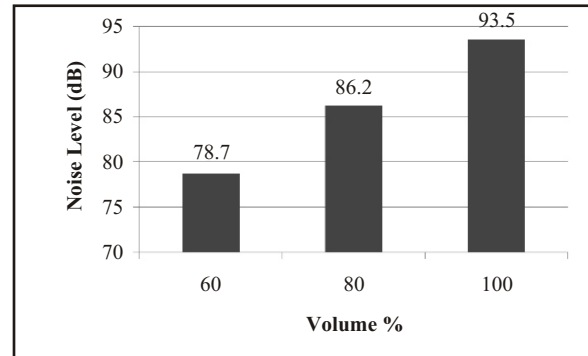


Fig. 6. Noise level (dB) at different volume percentage for Type F Headphones

At a volume of 60, 80 and 100 %, noise levels were 69.1, 71.1 and 73.3 dB respectively for Type G headphones as shown in Fig.7. All noise levels were within permissible limits.

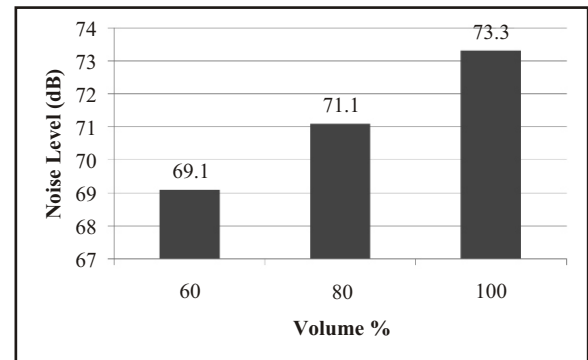


Fig. 7. Noise level (dB) at different Volume percentage for Type G Headphones

At a volume of 60, 80 and 100 %, noise levels were 50.8, 59.7 and 68.4 dB respectively for Type H headphones as shown in Fig. 8. All noise levels were within permissible limits.

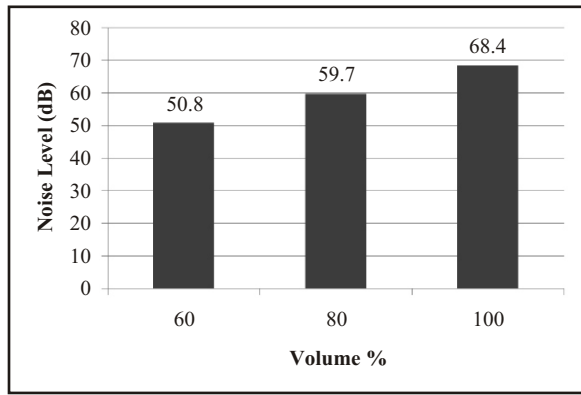


Fig. 8. Noise level (dB) at different Volume percentage for Type H Headphones

At a volume of 60, 80 and 100 %, noise levels were 62.3, 64.6 and 65.2 dB respectively for Type I headphones as shown in Fig. 9. All noise levels were again within permissible limits.

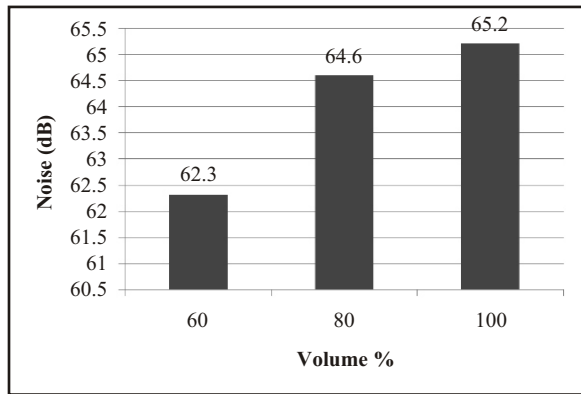


Fig. 9. Noise level (dB) at different Volume percentage for Type I Headphones

At a volume of 60, 80 and 100 %, noise levels were 68.4, 76.9 and 87.2 dB respectively for Type J headphones as shown in Fig. 10. All noise levels were within permissible limits.

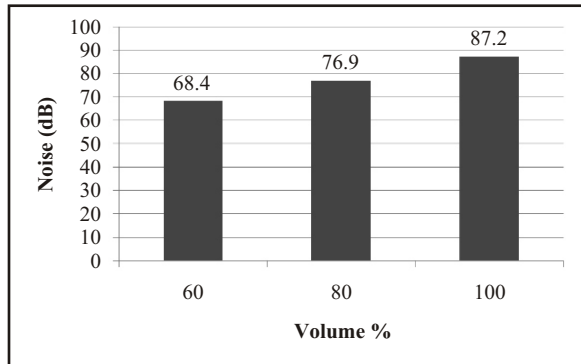


Fig. 10. Noise level (dB) at different Volume percentage for Type J Headphones

Comparison of results for Category 1 and 2 types of headphones are given in Table III and IV respectively. It is clear from Table III that with the percentage of volume and resulted noise levels had a direct relationship. Noise levels in Category 1 were meeting permissible limits of 85dB at 50 and 100% of volume but exceeded the limit when volume exceeded 100% of volume.

In case of category 2, the relationship was not direct entirely Table IV. Type F of category 2 headphones exceeded the permissible limits even at low volume i.e. 60% due to poor quality of headphone and muffling capacity. However noise levels in type G, H and I were all within permissible limits.

TABLE III
COMPARATIVE RESULTS OF CATEGORY 1 TYPE OF HEADPHONES

Volume %age	Category 1 Types of Headphones				
	A	B	C	D	E
50	63	68.4	59.5	62.7	53.4
100	69.6	75.8	75.7	68.3	71.1
150	73.1	82.6	86.9	78.8	79.8
200	79.1	88.2	91.3		84.3

TABLE IV
COMPARATIVE RESULTS OF CATEGORY 2 TYPE OF HEADPHONES

Volume %age	Category 2 Types of Headphones				
	F	G	H	I	J
60	78.7	69.1	50.8	62.3	68.4
80	86.2	71.1	59.7	64.6	76.9
100	93.5	73.3	68.4	65.2	87.2

DISCUSSION & CONCLUSION

This research revealed that;

1. Noise levels in most of the headphone (category 1 and 2) were less than 85 dB (OSHA standard) at 100% of volume.
2. Noise levels in Category 1 were meeting permissible limits of 85dB at 50 and 100% of volume but exceeded the limit when volume exceeded 100% of volume.
3. Type F of category 2 headphones exceeded the permissible limits even at low volume i.e. 60% due to poor quality of headphone and muffling capacity.
4. Noise levels were less than the given threshold standards of 85 dB but it could be harmful at lower values in case of extended exposure time and proximity of source (headphones) to human ears.

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