

Conference Paper

Correlation Between the Length of Stay Around Railways and Quality of Life

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Abstract

One of the strongest noise in the environment is train noise. Chronic exposure to noise can affect the psychology and physiology of various systems in the body. Prolonged changes in homeostasis lead to a decline in the quality of life. This study aimed to assess the correlation between the length of stay around railway and quality of life. This was a cross-sectional study conducted in Surakarta, Indonesia with involving 60 male participants aged 25-60 years old who have lived along the railway for at least one year. Participants who have chronic diseases and disabilities were excluded. The noise level was measured using the sound level meter. Nottingham Health Profile (NHP) was used to assess the quality of life. The length of stay data was obtained from the district administration database. We found that the participants' NHP scores had negative correlation with the noise levels ($p < 0.01$, $r = -0.562$). The length of stay around the railway also had a negative correlation with the NHP scores ($p < 0.05$, $r = -0.364$). These findings showed that there was an inverse correlation between noise level around the railway and quality of life. In conclusion, the length of stay around the railway had an inverse correlation with quality of life.

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1. Introduction

Noise is sounds which cause environmental discomfort and health problems [1]. Noise can be originated from industrial machinery, household appliances and means of transportation. One source of noise from means of transportation is derived from trains generated by its engines and wheel friction with the railroads. Train noise has a high noise level. A study reported that train noise level can reach more than 90 dB at a distance of 10 m. Types of engines, carriages, wheels, and railroads also influence the noise level. Also, the train that has a faster speed can cause a higher noise level [2].

Noise exposure can cause stress to the body [3]. The emerged stressors will stimulate the body to carry out the mechanism of General Adaptation Syndrome (GAS) so

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that the body remains in a state of homeostasis. The initial response to stress begins through the hypothalamus-pituitary-adrenal axis (HPA) which activates the sympathetic and endocrine systems, one of which is characterized by an increase in cortisol secretion [4]. If the stressors occur continuously, it will cause hypersecretion of the cortisol hormone which may disturb the body homeostasis [5].

Noise exposure has shown to cause various problems in the functions of the human body such as hearing loss, cardiovascular disease and metabolic diseases [6]. Hearing loss due to noise exposure is also called noise-induced hearing loss (NIHL) as the result of hair cell damage in the cochlea which is then replaced by connective tissues [7]. Previous studies report that noise exposure increases the risk of cardiovascular diseases such as hypertension and ischemic heart disease. Noise exposure will trigger sympathetic system activity [8, 9]. In addition to physical effect, noise also causes psychological problems such as sleep disturbance, fatigue and decreased cognitive function. Manifestations of cognitive impairment include decreased concentration and memory [6, 10].

In general, quality of life is a comprehensive concept of an individual's functions which includes physical and mental aspects. Quality of life is influenced by a person's physical, intellectual, emotional and social conditions [11]. The Nottingham Health Profile (NHP) is an instrument that has been widely used in various studies to assess the quality of life in adults. NHP is a questionnaire designed to describe the perception of one's physical, mental and social health status [12–15].

Several studies have proven the influence of noise on quality of life. Populations exposed to noise every day will experience an accumulation of physical and mental health disorders [1, 16, 17]. A study reported that people who live in quiet areas have a better quality of life than those who live near to crowds [18]. The purpose of this study was to assess the correlation between the lengths of stay around the railway with the quality of life.

2. Methods

2.1. Participants

This study involved 60 male participants aged 25-60 years old who lived around the railway in Nusukan, Surakarta. Male participants were selected to minimize the effects of hormonal changes which affect the psychological and physical condition [19]. The participants have lived around the railway for at least one year. This is based on previous studies showing that noise exposure of more than 1 year can trigger stressful conditions

and the emergence of various disorders [20]. The participants in this study were selected using random sampling techniques and the participants with a history of severe illness, congenital disease and disability were excluded. The types of occupation in this study were grouped according to ILO classification [21]. Data on education level, type of occupation and length of stay were obtained from the administration database in the district office. The length of stay was grouped into 1-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years and 26-30 years.

2.2. Noise level

The noise level was measured using a sound level meter that had been calibrated using a sound calibrator. The measurement was carried out in an open area of settlement around the railway. The measurement was carried out during the 24-hour activity. Noise measurement was carried out four times during the day for 16 hours (06.00-22.00 hours) and three measurements at night for 8 hours (22.00-06.00). The measurement was carried out by directing the microphone to the most dominant noise source at the level of the examiner's ear. The windscreen was installed to the microphone. Each measurement was carried out for 10 minutes.

2.3. Quality of life assessment

Quality of life assessments was carried out using the Nottingham Health Profile (NHP) questionnaire adapted in Indonesian version and has been tested for validity and reliability. NHP questionnaire consisted of 38 questions covering 6 aspects, namely energy level (three items), pain (eight items), emotional reactions (nine items), sleep disturbances (five items), social isolation (five items), and physical mobility (eight items) [22]. All participants filled out the NHP questionnaire with interviews.

3. Results and Discussion

Noise level measurements were carried out in several places. The measurement results of daytime noise levels (85.5 ± 3.1 dB) were higher than night noise level (85 ± 2.8 dB). The results of noise measurements in settlement areas with a maximum distance of 20 m from the railway showed an average noise level of 85.3 ± 2.9 dB (in the range of 80 - 90 dB). Train noise is one of the big noises because it consists of the noise of the train engine itself and the railroad vibration [23].

The characteristics of the participants with an average age of 45 ± 11.67 years old are shown in Table 1. The educational background of the participants is mostly junior high school (43.3%) and only 4 participants (6.7%) with undergraduate level. The most abundant type of the participants' occupation is the primary occupation, namely working as a factory worker, builder and cleaning worker. This phenomenon is following the study of the analysis of Indonesia settlement population which shows that the population around the railway is occupied by middle and low economic level population [24].

TABLE 1: Responden characteristics.

Variable		Number
Age		45 ± 11.67
Education level	Elementary school	16 (26.7 %)
	Junior high school	26 (43.3%)
	Senior	14 (23.3%)
	University graduate	4 (6.7%)
Occupation	Elementary occupation	34 (56.7 %)
	Clerical support workers	17 (28.3%)
	Armed forces occupation	2 (3.3%)
	Trades	6 (10%)
	Professional	1 (1.7%)

The largest number of participants in the groups with the length of stay 1-5 years and 26-30 years (each by 20%) is shown in Table 2. The highest NHP scores were found in the group of 1-5 years stay, and the lowest NHP scores are found in the group of 26-30 years stay. Pearson correlation test results showed negative correlation between noise level and NHP score ($p < 0.01$, $r = -0.562$). Also, the length of stay around the railway also showed a negative correlation with NHP score ($p < 0.05$, $r = -0.364$).

Railway noise belongs to the source of noise from means of transportation which has a high noise level in addition to airplane noise. Although the noise is the result of human activities, transportation noise is an essential concern of the world because it has harmful effects on human health [25]. The results of measurements of the noise level in settlements around the railway reached an average of 85.3 ± 2.9 dB in 24 hours. The noise level brings terrible effect on human health. According to WHO, noise limit in a community that can cause health disorders is in an average of ≥ 55 dB during the day and an average of ≥ 50 dB at night [26]. Some countries have set a noise limit policy that can cause hearing loss is more than 75 - 85 dB [6].

This study shows that there is an inverse correlation between the noise level and NHP scores indicating that an increase in noise level is associated with a decrease in quality of life or vice versa [1]. Decreasing quality of life due to noise exposure is caused by

TABLE 2: Representation of the length of stay and NHP Score.

The length of stay (years)	Number	%	NHP score
1-5	12	20	33.14 ± 2.85
6-10	8	13.3	33 ± 2.7
10-15	10	16.7	32.8 ± 2.77
16-20	8	13.3	31.25 ± 1.7
21-25	10	16.7	30.67 ± 3.2
26-30	12	20	30.33 ± 1.75

psychological and physiological disorders [27]. The main mechanism for the emergence of physiological disorders is the direct physical stressors due to noise. Physical stressors in the form of noise will trigger neurohormonal changes in the body including the secretion of the stress hormone cortisol and activation of the autonomic nervous system [28]. Noise exposure that occurs for a long time will cause fatigue in the regulatory system of the cortisol hormone which consequently will interfere the body homeostasis [28, 29]. This phenomenon is by the results of this study which show an inverse correlation between the length of stay around the railway and the quality of life.

Chronic noise exposure can cause a shift in the hearing threshold and loss of hearing function at certain frequencies. Noise-induced hearing loss (NIHL) is caused by the damage on hair cell receptors in the cochlea and replaced by connective tissue. This decrease in hearing function not only affects the body functions but also affects the cognitive, social and attention-deficit functions when working on tasks [6, 27].

Chronic noise exposure affects not only the auditory system but also results in metabolic and cardiovascular system disorders such as hypertension and ischemic heart disease [8, 9]. Environmental noise that occurs primarily at night will disrupt circadian rhythms that will affect cardiometabolic mechanism [30]. Metabolic disorders caused by noise are among others an increase in blood pressure, blood fat concentration, blood viscosity, and blood sugar levels, all of which can increase the risk of atherosclerosis and cardiovascular disease [6, 8, 9].

Physical stress due to noise that lasts for a long time will unconsciously cause psychological and mental disorders. These symptoms include sleep disturbances, emotions, mood, discomfort and fatigue [3, 6, 30]. Sleep disturbances due to noise can be challenging to enter the stage of sleep, wake up in the middle of sleep and decrease sleep duration [31, 32]. Activation of the autonomic nervous system is the primary mechanism underlying sleep disturbance due to noise at night [32]. Decreasing quality and quantity

of sleep can lead to mental and social disorders, cognitive and concentration impairment that can eventually lead to decreased productivity and quality of life [1, 6, 16].

4. Conclusion

This study found that noise exposure had an inverse correlation with quality of life. The length of stay in the area around the railway also showed an inverse correlation with quality of life. Further research by comparing participants who live far from noisy sources needs to be done to strengthen the existing evidence.

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