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INVESTIGATION OF THE RELATIONSHIP BETWEEN NOISE POLLUTION AND ANXIETY

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ABSTRACT

There is a constant interaction between human beings and environment. Environmental factors may affect humans positively, although some other negative effects may also arise. For example, noise pollution is one of the physical parameters that may negatively affect human organism. Showing up in industrialized countries, noise attracts attention as a significant pollution factor. Noise pollution leads to many diseases as it influences physiological processes in the body. It also triggers some psychological disorders by influencing human psychology. One of those disorders is known as anxiety. Noise can shape one's cognitive assessments causing the brain to respond with the feeling of distress or anxiety. Whether or not noise will cause anxiety depends on many variables, such as personality, coping strategies and the person's previous mental status. It is also known that noise is associated with phobic anxiety as well. Based on the given circumstances, this study aims to investigate the relationship between anxiety and the noise existing in educational settings. A qualitative design; descriptive research was used in the study. The sample of the study consists of 339 students studying at Okan University. The study was conducted in two stages. In the first stage, noise level was detected in various places located in Okan University using the Cesva DC311 model device with T240385 serial number while in the second stage the Beck Anxiety Inventory was applied to students with the aim of investigating the relationship between noise and anxiety. The data obtained from the research were analyzed using Statistical Packages for Social Sciences (SPSS 21.0 version). Following the analyses carried out, it has been found that individuals are more likely to have anxiety problems in places where higher noise levels exist.

INTRODUCTION

Noise, regarded as pollution in industrialized countries, causes several health hazards to humans and together with many other factors, it leaves a destructive impact on health which may cause physiological and psychological destruction that may ultimately lead to death [23]. Besides the impact noise has on hearing physiology, its impact on other physiological processes has also been a major subject of noise-related studies conducted in recent years. Especially during the recent years, noise has been considered as a far-reaching key component of the biological system. The impact of noise extends from gene expression to the functions of the heart. Research on neuroscience has examined the function of noise in each phase of sensory motor lob, from one protein signalization to body movement. According to a research conducted in this field, the influence of noise on the neural system occurs step by step. Those steps are: sensory noise composed of signal transmission, amplification and receptor neuron; electrical noise involving ion channels of related membranes; cellular noise responsible for action potential, synaptic transmission and network interaction; and motor noise responsible for motor neurons and muscle movements. Noise is an inevitable consequence of the brain operating with molecular components and complex networks of neurons that generate behavior [10].

Exposure to noise, which is a biological stress source, causes several health risks. Among them; high blood pressure, coronary heart disease, ulcer, colitis, migraine and headache can be named. Research results show that there is a relationship between noise exposure and the health problems experienced after the exposure. Furthermore, research findings estimate that noise is also correlated with viral infections and the toxins produced in the body. Noise exposure releases adrenalin hormone in the blood and increases the level of response given to a stimulus causing a subsequent increase in the heart rate, blood pressure, and breathing rate, which causes vasoconstriction (constriction of blood vessels), muscle strain and limitation in gastro-intestinal mobility. Also, continuous or/and interval noise disturbs sleep after which many psychological effects arise. First, the individual may have difficulty in falling asleep, maintaining the sleep and waking up at the proper time. Following that, increase in heart rate, blood pressure, vasoconstriction and depression are observed and individual's dynamism decreases during the day. It is already confirmed by the research that continuous exposure to noise higher than 30 dB disturbs sleep [22].

Negative effects of noise on human health include other physiological problems among which cardiovascular and gastric problems constitute the major ones. Effects of noise on the cardiovascular system have been among the most popular subjects of research [17]. Findings of many studies indicate that individuals exposed to at least 85 dB continuous noise have higher blood pressure compared to those who are not exposed to noise. In this vein, most of the studies confirm that exposure to high frequency noise rises blood pressure leading to physiological and psychological problems [25].

In his study, in which he aimed to show the impact of noise on the cardiovascular system, Babish [2] concluded that long term exposure to traffic noise leads to ischemic heart diseases while exposure to 65

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dB daytime and 55 dB night time noise causes heart attacks. Despite the limited research, gastric problems are also found to appear as a result of noise. In their study, Bugliarello et al. [4] examine the effect of noise on gastro-intestinal system and they assert that noise may have an impact on the development and progression of ulcer.

Besides physiological effects, noise can also result in psychological problems such as nervousness, anxiety, anger, stress and lack of motivation and poor morale. In addition to this, noise may also cause anti-social behaviour such as violence [9] [19]. A person exposed to noise, may face many psychological obstacles like difficulty in maintaining speaking and listening skills. Laboratory studies carried out in this field showed that excessive noise can reduce helping behaviours and increase stress-related aggressive behaviour [12] [18] [19]. In addition to these psychological effects, noise exposure may also lead to psychiatric disorders by altering serotonergic and dopaminergic activity in the brain [26] and one of these psychiatric disorders is anxiety disorder.

Being a highly common disorder, anxiety has been reported to be experienced with a 7.8-9.3 % frequency in a life-time [21][8]. It is known that anxiety disorders are often co-morbid with each other and with other psychiatric disorders. Therefore, it is considered almost impossible to associate a person with just a single anxiety disorder [13]. The etiology of this co-morbidity depends on the origin of the cause of the disorder and / or on shared risk factors [20] [14]. Anxiety disorders can share common symptoms such as fear, fatigue, shortness of breath, sweating, dizziness and numbness in the feet, heart palpitation, sleep problems, xerostomia and nausea (DSM-IV, 2000).

Bystritsky, Khalsa, Cameron & Schiffman [5] have stated that anxiety comes from a non-linear process and they have developed a model for this process, named ABC. According to this model; alarms are defined as feelings or physiological reactions developed by the individual in response to sensations or triggering events. A well-organized brain circuit can easily process alarm-related information. Decision-making process is shaped by previous experiences, personal and cultural backgrounds and belief perceived through sensory organs. When compared to people who do not have anxiety disorders, those with anxiety disorder cannot handle decision-making process, because when they are supposed to process a danger related information they try to work through it more carefully and by doing so, they fall into ambiguity and catastrophic thinking. As a result, they begin to develop coping strategies. For example; they develop some behaviors or mental activities in order to reduce anxiety or to avoid danger. The entire process is carried out by the mutual interaction of the brain cortex and amygdala and through the interaction of the cortex, basal ganglion and amygdala- three highly important brain structures: amygdala responsible for alarms, basal ganglions responsible for coping strategies and the brain cortex responsible for beliefs. Especially, the amygdala has a highly critical importance as it is responsible for the identification of the symptoms that may lead to anxiety or fear and for developing emotional reactions in return. In addition, temporal and prefrontal cortical structures are also among the areas that are closely related to anxiety in the brain cortex [6]. Anxiety-related neuronal circuits are governed by multiple neurotransmitter systems; the most extensive of which are GABA and glutamate. Neurotransmitters such as serotonin, dopamine and norepinephrine are also closely related to pathological anxiety states. However, anxiety disorders are not dependent simply on one neurotransmitter. The networks governed by these neurotransmitters may have extensive interrelationships, multiple feedback mechanisms, and complex receptor structures [5].

Genetic relationships and environmental factors are regarded by Hetteema et al [14] as main factors causing anxiety problems. It is concluded by previous studies, especially those on family and twin children, that genetic predisposition triggers anxiety. In addition, anxiety disorders can show up as physiological disorders, that is why a complex relationship may appear between medical disorders and anxiety disorders [29]. Metabolic and autonomic problems arising from any disease can result in anxiety; in other words, the symptoms of a medical illness can be a trigger for anxiety. Sometimes physiological disorders themselves can mimic anxiety disorder [5]. Studies have shown that; chronic anxiety increases the risk of coronary heart disease [28].

Anxiety also influences many aspects of the person's performance negatively by triggering stressful life events. As already mentioned, one of the main environmental factors that causes anxiety is noise. As a consequence of noise, anxiety emerges as a psychological response, which is defined as the interaction of anxiety, noise and distress. Noise stimulus is influenced and produced by environmental conditions. The volume of the noise and the sensitivity level of the person to that sound are considered to be main components of noise stimulus. Noise can influence one's cognitive assessments causing the person to experience distress or anxiety. Whether or not the person will produce anxiety as a response to noise depends on many variables, such as type of personality, coping strategies and the previous mental status of the person [11]. According to the research; sensitivity to noise, especially, seems to be highly influential in developing anxiety when exposed to abnormally high noise.

Literature review shows that noise is also associated with phobic anxiety [24]. Kipper [16], in his work, states that some soldiers who were exposed to battles, had frequent anxiety problems in response to loud voices [24]. Furthermore; in a research, implemented on animals with the aim of showing how prenatal exposure to noise causes decrease in postnatal behavioral performance, maternal stress during pregnancy has been shown to have long-term effects on off spring such as anxiety, learning disability and decreased interest [15]. In another study conducted on mice, noise pollution has been found to result in anxiety-like behaviors [7].

As the literature review shows, the number of studies conducted on the subject is not enough. Taking this into consideration, we aim to investigate the relationship between noise and anxiety in our research. Accordingly, anxiety level is predicted to be higher at places where noise level is relatively higher.

MATERIALS AND METHODS

The research is structured with a descriptive model using a quantitative research method. The results of the research were obtained at Okan University Tuzla Campus in May 2017. The students who are studying at Okan University constitute the population in line with the main objective of the research. The power analysis was calculated using the Raosoft Sample Size Calculator, assuming a 95% confidence interval and anxiety frequency of 27%. According to this calculation, it is enough to include 297 participants in the survey. Using the random sampling method, 339 students were reached and included in the sample group. Participation of the students was totally ensured on a volunteer basis.

In the first stage of this two-stage study, noise level was detected in various points of Okan University using the Cesva DC311 model device with T240385 serial number while in the second stage the Beck Anxiety Inventory was applied to participations with the aim of investigating the relationship between noise and anxiety.

The Beck Anxiety Inventory is used to distinguish between diagnostic groups with and without anxiety by calculating clinical anxiety status of the people. It is a quartet Likert type scale consisting of 21 items based on the self-report of the participants. The total score that can be obtained from the scale is between 0 and 63. As the obtained score increases; an increase in the level of anxiety is observed. The internal consistency coefficient of the scale was calculated as .92 [3] [27]. The Turkish validity and reliability study of the scale was performed by [27] and the internal consistency coefficient of the scale was calculated as .93, which supports the use of the scale as a reliable measurement tool in the Turkish population.

The data obtained from the research were analyzed using Statistical Packages for Social Sciences (SPSS 21.0 version). Finding that the data follow a normal distribution model, one-way analysis of variance (one-way ANOVA) and correlation analysis were carried out.

RESULTS

This study was conducted at Tuzla Campus of Okan University and the sound measurements were made in 6 different points. The first point was the library in the basement of the Life Center building of the university and the result was 30 dB. In the second point, the second floor of Faculty of Health Sciences where the classrooms are located, the sound level was measured as 42 dB. In the third point, the smoking area in the 4th floor of Health Sciences Faculty, the result was 57 dB. The fifth point was measured as 86 dB at Starbucks located in the Life Center of the university. And the last measurement was made during the graduation ceremony hold in the amphitheater next to the Engineering Faculty and the result was 92 dB.

The scores participants obtained from the Beck Anxiety Inventory shows that the score range is between 0 and 60 while the average score was calculated as 16,20. In [Table 1], you can see participants' average scores calculated in each point.

Table 1: Average scores obtained from the Beck Anxiety Inventory in each measurement point

Measurement points	dB	N	Avr.	SS.
1.Point	30	49	10.43	8.09
2.Point	42	56	12.38	8.92
3.Point	57	55	16.35	10.69
4.Point	71	62	16.47	9.75
5.Point	86	63	17.87	10.59
6.Point	92	54	23.04	15.38

One-way ANOVA was implemented in order to identify whether there is a meaningful relationship between the independent variable noise and total scores of the participants depending on measurement points. The results are given in [Table 2].

Table 2: Results of One Way ANOVA between Noise Level and Avarage Anxiety scores

	Measurement Points	n	Avr.	s.s.	SD	F	P	Meaningful Difference	
ANXIETY	1.Point	49	10.43	8.09	5	/	8.826	.000	1-4
	2.Point	56	12.38	8.92					1-5
	3.Point	55	16.35	10.69					1-6
									2-6

	4.Point	62	16.47	9.75	333			3-6
	5.Point	63	17.87	10.59				4-6
	6.Point	54	23.04	15.38				

$p < .01$

Results of one-way ANOVA given in [Table 2] reveal a meaningful relationship between the independent variable noise and the participants' anxiety level. ($F(5-333) = 8.826, p < .01$). When average anxiety scores were compared, a meaningful difference was found between the first measurement point (30 dB) and the fourth (71 dB), fifth (86 dB) and sixth (92 dB) measurement points. At the same time, a significant difference was detected between the sixth measurement point (92 dB) and the second (42 dB), third (57 dB) and fourth (71 dB) measurement points. These differences indicate a positive correlation between the variables; the average level of anxiety increases as the noise level increase.

Correlation analysis was implemented in order to identify whether there is a meaningful relationship between the independent variable noise and total scores of anxieties. The results of the analysis show that a meaningful relationship exist between the total score of anxiety and the noise level measured in each point ($r = .329, p < .01$). When the results are taken into consideration, it can be concluded that individuals are more likely to experience anxiety problems in places where the noise level is higher.

DISCUSSION

As seen in the literature, noise pollution emerging in industrialized countries is highly important in terms of human health and psychology. Especially in recent years, noise has been regarded as a significant factor influencing biological systems of living organisms. Anxiety may lead to a wide range of negative consequences ranging from gene expression to heart function, including many psychological disorders such as ADHD, anger, anxiety and depression. Regarded as a powerful stress source; noise may bring about high blood pressure, coronary heart disease, ulcer, colitis, migraine and many other similar diseases. At the same time, noise influences the immune system hindering the removal of the toxic substances out of the body and letting microbes into the body. What is more, anxiety is also known to have impact on hormones. It may lead to psychiatric disorders by altering the levels of hormones. One of the most important of those disorders is accepted as anxiety. Literature review suggests that there are limited number of articles investigating the relationship between noise and anxiety. Noise measurements were made at different points of Okan University and the noise levels were measured as 30 dB at the first point; 42 dB at the second point, 57 dB at the third point, 71 dB at the fourth point, 86 dB at the fifth point and 92 dB at the sixth point. Also, the data obtained from the Beck Anxiety Inventory and the data obtained from the noise measurements were compared and a significance relationship was found between noise and anxiety.

CONFLICT OF INTEREST

There is no conflict of interest.

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None

REFERENCES

- [1] American Psychiatric Association. [2000] Diagnostic and Statistical Manual for Mental Disorders: DSM- IV (4th ed.). Washington DC.
- [2] Babisch W. [2011] Cardiovascular effects of noise. *Noise and Health*. 13(52):201-204.
- [3] Beck AT, Epstein N, Brown G, Steer RA. [1988] An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology*. 56(6):893-897.
- [4] Bugliarello G, Alexandre A, Barnes J, Wakstein C. [1976] *The Impact of Noise Pollution: A Socio-Technological Introduction*. New York: Pergamon Press.
- [5] Bystritsky A, Khalsa SS, Cameron ME, Schiffman J. [2013] Current diagnosis and treatment of anxiety disorders. *Pharmacy and Therapeutics*. 38(1):30-57.
- [6] Charney DS, Drevets WC. [2002] The neurobiological basis of anxiety disorders. *Neuro psychopharmacology: The Fifth Generation of Progress*. Philadelphia, PA: Lippincott Williams & Wilkins. 901-930.
- [7] Di G, He L. [2013] Behavioral and plasma monoamine responses to high-speed railway noise stress in mice. *Noise and Health*. 15(65):217-223.
- [8] Eller T, Aluoja A, Vasar V, Veldi M. [2006] Symptoms of anxiety and depression in Estonian medical students with sleep problems. *Depression and Anxiety*. 23(4):250-256.
- [9] EPA. [1973] Public health and welfare criteria for noise. 550/4-73-002. U.S. Environmental Protection Agency.
- [10] Faisal AA, Selen LP, Wolpert DM. [2008] Noise in the nervous system. *Nature Reviews Neuroscience*. 9(4):292-303.
- [11] Gast PL, Baker CF. [1989] The CCU patient: anxiety and annoyance to noise. *Critical Care Nursing Quarterly*. 12(3):39-54.
- [12] Geen RG, Powers PC. [1971] Shock and noise as instigating stimuli in human aggression. *Psychological Reports*. 28(3):983-985.
- [13] Goldenberg IM, White K, Yonkers K, Reich J, Warshaw MG, et al. [1996] The infrequency of "pure culture" diagnoses among the anxiety disorders. *The Journal of Clinical Psychiatry*. 57(11):528-533.
- [14] Hettema JM, Prescott CA, Myers JM, Neale MC, Kendler KS. [2005] The structure of genetic and environmental risk factors for anxiety disorders in men and women. *Archives of General Psychiatry*. 62(2):182-189.

- [15] Igosheva N, Taylor PD, Poston L, Glover V. [2007] Prenatal stress in the rat results in increased blood pressure responsiveness to stress and enhanced arterial reactivity to neuropeptide Y in adulthood. *The Journal of Physiology*. 582(2):665-674.
- [16] Kipper DA. [1977] Behavior therapy for fears brought on by war experiences. *Journal of Consulting and Clinical Psychology*. 45(2):216-221.
- [17] Knipschild P, Oudshoorn N. [1977] VII. Medical effects of aircraft noise: drug survey. *International Archives of Occupational and Environmental Health*. 40(3):197-200.
- [18] Mathews KE, Canon LK. [1975] Environmental noise level as a determinant of helping behavior. *Journal of Personality and Social Psychology*. 32(4):571-577.
- [19] Nassiri P, Azkhosh M, Mahmoodi A, Alimohammadi I., Zeraati H., Shalkouhi PJ, Bahrami P. [2011] Assessment of noise induced psychological stresses on printer workers. *International Journal of Environmental Science & Technology*. 8(1):169-176.
- [20] Neale MC, Kendler KS. [1995] Models of comorbidity for multifactorial disorders. *American Journal of Human Genetics*. 57(4):935-953.
- [21] Regier DA, Boyd JH, Burke JD, Rae DS, Myers JK, et al. [1988] One-month prevalence of mental disorders in the United States: based on five Epidemiologic Catchment Area sites. *Archives of General Psychiatry*. 45(11):977-986.
- [22] Shahid M, Bashir H. [2013] Psychological and physiological effects of noise pollution on the residents of major cities of Punjab (Pakistan). *Peak Journal of Physical and Environmental Science Research*. 1(4):41-50.
- [23] Singh N, Davar SC. [2004] Noise pollution-sources, effects and control. *J Hum Ecol*. 16(3):181-187.
- [24] Stansfeld SA. [1992] Noise, noise sensitivity and psychiatric disorder: epidemiological and psycho physiological studies. *Psychological Medicine Monograph Supplement*. 22:1-44.
- [25] Stansfeld SA, Matheson MP. [2003] Noise pollution: non-auditory effects on health. *British Medical Bulletin*. 68(1):243-257.
- [26] Tavakoli O, Ahmadi R, Tavakoli P. [2013] Effects of noise pollution on anxiety level in rat. 4th International Conference on Medical, Biological and Pharmaceutical Sciences (ICMBPS), Dubai.
- [27] Ulusoy M, Sahin N, Erkmen H. [1998] Turkish version of the beck anxiety inventory: psychometric properties. *Journal of Cognitive Psychotherapy: An International Quarterly*. 12(2):163-172.
- [28] Weissman MM, Markowitz JS, Ouellette R, Greenwald S, Kahn JP. [1990] Panic disorder and cardiovascular/cerebrovascular problems: results from a community survey. *The American Journal of Psychiatry*. 147(11):1504-1508.
- [29] Wittchen HU, Hoyer J. [2001] Generalized anxiety disorder: nature and course. *Journal of Clinical Psychiatry*. 62:15-21.