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Biopsychological Approach on Hearing Impairment Caused by Instrumental Hearing Habit

A Sulianti*, N Darojah, N G Rosalina, B N Wahid and M A Ramdhani

UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105 Bandung, West Java, Indonesia.

*ambarsulianti@uinsgd.ac.id

Abstract. Many researches showed the effect of listening instrumental music to improve concentration in learning. Nevertheless, some psychologies student felt no enhancement in concentration although they had instrumental hearing habits via earphones. This study aims to analyses the effect of listening to music using earphone to hearing impairment. This study was conducted to 45 psychology's students of who had daily listening's habit by earphones. Research subjects were divided into 4 groups: those who had earphone listening habits <15 minutes, 15-30 minutes, 30-45 minutes, 45-60 minutes, and > 60 minutes. Weber hearing tests were done using tuning fork to measure hearing impairment. Analysis of research result using Chi-Square shows Chi square value of the research was higher than the table ($p = 0.008$). Thus, music listening habits via earphones affect the hearing impairment. This study found that right ear impairment was dominant. This should be considered by students who choose earphone as a method to listen to the music.

1. Introduction

Teaching and learning processes are influenced by stress and concentration. Stress is a non-specific body response towards dangers [1]. The study is based on physiological description of response patterns known as general adaptive syndrome (GAS) focusing on homeostatic-maintaining conditions [2–6]. Recent studies show that students experience stress either in medium or high level. They have been trying to find a way to manage stress during their study. In relation to stress, there have been a lot of studies on the use of music to deal with stress [7–13]. Instrumental music has also been proven to be influential in improving concentration. Therefore, listening to instrumental music is able to improve learning outcomes by reducing stress and enhancing learning concentration.

As development of every aspect of life, including technology, grows rapidly, there are both positive and negative effects of the development. One of the rapid developments is listening to music using earphones. Earphones are a tool that transforms electric energy into sound waves. This tool is usually utilized to listen to sound using communication or computer devices. Nowadays, using earphones is a need as well as a lifestyle that gives their users comfort in having clear sound and privacy. Besides, earphones are portable; they can practically be used everywhere and every time. However, the use of earphones with high volume in a long-term causes noise. In relation to this, there have been studies on the effect of listening to loud music towards hearing impairment [14–22].

Noise appears to be one of the most influential factors in hearing impairment. Humans' hearing systems consist of three main hearing components namely main peripherals (outer, middle, and inner



parts), and acoustic nerves (the eighth cranial). Outer ears collect sound energy transmitted to the middle ears through tympanic membrane. Eardrums vibrate and receive music transmitted by inner ears through ossicles in the middle part. The inner ears consist of two parts namely vestibular system functioning as balancing organ and cochlea. Cochleas look like snails, consisting of thousands of smooth hair cells that function as a hearing sensor in Corti organ. The inner part of the hair cells transforms this vibration into electrical signals and sends the signals to the brain through hearing nerves. Brains then translate those signals into sounds and voices that we hear and understand [23,24] Noise causes oxidative stress inducing mal-adaptation towards the change of center hearing system. Damage in neuronal cortex is related to the damage of inner ears namely cochleas [25]. Hearing impairment is influenced by the intensity of noise [23], age [26], and sensitivity towards temporal fine structure (TFS) [26], and the length of noise [23]. At first, hearing impairment due to noise is commonly not realized since it does not disrupt daily conversations [27]

Most of psychology students use earphones frequently since they know the benefits of listening to instrumental music while doing activities. However, previous studies found that listening to instrumental music while studying did not improve learning concentration. In contrary, most of the students listening to instrumental music while studying felt that their concentration decreases. This paper aims to analyze hearing impairment of psychology students getting used to listening to instrumental music using earphones while studying and its relation to hearing impairment and reduction of learning concentration in terms of bio-psychology.

2. Methods

This study employs quantitative participation action research. The subjects of the study are 45 psychology-majoring students ranging from 19-20 years old who get used to listening to instrumental music using earphones and do not have hearing loss - related problems (having good Rinne Test results). Subject of the study are divided into four groups based on the duration of listening to music using earphones habit within 1-15 minutes, 16-30 minutes, 31-45 minutes, 46-60 minutes, and more than 60 minutes in each session of listening to music using earphones.

The hearing function tests used in this study are Rinne and Webber tests. Rinne test is conducted prior to the other that aiming to compare air conduction with the conduction of bones in the checked ears. The procedure of this test is as follows.

- First of all, subjects are requested to cover their ears intermittently, inserting their pointing fingers into their ears repeatedly.
- After that, tuning forks should clang at 512 Hz and their limbs should be stuck on vibrated mastoideus process in one ear until the subjects say that the vibration of the tuning forks is no longer heard.
- The between parts of the tuning forks should be then put close to the front part of the ear bones of the subjects rapidly. The next process is asking the subjects whether they still hear the sound of the tuning forks. It is believed that sounds transmitted through the air are more easily heard than those transmitted through bones. Normally the vibration produced by tuning forks through the air lasts longer than the vibration through the other things.

All the subjects pass the Rinne test well will proceed to Webber test. Webber test itself is done by comparing the transmission through bones between subjects' both ears. This test is done by clanging tuning forks at 512 Hz and putting their limbs horizontally in the mastoideus process through an ear of each test taker. The vibration produced by the tuning forks will be transmitted by the skull so that it can be heard in all parts of the head. Next step is to do the exact same thing in the other ear. The subjects are then asked which ear hears louder sounds.

The interpretation of Webber test is elaborated as follows.

- If the subjects hear the sounds louder in their right ear, lateralization happens. This means that there is damage in their left ear, and vice versa.
- In the meantime, subjects are considered having normal hearing if the volume of sounds they hear balanced between their right ear and left ear.

The data in this study is analyzed using Chi Square.

3. Results and discussion

Characteristics of hearing function of the subjects having good results of Rinne test is described in Table 1.

Table 1. Description of Subjects' Hearing Function Test

Duration of Using Earphones	< 15 minutes	15 - 30 minutes	31 - 45 minutes	46 - 60 minutes	> 60 minutes	Total
Total	11	4	3	6	21	45
Percentage	24	75	3	67	86	100

Table 1 shows that the highest percentage of using earphones habit lies on > 60 minutes (86%). The results of hearing impairment damage from five groups are categorized based on duration is described in Figure 1.

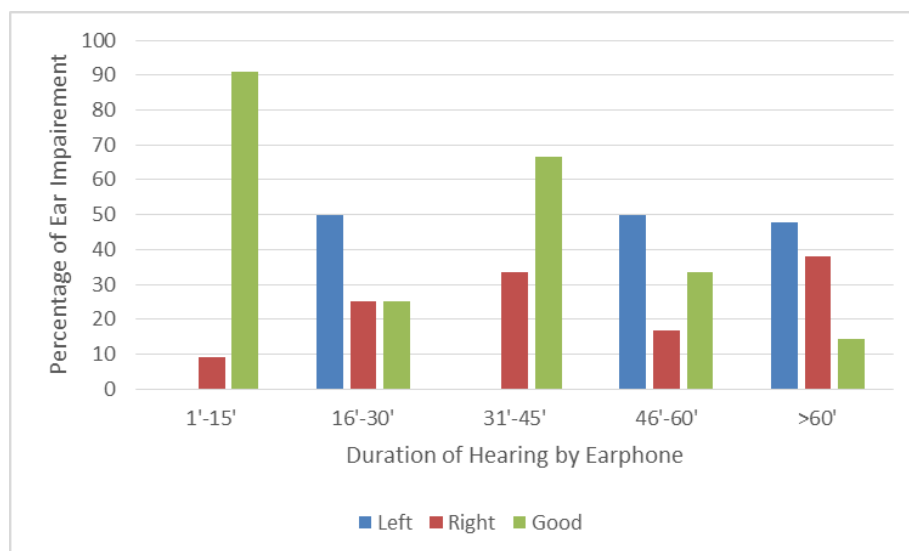


Figure 1. Damages of Hearing Impairment Based on Duration of Using Earphones

Based on Figure 1., it can be seen that the subjects' hearing functions is least damaged in the group using earphones 1 - 15 minutes a day and the most damaged one is the group using earphones > 60 minutes. It is also found that subjects with the most damage in the right ear (left ear lateralization) are more than those with right ear lateralization. To have further investigation on the difference of both ears, Chi-Square analysis is administered in each group.

Table 2. Chi-Squ Analysis on Subjects' Hearing Function test

	Chi-Square Tests		
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	20.791 ^a	8	.008
Likelihood Ratio	24.736	8	.002
N of Valid Cases	45		

a. 12 cells (80,0%) have expected count less than 5. The minimum expected count is ,80.

Based on Table 2., it is proven that the results of Chi Square calculation are 20.791. Using the level of significance at 95%, $\alpha = 5\%$, $df = 4$, the calculation shows that the Chi-Square table is 9.488. Thus, there is a significant difference of hearing impairment based on duration of using earphones ($p:0.008$).

The results of the study show that 86% of the subjects have the habit of using earphones for more than 60 minutes in each time. However, there are subjects with lateralization in every group. This is due to their comfort of using earphones particularly their comfort of listening to music using earphones when they are in stress. This comfort of listening to music using earphones can sometimes be a boomerang for them; it often leads to hearing impairment. A meta-analytical study that has been conducted for 6 decades show there is significant influence of noise towards hearing impairment. Other studies also supporting this fact by proving that hearing impairment is also caused by being in a rock concert, coming to a night club, and those places of such. Hearing loss caused by noise is getting bigger especially in youth.

Studies reveal that most of the subjects in hearing impairment issue have more damages in their right ear rather than the left one. Every ear has connection to certain areas in the brain hemisphere, yet what connects the ears to the brain is stronger for counter-lateral. Thus, the function of the right ear is managed more by the brain lobe, the left temporal part. One of the strengths of left brain temporal lobe based on the right one is the ability of the incoming sound perception [30].

Ears appear to be less sensitive towards sounds with extreme frequency, either very low or very high one, and rather sensitive towards mid-frequency sounds. This sensitivity is capture by A-weighting, which is basically a band pass filter emphasizing the frequency between 1000 Hz and 4000 Hz and is de-emphasized below and above those frequencies. Decibel is a sound intensity measurement while dBA is a sound intensity with contour "A" filter adjusting the measurement into less sensitive towards the extreme frequencies. Therefore, noise is explained in A-weighted decibels (dBA) [31].

Actually, the earphones the subjects use is used with extreme frequencies yet they use them repeatedly as a medium to reduce stress. The National Institute for Occupational Safety and Health (NIOSH) recommend maximum noise level of 85 dBA for eight hours with time-intensity trading ratio of 3 dB. Thus, one exposed to 88 dBA for four hours have the same risk for NIHL as one exposed to 91 dBA for two hours or 100 dBA for 15 minutes or 103 dBA for 7.5 minutes [31].

Sensorial hearing impairment can be caused by damages in hair cells inside the corti organ or decrease of the hair inner cells that are responsive towards sounds. Sound exposure within a long time through earphones creates oxidative stress that also comes up with oxidant. One of the characters of the oxidant is it is very reactive and easily productive towards cell damage around it, even in the DNA. A study to a rat finds out that oxidative stress in the ears lead to the damage of the DNA's vibrating hair in the corti [32]. The sound wave transmitted by earphones is also influential to the brain. Cerebrum consists of several lobes, one of which is temporal lobe located at the top of the ear. This kind of lobe works to manage hearing. The damage of the left temporal lobe causes damage of the ears as well, particularly the right one (contra-lateral). The main function of the left temporal lobe is

to perceive sounds coming into the right ear. The damage of hearing reduces students' concentration in comprehending the materials their lecturers give. This is what causes the reduction of concentration even though they have a habit to listen to instrumental music while studying.

The loss of hearing due to the use of earphones occurs gradually; it can be months or even years. Since it is a gradual thing, the subjects usually did not realize it in the first place. The moment they do, it is too late since it is already irreversible. This condition is what influences their productivity so that it finally reduces their concentration in learning. Interaction between students and lecturers will reach its maximum quality when they materials the lecturers give are understood well by the students. Thus, clear hearing is very important.

4. Conclusion

To cope with stress in teaching and learning processes, psychology students usually listen to music. In terms of efficiency, earphones are the main choice to listen to music. However, repeated use of earphones causes hearing impairment. This damage is more frequently found in the right ear which influences the ability to perceive sounds. Based on the duration, the top group with the most hearing is that listening to music more than 60 minutes. It is recommended that students use other devices except earphones to listen to music.

References

- [1] Maguire J 2014 Stress-induced plasticity of GABAergic inhibition. *Front. Cell. Neurosci.* **8** 157
- [2] Koolhaas J, Bartolomucci A and Buwalda B 2011 Stress revisited: a critical evaluation of the stress concept *Neurosci.*
- [3] Sies H 2015 Oxidative stress: a concept in redox biology and medicine *Redox Biol.*
- [4] Siddiqui N J 2014 *A Qualitative Study of Stress Perception and Reactions to Stress in Urban African American Children and Adolescents* (Tulane University)
- [5] Shah N, Morsi Y and Manasseh R 2014 From mechanical stimulation to biological pathways in the regulation of stem cell fate *Cell Biochem. Funct.*
- [6] Bano A 2014 Impact of Meaning in Life on Psychological Well Being and Stress Among University Students *Existenzanalyse* **31/1/2014** 21–5
- [7] Migneault B, Girard F, Albert C and Chouinard P 2004 The effect of music on the neurohormonal stress response to surgery under general anesthesia *Anesth.*
- [8] Nilsson U 2009 The effect of music intervention in stress response to cardiac surgery in a randomized clinical trial *Hear. Lung J. Acute Crit. Care*
- [9] Kenny D, Davis P and Oates J 2004 Music performance anxiety and occupational stress amongst opera chorus artists and their relationship with state and trait anxiety and perfectionism *J. Anxiety Disord.*
- [10] Khalfa S, BELLA S, Roy M and Peretz I 2003 Effects of relaxing music on salivary cortisol level after psychological stress *Ann. New*
- [11] Carr C, d'Ardenne P, Sloboda A and Scott C 2012 Group music therapy for patients with persistent post-traumatic stress disorder—an exploratory randomized controlled trial with mixed methods evaluation *Psychol.*
- [12] Cooke M, Holzhauser K and Jones M 2007 The effect of aromatherapy massage with music on the stress and anxiety levels of emergency nurses: comparison between summer and winter *J. Clin.*
- [13] Labbé E, Schmidt N, Babin J and Pharr M 2007 Coping with stress: the effectiveness of different types of music *Appl. Psychophysiol.*
- [14] Henderson A E and Testa M A 2011 *Prevalence of Noise-Induced Hearing-Threshold Shifts and Hearing Loss Among US Youths* **127**
- [15] Vljakovic S, Lin S, Wong A and Wackrow B 2013 Noise-induced changes in expression levels of NADPH oxidases in the cochlea *Hear. Res.*
- [16] Kumar A, Mathew K, Alexander S A and Kiran C 2009 Output sound pressure levels of

- personal music systems and their effect on hearing. *Noise Health* **11** 132–40
- [17] Masterson E, Tak S and Themann C 2013 Prevalence of hearing loss in the United States by industry *Am. J.*
- [18] Sulaiman A, Seluakumaran K and Husain R 2013 Hearing risk associated with the usage of personal listening devices among urban high school students in Malaysia *Public Health*
- [19] Schaette R and McAlpine D 2011 Tinnitus with a normal audiogram: physiological evidence for hidden hearing loss and computational model *J. Neurosci.*
- [20] Organization W H 2015 Hearing loss due to recreational exposure to loud sounds: a review
- [21] Daud M, Noor R, Rahman N and Sidek D 2010 The effect of mild hearing loss on academic performance in primary school children *Int. J.*
- [22] Mutswanga P and Makoni E 2014 *Risks of Noise Induced Hearing Loss through Ear/Headphone Music to People in Zimbabwe: Changing Lifestyles of People through Healthy Hearing Practices*
- [23] Hong O, Kerr M, Poling G and Dhar S 2013 Understanding and preventing noise-induced hearing loss *Disease-a-month*
- [24] Malmierca M and Ryugo D 2011 Descending connections of auditory cortex to the midbrain and brain stem *Audit. cortex*
- [25] Fetoni A R, Bartolo P De, Letizia S, Eramo M, Rolesi R, Paciello F, Bergamini C, Fato R, Paludetti G, Petrosini L and Troiani D 2013 *Noise-Induced Hearing Loss (NIHL) as a Target of Oxidative Stress-Mediated Damage: Cochlear and Cortical Responses after an Increase in Antioxidant Defense* **33** 4011–23
- [26] Moore B, Glasberg B and Stoev M 2012 *The influence of age and high-frequency hearing loss on sensitivity to temporal fine structure at low frequencies (L)*
- [27] Feder K, Michaud D and Ramage-Morin P 2015 Prevalence of hearing loss among Canadians aged 20 to 79: Audiometric results from the 2012/2013 Canadian Health Measures Survey *Health (Irvine. Calif).*
- [28] Carter L, Williams W, Black D and Bundy A 2014 The leisure-noise dilemma: hearing loss or hearsay? What does the literature tell us? *Ear Hear.*
- [29] Kimura D 1967 Functional asymmetry of the brain in dichotic listening *Cortex* **164-78**.
- [30] Shankweiler D and Studdert-Kennedy M 1967 Identification of consonants and vowels presented to left and right ears *Q. J. Exp. Psychol.* **XIX** 59–63
- [31] Levey S, Fligor B, Ginocchi C and Kagimbi L 2012 The effects of noise-induced hearing loss on children and young adults *CICSD*
- [32] Fetoni A, Bartolo P De and Eramo S 2013 Noise-induced hearing loss (NIHL) as a target of oxidative stress-mediated damage: cochlear and cortical responses after an increase in antioxidant defense *J.*