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THE RELATIONSHIP OF NOISE INTENSITY AND HYPERTENSION IN COMMUNITIES LIVING AROUND KENDAL REGENCY RAILWAYS

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ABSTRACT

The Relationship of Noise Intensity and Hypertension in Communities Living Around Kendal Regency Railways. Railway traffic contributes significantly to noise pollution in urban areas, adversely affecting human health. This study focuses on the impact of train noise on hypertension among residents living near the Kendal Regency railroad tracks. With 105 participants residing within 0–30 meters from the tracks, aged 25–64, the study utilized purposive sampling to select 50 individuals. The average noise intensity measured was 73.1975 dBA, exceeding the permissible limit of 70 dBA. While the mean systolic and diastolic blood pressures indicated pre-hypertension, statistical analysis revealed a significant association between age and hypertension incidence ($p = 0.042$), with those over 40 facing a 4.5 times higher risk. However, no significant association was found between noise intensity and hypertension incidence ($p = 0.292$), systolic ($p = 0.312$), or diastolic blood pressure ($p = 0.729$). Additionally, factors such as distance from home, length of stay, rest, BMI, water consumption, and physical activity showed no significant association with hypertension incidence ($p > 0.05$). These findings suggest that while age is crucial in hypertension risk, noise intensity from railway traffic may not be a primary contributing factor. Further research is warranted to explore additional variables impacting hypertension in railway-adjacent communities.

INTRODUCTION

The role of the transportation sector in the era of industrialization has had a positive impact on accelerating the mobility of people, goods, and services. One of the most effective and efficient modes of transportation is the train. In addition to the positive benefits of transportation, trains can also have negative effects such as noise and vibration, which can negatively impact people's health. Noise is an undesirable sound that arises from an activity that has an impact on health problems or comfort at a certain level and time.[1] The Ministry of Environment's Decree No. 48/MENLH/II/THN1996 establishes noise level standards for areas frequented by motor vehicles. transportation/services 70 dBA.(1) High noise intensity has an impact on hearing and non-hearing disorders such as communication disorders, concentration disorders, and subjective sleep disorders (insomnia).(2) One study states that noise directly affects non-auditory health or indirectly through activation of the sympathetic nervous system and endocrine system.(3) Suherwin

(2004) found in his research that the risk of health effects from train noise is 3.47 times higher than that of other noise sources.[4] Exposure to noise causes a response in which the body releases stress hormones, namely epinephrine, noropinephrine, and cortisol. Prolonged exposure to noise causes the continuous release of stress hormones until their concentration increases and results in a faster heart rate, which causes an increase in blood pressure. Prolonged noise results in high blood pressure, which continues to increase until it is difficult to return under normal conditions. This condition impacts the risk of developing hypertension.[5]

Two categories of risk factors for hypertension exist: those that are uncontrollable, such as family history, gender, and age. Conversely, controllable factors encompass diet, water and salt consumption, physical inactivity, smoking, and obesity. According to WHO statistical data from 2015, 1.13 billion people worldwide suffer from hypertension, with a predicted increase of 1.5 billion cases by 2025.[6] The Institute for Health Metrics and Evaluation reported in 2017 that high blood pressure caused 1.7 million deaths in Indonesia (23.7%). Riskesdas (2018) stated that the prevalence of hypertension cases in Indonesia was 34.1% of the population aged ≥18 years. The estimated number of hypertension cases in Indonesia reached 63,309,620 people, while the number of deaths caused by hypertension was 427,218 deaths.[7]

Kendal district health data in 2016 saw 10,776 people suffering from essential hypertension and 7,978 people from other hypertension. In 2017, hypertension cases increased by 26,473 people with essential hypertension. The prevalence of hypertension cases in women in 2016 was 32.96% greater than that in men, namely 28.70%, and in 2018, there was an increase in hypertension cases in women, reaching 36.85% and 31.34% in men. We can conclude that women experience a higher incidence of hypertension than men. Based on data from the Brangsong Community Health Center in 2021, 3989 cases of hypertension occurred in women, and women who live around the crossing spend more time at home than men. Unhealthy lifestyles, obesity, and age factors tend to influence hypertension in women.

Kendal Regency is an area that is on the railway line. We conducted the research in the railway track area of Brangsong sub-district. The preliminary data on noise intensity, collected in residential areas at a distance of 10 m from the rail in a single measurement, reveals a daytime Leq value of 85.61 dBA. This value surpasses the Noise Absorption Cap (NAB) of 70 dBA for environments affected by transportation or service modes. The lowest noise value is 37.9 dBA when the train is clearly visible, and the highest is 101.8 dBA when the train passes directly in front of the measurement. Based on the departure schedule, the intensity of trains varies daily, with 90 different types of trains passing through residential areas within a time span of 15-30 minutes. From 10 respondents, scores were obtained. The maximum systolic pressure is 160, the diastolic pressure is 100 mmHg, and the average is 125/86 mmHg. About 30 people who live around the railroad tracks suffer from hypertension. Based on the noise intensity and high number of trains, as well as the health impacts of exposure to noise, the researchers intend to conduct research regarding the relationship between noise intensity and the incidence of hypertension in people living around the Kendal district railway tracks.

MATERIALS AND RESEARCH METHODS

We used a cross-sectional approach and an analytical observational research method. We calculated the population size in settlements within a radius of 0-30 meters from the railway crossing. We then used the minimum sample formula to identify 105 families from four research areas in Brangsong District, Kendal Regency, and used purposive sampling to select 50 individuals who satisfied the inclusion criteria. These included women aged 25–64 years, who had stayed for a minimum of 5 years and had no history of serious

illnesses such as heart, diabetes, or kidney. The independent variable is noise intensity, the dependent variable is the incidence of hypertension, and the confounding variables are age, length of stay, distance from home, length of stay, BMI, sports activity, drinking water consumption, and excess salt consumption.

The primary data in the study included noise intensity measurements, nutritional status measurements (BMI), blood pressure measurements, and questionnaires. We divided the noise intensity measurements into 4 areas: Tosari village RT 3 RW 2 and RT 1 RW 3, and Brangsong village RT 23 and 24 RW 8, each with 3 measurement points at distances of 10 m, 20 m, and 30 m. The Extech G098187 series Sound Level Meter, a product of China, serves as the tool for measuring noise. We conducted measurements for 24 hours, collecting 7 noise measurement data: 4 during the day (06.00–22.00 WIB) and 3 during the night (22.00–06.00 WIB), in accordance with SNI 8427:2017. With the following calculation formula:

Day and night noise formula (L_{sm}) 24 hours

$$L_{sm}=10\text{Log}\frac{1}{24}\ \{16.\ 10^{0.1.Ls}+..+8.\ 10^{0.1(\overline{Lm+5})}\}\ dB\ (A)$$

We measured the respondent's weight and height to determine their nutritional status (BMI). The respondent stood upright, positioned their feet in the middle of the digital body scale, maintained a calm attitude, and looked straight ahead to measure their body weight. The respondent measured their height with a measuring meter by standing upright, keeping their legs straight without shoes, and placing their back, heels, and head against a wall parallel to the meter. Check your blood pressure using a sphygmomanometer. The data tool uses a 2x2 chi square tabulation test. If the expected count tabulation is less than 5, we employ Fisher's exact test as an alternative.

RESULTS OF RESEARCH AND DISCUSSION

General Description of The Research Area

The research area covers 4 areas, namely Tosari village RT 3 RW 2 and RT 1 RW 3, as well as Brangsong village RT 23 and 24 RW 8, which are settlements near the train tracks in Brangsong sub-district, with the radius of the research area limited to a distance of 10 to 30 meters from the train tracks. fire. In one day, approximately 60 trains pass through the crossing, going in various different directions. Meanwhile, based on the schedule at JPL Srogo, there should be 90 trains passing through the area. Passing trains generate noise intensity ranging from 65.18 to 80.3 dB (A). Based on existing train noise intensity measurement data obtained, the impact of train noise can disrupt the health of people who live around train tracks.

The research area encompasses the working areas of Bangsong I and II health centers. In 2021, there were 4383 cases of hypertension in the working area of Bangsong 1 health center, with 394 cases reported by men and 3989 cases by women. However, in 2022, the number of hypertension cases dropped to 2432, with 277 cases reported by men and 2155 cases by women. According to data on the top 10 diseases in the work area of Brangsong I Community Health Center, hypertension ranks 9th with 53 cases, while Brangsong II Community Health Center ranks 3rd with 52 cases of hypertension.

Univariate analysis

1. Respondent characteristics based on numerical variables

Table 1 Characteristics of Respondents Based on Numerical Variables

No.	Variable	Min	Max	Mean	Median	elementary school
1	Age	25	64	45.58	46.50	12,580
2	Stay period	5	64	33.12	27.00	21,330
3	Length of stay	9	23	20.48	22.00	3,079
4	Distance from home	10	30	20.50	20.00	7,321
5	Long rest	5	10	7.56	8.00	1,198
6	Mass Index	16	37	25.30	24.35	4,654
7	Systolic pressure	96	178	130.28	128.00	21,668
8	Pressure diastolic	66	115	84.18	80.00	11,061

The table revealed that the average age of the respondents was 45.58 years, spanning from 25 to 64 years. The average length of stay for respondents was 33.12 years, ranging from 5 to 64 years. The average length of stay in a day is 20.48 hours, with a range between 9 and 23 hours. The average distance of the respondent's house from the train tracks is 20.50 meters, with the closest distance being 10 meters and the furthest being 30 meters. The average length of rest per day was 7.56 hours, with a range between 5 and 10 hours. The average body mass index (BMI) is 25.30 kg/m2, with a minimum value of 16 kg/m2, a maximum of 37 kg/m2, and a standard deviation of 4.654. The respondents' average systolic blood pressure was 130.28 mmHg, with the lowest pressure being 96 mmHg and the highest being 178 mmHg. Meanwhile, the average diastolic blood pressure was 84.18 mmHg, with the lowest pressure being 66 mmHg and the highest being 115 mmHg.

2. Respondent characteristics based on categorical variables
   The following is data on the characteristics of respondents based on categorical variables presented in table 2.

Table 2 Characteristics of Respondents Based on Categorical Variables

No.	Variable Frequency	(person)	(%)
1	Age		
	a. ≥ 40 year	32	64.0
	b. < 40 years	18	36.0
2	Residence Periode		
	a. > 10 year	40	80.0
	b. ≤ 10 years	10	20.0
3	Length of stay		
	a. ≥ 16 O'clock	45	90.0
	b. < 16 hours	5	10.0
4	Distance from home		
	a. 10-20 meters	27	54.0
	b. 21-30 meters	23	46.0
5	Long Rest		
	a. Enough	40	80.0
	b. Less	10	20.0
6	train noise		
	a. Yes	21	42.0
	b. No	29	58.0
7	Loud noise at night		
	a. Yes	46	92.0
	b. No	4	8.0
8	Noisy at Night		
	a. Yes	9	18.0
	b. No	41	82.0

9	Body Mass Index (BMI)		
	a. ≥ 25 kg/m2	25	50.0
	b. < 25 kg/m2	25	50.0
10	Sleep Disorders		
	a. Yes	13	26.0
	b. No	37	74.0
11	Excessive salt consumption		
	a. Yes	17	34.0
	b. Do not	33	66.0
12	consume drinking water		
	a. < 1.5 liters	9	18.0
	b. ≥ 1.5 liters	41	82.0
13	Active exercise		
	a. Yes	27	54.0
	b. No	23	46.0
14	Systolic pressure		
	a. ≥ 140 mmHg	18	36.0
	b. < 140 mmHg	32	64.0
15	Diastolic pressure		
	a. ≥ 90 mmHg	14	34.0
	b. < 90 mmHg	36	66.0
16	Hypertension		
	a. Hypertension	22	44.0
	b. Normal	28	56.0

Based on table 2, it shows that 32 people (64.0%) were more than 40 years old compared to those classified as less than 40 years old, namely 18 people (36.0%). Respondents with a stay of > 10 years were 40 people (80.0%) more than respondents with a stay of ≤ 10 years, namely 10 people (20.0%). The percentage of respondents' length of stay ≥ 16 hours per day is 45 people (90.0%) greater than long-stayed < 16 hours per day, namely 5 people (10.0%). The distance between the houses of respondents who live around 10–20 meters from the train tracks is 27 people (54.0%) more than the distance between the respondents' houses, which are 21–30 meters from the train tracks, namely 15 people (46.0%). There were 40 respondents (80.0%) who had sufficient rest duration, compared to 10 respondents (20.0%) who had insufficient rest duration. 29 respondents (58.0%) reported not feeling the train noise, a higher percentage than the 21 respondents (42.0%), and 92.0% reported that the noise was louder at night than those who did not feel it. Specifically, 8.0% of respondents reported no noise at night, while 41 respondents (82.0%) reported no noise at all, compared to 9 respondents (18.0%) who reported noise.

The results showed that there were 25 respondents with a BMI ≥ 25 kg/m2 and < 25 kg/m2 (50.0%). The majority of respondents, 37 (74.0%), did not experience sleep disorders, outnumbering the 13.0% who did. The percentage of respondents who did not like consuming excess salt was 33 (74.0%). The number of respondents who consumed <1.5 liters of drinking water per day was 82.0%, or 41 respondents. The results of this study illustrate that there were 27 more respondents (54.0%) who did sports activities than respondents who did not do sports. Systolic blood pressure was classified as abnormal (≥140 mmHg) in 18 people. There were 14 respondents who had diastolic blood pressure that was classified as abnormal (≥ 90 mmHg), and 22 respondents (44.0%) had hypertension.

3. Noise Intensity

   Below is a table of measurement results of noise intensity in 4 residential areas around railway crossings at distances of 10, 20 and 30 meters.

Table 3 Results of Noise Intensity Measurements in Residential Areas around the Brangsong District Railway in 2022

Location	Distance (m)	Location point	Noise Intensity (dB(A))		
			Ls	Lm	NGO
Tosari	10	1	77.7	77.2	79.74
RT 3 RW 2	20	2	66.7	69.6	71.07
	30	3	69.4	67.6	70.75
Tosari	10	4	75.4	79	80.3
RT 1 RW 3	20	5	70.2	73.9	75.16
	30	6	63.9	70.8	71.52
Brangsong	10	7	77.5	76.4	79.2
RT 23 RW 8	20	8	69.3	64.2	69.23
	30	9	61	63.7	65.18
Brangsong	10	10	77.2	72.5	77.32
RT 24 RW 8	20	11	68.1	69.7	71.53
	30	12	62.6	66.1	67.4

Based on table 3, the highest noise intensity is at point 4 which is 10 meters from the train track at 80.3 dB(A) and the lowest noise intensity is at point 9 at 65.18 dB(A) at a distance of 30 meters from the train track. . Statistical results show that noise intensity has value average 73.1975 dBA. In table 4, noise intensity data is presented based on the noise intensity level as follows.

Table 4 Noise Intensity in Residential Areas Near the Railway Tracks in Brangsong District in 2022

No	Noise Intensity (Lsm) (dBA)	Frequency (dots)	Percentage (%)
1	Tall	9	75.0
2	Low	3	25.0
	Total	12	100

Table 4 above explains that of the 12 measurement points from four regions, the highest intensity was classified as high (≥70 dB(A)), namely 9 locations with high intensity and 3 locations with relatively low intensity (<70 dB(A)). . We did not conduct measurements on each respondent's house individually, but rather in groups based on their house's distance from the train track. KEPMENLH No. 48/MENLH/II/THN 1996 establishes a standard noise level of 55 dBA for residential areas and 70 dBA for residential areas near transportation modes. The research results show that environmental noise has exceeded the permissible threshold and can cause health problems. In line with Tri Wahyuni's research in 2009 regarding train noise in the city of Surakarta, it showed that the results of measuring the intensity of train noise in residential areas were around 62.5–92.6 dB (A) at a distance of 5-55 meters from the train tracks.[8]

Bivariate analysis

Below is presented a bivariate analysis in table 5 regarding analyzing the relationship between individual characteristics and the incidence of hypertension in people living around the Kendal district railway.

1. Relationship between individual characteristics and the incidence of hypertension

Table 5 Relationship between individual characteristics and the incidence of hypertension

No.	Variable	Hypertension Occurrence						
		Hypertension		*Normal*				
		f	%	f	%	*p-value*	OR	95%Cl
1	Age							
	≥ 40 Years	18	81.8	14	50.0	0.042	4,5	1,211-
	< 40 Years	4	18.2	14	50.0			16,719
2	Distance from home							
	10-20 meters	13	59.1	14	50.0	0.723	1,444	0.468-
	21-30 meters	9	40.9	14	50.0			4,46
3	Length of stay							
	≥ 16 Hours	21	95.5	24	85.7	0.368	3,5	0.362-
	< 16 hours	1	4.5	4	14.3			33,818
4	Stay period							
	≤ 10 years	3	13.6	7	25.0	0.480	0.474	0.107-
	> 10 years	19	86.4	21	75.0			2,098
5	Long rest							
	Enough	16	72.7	24	85.7	0.302	0.444	0.108-
	Not enough	6	27.3	4	14.3			1,829
6	BMI							
	≥ 25 Kg/m2	13	59.1	12	42.9	0.393	1,926	0.621-
	< 25 Kg/m2	9	40.9	16	57.1			5,977
7	Drinking Water Consumption							
	< 1.5 liters	2	9.1	7	25.0	0.266	0.300	0.056-
	≥ 1.5 liters	20	90.9	21	75.0			1,62
8	Consumption More salt							
	Yes	4	18.2	13	46.4	0.073	0.256	0.69-
	No	18	81.8	15	53.6			0.954
9	Activity Sport							
	Yes	11	50.0	16	57.1	0.828	0.750	0.244-
	No	11	50.0	12	42.9			2,303

The table above shows that there is a relationship between age and the incidence of hypertension (p-value = 0.042; OR = 4,500) and that respondents aged more than 40 years have a 4.5 times higher risk of becoming hypertensive sufferers. The older a person gets, the greater the risk of someone experiencing hypertension; this occurs due to the influence of degeneration with increasing age. Husna (2014) stated the same results: there was a relationship between age and the incidence of hypertension (p = 0.025; OR = 0.200) in women who lived around the Semarang city railway. About 50–60% of individuals aged 40–60 years have blood pressure higher than or equal to 140/90 mmHg.[9] Distance from the respondent's house shows a p value of 0.723, meaning that there is no relationship between distance from home and hypertension. Train noise is intermittent noise that has periods of relative calm, and respondents have adapted to noisy environments over a long period of time. There is a difference in land contour between the railway track and the respondent's house, which can cause noise to be less influential on the respondent and cause hypertension. Respondents' length of stay showed no relationship with the incidence of hypertension (p = 0.368). Prolonged exposure to noise causes blood pressure to increase, and it is difficult to return to normal blood pressure.[10] A person who is exposed to 75 dB of noise for 8 hours per day if it occurs in just 1 day does not cause significant health problems; however, if it occurs for weeks to years, it will one day cause a person's hearing loss

(deafness).[11] The high intensity of the produced noise does not significantly increase people's blood pressure. People who have lived for a long time are used to the noise, so they don't feel disturbed.

Length of stay showed no relationship with the incidence of hypertension (p = 0.480). Rosidah (2004) stated that there was no significant relationship between length of stay and the incidence of hypertension (p = 0.900). Levi (1966) stated that urinary adrenaline and noarrenaline levels were higher in subjects exposed to noise for a short time. With the same exposure over a longer period of time, adrenaline and noarrenaline levels only increase slightly, so that the habituation factor affects the autonomic system regarding exposure to noise and can chronically reduce the ear's sensitivity to perceiving sound because the hearing organs may be disturbed, so that exposure to noise does not cause physiological effects. such as increased blood pressure.[12] The incidence of hypertension does not correlate with the length of rest (p value = 0.302). The average rest time for respondents is 7.56 hours per day, which is sufficient because someone is advised to rest 8 hours a day. Poor-quality sleep conditions can change the stress hormone cortisol and the sympathetic nervous system so that it can result in increased blood pressure.[13] An individual's condition can also have an impact on their sleep patterns. Factors that influence sleep patterns are stress, physical environment, diet, medication. , physical exercise, illness, and lifestyle.[14]

According to Mungreiphy et al., it was revealed that the more an individual's BMI increases, the more their blood pressure increases. The results of the body mass index analysis had an average of 25.30 kg/m2. Respondents who have a BMI tend to be obese (≥ 25 kg/m2), as many as 13 people. In line with Rinawang's (2011) research, it was found that the proportion of hypertensive sufferers who were not obese was greater than that of hypertensive sufferers who were obese.[15] The body needs 1–2.5 liters, or 6–8 glasses, of mineral water every day. Almost all reactions in the body require fluid. Drinking too little water will disrupt the reactions that occur. Therefore, the body needs fluids so that metabolism runs normally. The results showed that there was no relationship between drinking water consumption and the incidence of hypertension (p-value = 0.266) because hypertensive respondents needed sufficient drinking water a day (≥1.5 liters). Statistical results show that excessive salt consumption is not related to hypertension (p = 0.073). This is because 66.0% of the respondents do not have the habit of consuming excessive salt. Sports activity obtained a p-value of 0.828, which means that sports activity has no relationship with the incidence of hypertension. In line with research by Prasetyo et al. (2015), there is no relationship between physical activity and the incidence of hypertension in young adults.[16] People who are less active in sports tend to be overweight. Exercise can prevent obesity and reduce salt intake in the body. Aerobics for 30-45 minutes per day can reduce peripheral resistance, which will prevent hypertension.[17]

2. Correlation of Noise Intensity with Blood Pressure

An analysis table of the relationship between noise intensity and systolic blood pressure is presented in table 6 and an analysis of the relationship between noise intensity and diastolic blood pressure is presented in table 7 as follows.

Table 6 Correlation of Noise Intensity with Systolic Blood Pressure

Noise intensity	Pressure Systolic Blood				*p-value*	*OR*	*95%CI*
	Tall		Normal				
	f	%	f	%			
≥70 dBA	15	83.3	21	**65.6**	0.312	2,619	0.622-
<70 dBA	3	**16.7**	11	34.4			11,036
Total	**18**	**100.0**	**32**	**100.0**			

The results of the study stated that the minimum value for systolic blood pressure was 96 mmHg and the maximum value was 178 mmHg. Meanwhile, the average systolic blood pressure of respondents was 130.28 mmHg.

Table 7 Correlation of Noise Intensity with Diastolic Blood Pressure

Noise intensity	Pressure Systolic Blood				*p-value*	*OR*	*95%CI*
	Tall		Normal				
	f	%	f	%			
≥70 dBA	11	78.6	25	69.4	0.729	1,613	0.375
<70 dBA	3	21.4	11	30.6			6,949
Total	**14**	**100.0**	**36**	**100.0**			

From the table above, the respondent's diastolic blood pressure shows a minimum value of 66 mmHg and a maximum value of 115 mmHg, while the average diastolic blood pressure of the respondents is 84.18 mmHg. The average value of systolic and diastolic blood pressure in respondents, according to the VIIth Joint National Committee (JNC), is in the pre-hypertension category. Generally, an increase in systolic blood pressure leads to an increase in diastolic blood pressure. Cardiac output, a function of volume, heart rate, and venous capacity, tends to influence systolic blood pressure. Total peripheral resistance influences diastolic pressure. Exposure to noise results in a response in the brain to stress hormones and the nervous system, which increases heart rate. Therefore, exposure to noise can lead to an increase in systolic blood pressure, but it takes time for the diastolic blood pressure to rise. The regulatory system detects changes in blood pressure, prompting the body to automatically strive for normal blood pressure, leading to a higher systolic blood pressure than an increase in diastolic blood pressure. [10]
Statistical tests prove that there is no relationship between noise and systolic (p-value 0.312) and diastolic (p-value 0.729) blood pressure. In line with Diana's research, KW (2019) found that there is no relationship between noise and blood pressure in housewives in the Turirejo settlement, Lawang District, Malang (p = 0.070). [18] Diastolic hypertension is defined as blood pressure with a value of 90 mmHg or more. An increase in diastolic blood pressure, without a corresponding increase in systolic blood pressure, causes this pressure. Children or young adults often experience diastolic hypertension.[19] Diastolic blood pressure increases more often in people under 50 years of age.[20] The absence of therapy or medication may lead to the development of systolic-diastolic hypertension.[21] A total of 46 respondents (92%) admitted that noise was louder at night. However, 82% of respondents, or 41 people, did not feel the noise could disturb their activities and continued to carry out their activities as usual.

3. Relationship between Noise Intensity and Hypertension
   The following table is presented regarding the relationship between noise intensity and the incidence of hypertension, which can be seen in table 8.

Table 8 Correlation of Noise Intensity with the Incident of Hypertension

Noise intensity	Pressure Systolic Blood				*p-value*	*OR*	*95%CI*
	Tall		Normal				
	f	%	f	%			
≥70 dBA	18	81.8	18	**64.3**	0.292	2,5	0.661
<70 dBA	4	**18.2**	10	35.7			9,461
Total	22	**100.0**	28	100.0			

The results of the statistical analysis of the chi square test show a p-value of 0.292, which is greater than the alpha value, meaning there is no significant relationship between noise intensity and the incidence of hypertension. Hypertension is characterized by an increase in systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg. Exposure to noise triggers the nervous system by increasing the speed of the heart rate so that it has a direct impact on systolic blood pressure, but diastolic blood pressure takes time.(10)

The nervous system and hormones in the community absorb noise exposure, which can raise blood pressure. The brain then interprets this as stress or a threat, leading to the release of stress hormones such as epinephrine, noropinephrine, and cortisol. Noise-induced stress impacts the nervous system and influences heart rate. Prolonged exposure to noise will result in the continuous release of stress hormones until the concentration of stress hormones increases. High concentrations of stress hormones result in a faster heart rate, which causes blood pressure to increase. The body's adaptation to noise also affects blood pressure, where the body's adaptation to prolonged noise causes blood pressure to increase and makes it difficult to return to normal conditions. This impacts the risk of hypertension and related diseases. (10)

Ducan asserts that the use of barriers reduces noise. Ducan divides barriers into three categories: permanent barriers like walls, mounds of land, and surface contours. Barriers are not permanent, namely barriers in the form of vegetation such as shrubs and trees. There are also hybrid barriers that combine both permanent and non-permanent elements.(11) The first step involves planting trees and designing a concrete wall as a permanent barrier to reduce noise. Trees and concrete are each capable of reducing 3.4–8 dBA for trees with the minimum leaf density and 15-20 dBA for concrete walls with a minimum height of 2.5 m, a thickness of 0.05 m, and a minimum length of 100 m.(22) The use of trees also requires consideration; a minimum trunk diameter of 0.2 m is capable of reflecting, deflecting, and scattering sound waves and can reduce noise up to 8.1 dBA.(23) How can we manage noise in enclosed spaces to minimize our exposure to noise coming from outside? It is best to arrange rooms that require a higher level of quiet, such as study areas and bedrooms, outside the house so that they are not close to sources of noise.

4. Relationship between distance from home and noise intensity
   Analysis of the relationship between distance from the respondent's house and noise intensity is presented in table 9.

Table 9 Relationship between House Distance and Noise Intensity

Noise intensity	Pressure Systolic Blood				*p-value*	*OR*	*95%CI*
	Tall		Normal				
	f	%	f	%			
10-20m	23	63.9	4	28.6	0.053	4,423	1,153
21-30m	13	36.1	10	71.4			16,964
Total	36	100.0	14	100.0			

Table 9 shows that of respondents with a house distance of 10–20 meters, there were 23 people who were exposed to high-intensity noise (≥70 dBA). Meanwhile, houses 21–30 meters away from the railroad crossing exposed 13 people to high noise. The p value is 0.053 ($p > 0.05$), meaning there is no relationship between the distance to the respondent's house and the noise intensity.

The condition of the ground surface contour is one of the causes of differences in noise intensity in each region. The results of observations in the research area indicate that the ground surface of the train tracks is located higher than the contour of the ground surface surrounding the respondent's house. Measurements in residential areas where there are buildings can cause differences in noise intensity. This is because the buildings act as dampers. Apart from that, different types of trains, train speeds, the number of carriages, and the noise arising from train horns can cause differences in noise intensity.

CONCLUSIONS AND RECOMMENDATIONS

The results of the study show that there is a relationship between age and the incidence of hypertension. However, there was no relationship between noise intensity and hypertension, systolic and diastolic pressure, or distance from home. There was no relationship between distance from home, length of stay, length of rest, BMI, excessive consumption of drinking water and salt, and sports activity on the incidence of hypertension. Future researchers should aim to measure stress levels and check blood pressure multiple times.

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