Conference Paper

Noise Effect on People Living Near Railroad

Fina Violita Christi and Retno Adriyani

Department of Environmental Health, Universitas Airlangga, Surabaya, Indonesia

Abstract

People who live near railroad can be suffered from hearing effects, especially when noise has over the environmental quality standard — this study aimed to know the noise level and risk factors of hearing effects on people who lived near the railroad at Ngagel Rejo, Surabaya. This was an observational research with a cross-sectional approach. The sample size was 50 housewives who lived near the railroad. The distance between railroad and house was 3 meters and 100 meters radius. Noise level was measured by Sound Level Meter for 24 hours; the hearing loss was measured by audiometry examination and questionnaires were used to determine the characteristics of respondents and their risk factors of hearing the effect. Night and day noise ($L_{n}D$) were 65.89 dBA (above the environmental quality standard) for houses having 3 meters far from a railroad and 51.35 dBA for residences having 100 meters now from a railroad. Housewife characteristics showed 96% that they had been living near the railroad for >10 years and 20% homemakers suffered from minor conduction hearing loss. There was no relationship between environmental noise exposure from a train and hearing loss.

Keywords: Environmental noise; railroad; residential area; hearing loss.

Corresponding Author:
Fina Violita Christi
retnoadriyani@fkm.unair.ac.id

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1. Introduction

Noise is described as “unwanted sound,” which can cause several health effects for a community (Anizar 2009). Environmental noise is the accumulation of noise pollution from outside, caused by transportation, industrial and recreational activities. This noise is generally present in all areas of human activity. According to Indonesian Statistics Agency, passengers of a train in Indonesia has increased in the past two years 254,309 in 2014 and 325,945 in 2015, respectively. Besides, railways are also used for cargo transport such as petroleum and goods. However, there are negative impacts caused this kind of transportation, which is environmental noise. Noise generated by train is intermittent (Suma’mur 1996).

People who have been exposed to this kind of noise can have health problems, both auditory and non-auditory effects. Also, noise causes hearing loss, noise exposure leads to annoyance, disturbs sleep and causes daytime sleepiness, increases the occurrence

of hypertension and cardiovascular disease, and impairs the cognitive performance of children in school (Eriksson 2013; Basner et al. 2013).

Several studies have been conducted to measure the level of environmental noise in residential areas around Surabaya. Hariyanto (2012) had measured noise level (Ldn) in Bungurasih residential area, which is directly adjacent to the bus terminal and has high traffic level. The result was 78 dB(A). Another research had measured noise level (Ldn) in a residential area near a railroad track. The effect of environmental noise (Ldn) was 85.5 dB(A) at the residential area which had a distance less than 11 m from railroad track (Agustini 2012). Environmental quality standards for a residential area has been established by the Indonesian's Ministry of the Environment as high as 55 dB(A) (KepMenLH No. 48/1996). Both studies showed that noise in residential near the transportation activities had exceeded the Environmental Quality Standards.

Poor urban planning in some areas in Surabaya causes some residential exposing environmental noise due to railway activities such as inNgagel Rejo. This settlement was only about $\pm$ 3 meters from double rail track connecting two stations of Wonokromo and Gubeng. The number of a train which crossing the railroad was about 92 trips. The railway system in Surabaya was more or less a passenger-oriented system, and there were few freight services, due to the limited capacity of the tracks. Train schedule at both stations was started at 00:22 am until 23:08 pm. The settlement in Ngagel Rejo had known as a dense residential area for many years. Based on these circumstances there were some possibilities for someone to suffer from environmental noise. This study aimed to measure the level of environmental noise and identify the hearing loss that might occur in the community who lived near the railroad in Ngagel Rejo, Surabaya.

2. Methods

This study was an observational research with a cross-sectional approach. This study was conducted in Ngagel Rejo, Surabaya which is near the railroad, on May 2016. The population of this research were housewives with inclusion criteria 25-50 years old, stayed in 8 hours a day at home, had resided in research area at least five years, and willing to be a participant in this research. The sample size was calculated using Cochran formula (1977) for simple random sampling method. The sample size was 25 housewives who lived 3 meters from the railroad and 25 homemakers who lived 100 meters from the railroad. This study was approved by the Institutional Ethics Board of the Universitas Airlangga School of Public Health, Surabaya, and all participants gave informed consent.

Noise level measurement used in this research was *Extech DigitalSound Level Meter Model* 407730. Environmental noise was measured in the house, for 24 hours (L_{DN})

with permission. Audiometry test was conducted to a housewife who willing to be participants. Audiometry test was performed in a closed room that had noise less than 40 dB(A). Respondents were asked to wear a headset and gave a response when they heard the sound. Each respondent had an autograph from this test, which was interpreted by professionals. Data were analyzed using descriptive statistic, and chi-square produces for explaining the relationship between respondent characteristics and incidence of hearing loss.

3. Results

3.1. Noise level

Environmental noise was a measurement of the noise exposure in the respondent house that was caused by noise exposure from the train activities and others. Noise level was 24 hours measurement (L_{DN}). The noise level in a respondent house was shown in Table 1.

Table 1: Environmental Noise Level at Ngagel Rejo Residential, Surabaya, 2016.

House Location	Span Time	Noise Level		L_{DN} $dB(A)$
		Time	L_{eq} $dB(A)$	
3 meters from the railroad	06.00 – 09.00	07.55	64.22	65.89
	09.00 – 11.00	09.56	70.01	
	11.00 – 17.00	16.50	61.81	
	17.00 – 22.00	20.30	66.12	
	22.00 – 24.00	22.10	67.16	
	24.00 – 03.00	02.30	57.95	
	03.00 – 06.00	04.30	57.34	
100 meters from the railroad	06.00 - 09.00	07.10	50.15	51.35
	09.00 – 11.00	10.30	54.61	
	11.00 – 17.00	16.00	52.36	
	17.00 – 22.00	20.15	53.43	
	22.00 – 24.00	22.10	46.23	
	24.00 – 03.00	02.15	43.17	
	03.00 – 06.00	04.20	49.10	
*Environmental quality standar for environmental noise at residential area was 55 dB(A)				

The noise levels were measured at 65.89 dB(A) to the house within 3 meters of the railway and 51.35 dB(A) for a home within 100 meters of the railway. Based on the

noise measurement, the primary source of noise exposure at Ngagel Rejo was railway activities.

3.2. Respondent's characteristics

Age and residence time were respondent's characteristics to be observed. The frequency of distribution of age and residence time of respondent is shown in Table 2.

TABLE 2: Respondent characteristics, Ngagel Rejo Surabaya, 2016.

Characteristics	n=50	Persentage (%)
Age		
≤ 40 years old	34	68
> 40 years old	16	32
Residence time		
5-10 years	7	28
>10 years	43	86

Age can affect a person's physiological function of hearing. Commonly, the aging process begins at 40 years old, and it also decreases the hearing function. Only 32% of respondent in this study were above 40 years old; the most past was 48. Residence time described the exposure time of noise from railway activities. As a residential area, Ngagel Rejo is part of the old city in Surabaya. In this study, 86% of respondents had lived in this area of more than ten years, in fact, some respondents had been liveing in this area since they were very young.

3.3. Hearing loss

The frequency of distribution of respondent for hearing loss was shown in Table 3 below.

TABLE 3: Respondent hearing loss, Ngagel Rejo, Surabaya, 2106.

Hearing loss	Yes		No	
	n=50	%	n=50	%
Right Ear	5	10	45	90
Left Ear	6	12	44	88
Hearing loss	7	14	43	86

Based on audiometry test, 14% of respondent suffered from hearing loss, 12% left ear and 10% right ear. The type of hearing loss was determined by comparing the results of audiometric parts AC and BC. The symbol "o" and "x": two symbols for inspecting air (air conduction / AC). The symbol "o" to the right ear, and the symbol "x" to the left ear. The symbol "<" and ">": two symbols for examining bone (bone conduction / BC). The

symbol "<" for the right ear and the symbol ">" to the left ear. Examination by a special headset section installed behind the earlobe.

The results of the hearing screening respondents showed normal hearing and conductive mild hearing loss that can be seen on the audiogram in Figure 1 and Figure 2.

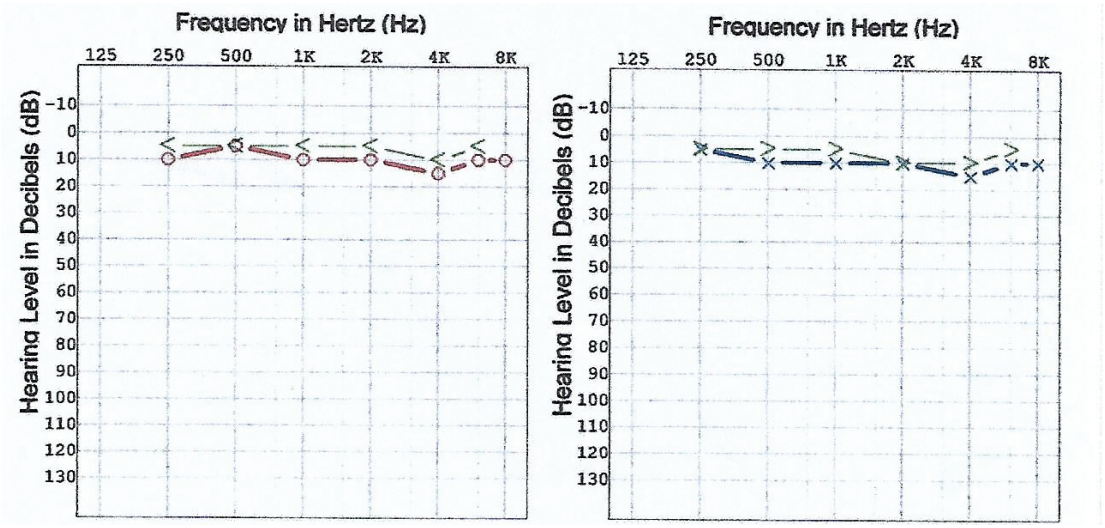

Figure 1: Normal Hearing Audiogram.

Audiogram of the respondent with normal hearing threshold described in Figure 1, AC and BC graphic was in normal position at 25 dB. Respondent did not have hearing loss in the outer, middle and inner ear.

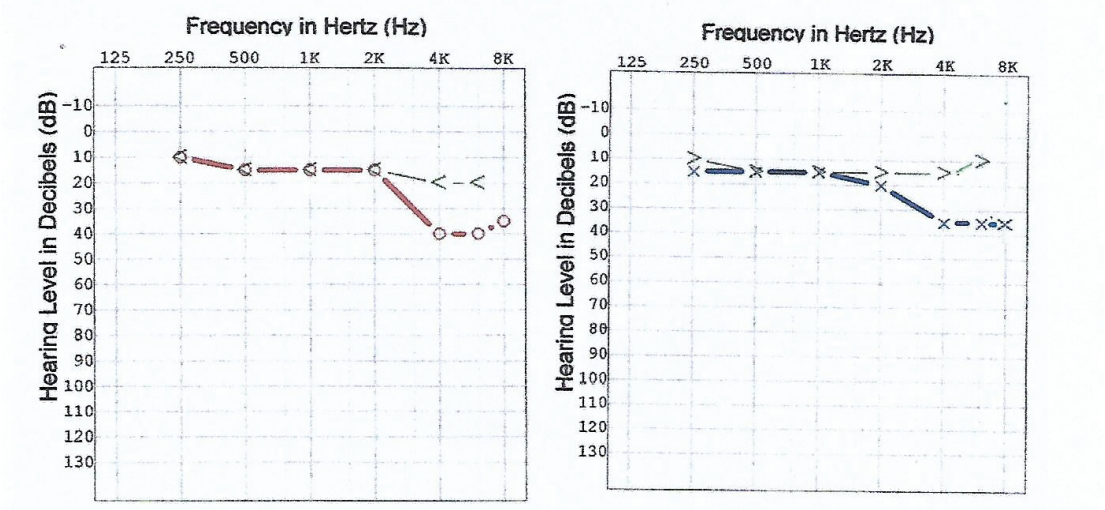

Figure 2: Conductive Mild Hearing Loss Audiogram.

The example of conductive mild hearing loss audiogram was shown in Figure 2. AC line showed uplift of hearing threshold and BC were in normal range. There was a hearing loss at the outer ear or middle ear, but inner ear was normal. Conductive hearing loss can be caused by many different causes, such as malformation of external ear, ear

canal, or middle ear structures, fluid in the middle from colds, ear infection in the middle ear, allergies, poor Eustachian tube function, perforated eardrum, impacted earwax, infection in the ear canal, foreign body in the ear, and otosclerosis (HLAA 2016).

3.4. The relationship between age and resident time with hearing loss

Association of respondent characteristics (age and residence time) with hearing loss were shown in Table 4 and Table 5.

Table 4: Crosstabulation between Age and Hearing loss of Respondent in Ngagel Rejo, 2016.

Age	Hearing type				Total	
	Normal		Conductive middle hearing loss			
	n	%	n	%	n	%
≤40 years old	34	100.0	0	0	34	100
>40 years old	9	56.3	7	43.8	16	100
Total	43	86.0	7	14.0	50	100
p value =0.000 < 0.05						

Above 40 years old respondents Conductive middle hearing loss was suffered by. There was a significant relationship between age and hearing loss.

Table 5: Crosstabulation between Residence Time with Hearing Loss of Respondent at Ngagel Rejo, 2016.

Residence time	Hearing type				Total	
	Normal		Conductive middle hearing loss			
	n	%	n	%	n	%
5-10 years	5	71.4	2	28.6	7	100
>10 years	38	85.7	5	11.6	43	100
Total	43	86.0	7	14.0	50	100
p value 0.250 > 0.05						

There was no relationship between residence time and the hearing loss. According to this, the incidence of hearing loss was not due to noise exposure. Hearing loss due to noise is determined by the noise exposure during a person's life; all age groups can be affected. It can also be affected by the type of sound. Exposure to various types of noise from early childhood may have a cumulative effect on hearing the loss in adults (Welch et al. 2013).

4. Discussion

Ngagel Rejo residential area which was within 3 meters of the railroad, exposed to the noise above the environmental quality standard for residential areas. The high level of noise could be related by the rail traffic passing through Ngagel Rejo, the distance between the house and the railroad, and also a quality of home's wall. Permanent house built of brick relatively able to reduce noise from outside (Christi 2016).

Environmental noise at residential near the railroad in this study agreed with the previous studies done by Suryani (2015) and Agustini (2012), in which the environmental noise level hit 70.73 dB (A) and 85.5 dB (A) respectively. The result of measurements of environmental noise in houses within 100 m of the railroad was still below the environmental quality standard for residential areas. Based on this study, the government should have the regulation about minimum distance between houses and the railroad, so that the public can be protected from noise exposure caused by trains. Besides that, controlling noise environment due to train activity can be done using the wall barrier, housing relocation, used electric train rather than diesel, used wall silencer and adjust the layout rooms in the house (Suherwin 2004 in Agustini 2012).

In this study, age had a significant relationship with hearing loss, as compared with resident time. According to Baktiansyah (2004), they were hearing function of someone who waw 40 years old starting to decrease (presbycusis). This hearing loss usually began at 40 years old with an average decline of 0.5 dB (A) per year (Rais 2003). This study implied that exposure to environmental noise due to the nearness of the house to the railroad did not cause auditory effects. However, although it didn't cause acoustic effects, many related studies found that that environmental noise induced non-auditory effects such as annoyance, disturbed the sleep and causeddaytime sleepiness, increased the occurrence of hypertension and cardiovascular disease, which could reduce quality of life (Basner et al. 2014; Welch et al. 2013).

5. Conclusions

It could be concluded that the residential area within 3 meters of the railroad in Ngagel Rejo, Surabaya was exposed with the noise above the environmental quality standard. However, the incidence of hearing loss in this area was not caused by the environmental noise from railway activities. Further research about non-auditory effects caused by railway activities should be conducted to find the significant relationship between environmental sound with a quality of life, especially in the urban community.

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