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The effect of traffic noise on public health

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Traffic;
Noise;
Sound level meter;
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Abstract

Objective: This paper aims to determine the level of noise generated by land transportation modes and their impact on the people who live nearby along arterial roads in the city of Parepare, Indonesia.

Method: This study is a vehicle traffic survey conducted simultaneously with noise level measurements using a sound level meter. The calculation uses the Equivalent Leq formula, to determine the impact arising from noise, using statistical applications.

Results: The highest noise level results are 88.8 dB (above the standard noise level based on Kep-48, MENLH, 11,1996 of 55–65 dB for each region). The impact of noise on public health by traffic on people who live around the road is a psychological disorder 80%, physiological disorders 35.7%, and the highest is a communication disorder 84.3%.

Conclusion: The impact of high-noise results needs to be socializing by the government to people who live around along the road.

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Introduction

The development of transportation volume continues to develop at a very rapid pace every time. But the growth of vehicle volume harms the environment, namely the occurrence of noise. The noise that arises not only because of the passing vehicle exhaust sounds but also caused by friction between the road surface and vehicle tires and even the sound of the horn. Heavy vehicles (trucks, buses), passenger cars are the main sources of noise on the highway.[1] Unwanted and persistent noise at work and traffic can cause loss of listening sensitivity that leads to deafness.[2,3]

According to (Bangun, L.P. et al., 2009) noise is an unwanted sound because it is not under the context of space and time so it can cause disruption to human comfort and health.[4] Meanwhile, according to (Maekawa and Lord, 1994) noise is a sound that interferes with hearing and is not in time.[5] Noise is unwanted sound both in the workplace and the environment in residence, depending on the source. Occupational noise usually occurs at work, and it generates

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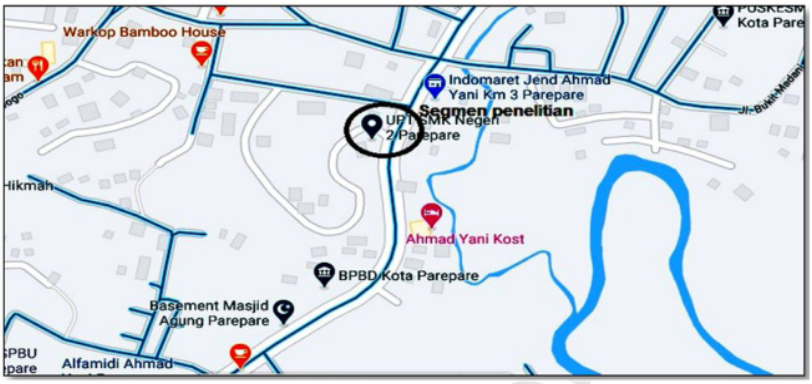

Figure 1 Research location.

Environmental noise from all places, including roads.[6] Road Traffic Noise Annoyance, Sleep Disturbance, and Public Health Services implications.[7,8]

(WHO) Night noise guidelines for Europe 2009, Noise becomes a dangerous environmental pollutant, which has physiological and psychosocial effects (the relationship between psychological and social aspects) which are detrimental to public health.[9] Environmental noise is very disturbing and suggests that outside environmental noise should not exceed 55 dB (A) and 40 dB (A) for day and night, to prevent the psychosocial effects caused. It also will affect public health.

Other problems in the Republic of Indonesia, which is a developing country, many people live very close to the road and ignore the required regulations (Government Regulation of the Republic of Indonesia No 34 of 2006 on Roads) both in the space owned by the road (Rumija) and the control room road (Ruwasja). With the existing problems, this study aims to determine the level of noise generated by land transportation modes and their impact on society.

Method

Study object and location

The object of *the* study is on roads that have a volume of vehicle density, both light vehicles, heavy vehicles and motorbikes, and population density along the road section of General Ahmad Yani, Parepare City, South Sulawesi Province. The location of the study is shown in Fig. 1.

The road is located in a residential area, public facilities, offices, and schools. This area if referring to the standard level of noise allotment of the area or environment of activities included in the residential area 55 dB, 65 dB office space, 55 dB school, and 60 dB public facilities (the noise level quality standard is based on KEP-48/MENLH/11/1996).

Data collection methods

Survey methods in this study include recording data needed to measure vehicle noise levels, and the object of research is a motorcycle (MC), light vehicles (LV), and heavy vehicles (HV) using a sound level meter. The place of observation was chosen because of the large number of vehicles passing by and the noise generated.

We interviewed with the community who lived around the road and interviewed according to the questions on the questionnaire. The question item on the questionnaire is the impact caused by each respondent on the noise caused by the mode of transportation. Noise disorders in the form of physiological disorders, psychological disorders, communication disorders (Meri Andriani, 2017), and (WHO. Burden of disease from environmental noise: quantification of healthy life years lost in Europe 2011).[10,11] Interviews and questionnaires as a data collection tool used to get information regarding the opinions, aspirations, hopes, perceptions, desires, beliefs, etc. of the individual/respondent.[12]

Data analysis methods

Traffic survey and measurement of noise level

It conducts vehicle traffic volume survey with noise level measurement is for seven days on 2–8 December 2019 at 07.00–20.00 wita. The vehicle volume that is calculating are motorcycles, light vehicle, and heavy vehicle.

Noise data retrieval is done by an ordinary sound level meter measured a momentary sound pressure level dB (A) for 10 min for each measurement. We do the reading every 5 s Leq (10 min), which represents a certain time interval, so we get 120 data. Then the data is processed to get equivalent noise level data using the following formula (Harris, 1991).

$$\text{Leq} = 10\,\text{Log}\left\{\frac{1}{(t1x10^{0.1L1}) + (t2x10^{0.1L2}) + (tnx10^{0.1Ln})}\right\}$$

where Leq is the equivalent noise value (dB), T is the total time period for data recording (600 s), n is the number of data recording (120 data), ti is the period of recording time (5 s), and Li is the reading result value (dB).

The equivalent noise level or Leq is a logarithmic scale whose values are in decibels (dB) which cannot be added directly.

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Table 1 The Regulation of the Minister of Health of the RI No. 718/Men/Kes/Per/XI/1987, regarding noise related to health.

No	Zone	Recommended noise level
1	A	35–45 dB
2	B	45–55 dB
3	C	50–60 dB
4	D	60–70 dB

The sound level meter is a device used for measuring sound intensity, working based on vibrations that occur. If there is an object or object that vibrates, it will cause changes in air pressure that will be captured by the equipment system, and then the analog needle will then show the number of noise levels expressed in dB values (SNI 7231: 2009 concerning the Noise Measurement Method in Place Work and Minister of the Environment Decree No. 48 of 1996 concerning Noise Level Standards).[13] Noise related to health can be seen in Table 1.

Noise zone
Information:

Zone A: Research site, hospital, place of health care, etc.
Zone B: Housing, education, recreation, and it is kind.
Zone C: Offices, Trade, Markets, and it is kind.
Zone D: Industry, Factory, Railway Station, Bus Terminal, and it is kind.

The influence on society by statistical test analysis
Techniques that can be used in analyzing the relationship between several variables include correlation coefficient, determinant coefficient, and regression analysis.[14] Quantitative Research Methods for Manual Calculation & SPSS.

Results and discussion

Traffic survey results and noise level measurements

Vehicle volume
The survey results of vehicle traffic volume for seven days on 2–8 December 2019 from 07.00 to 20.00 wita. Vehicle volume recapitulation can be seen in Table 2. Based on Table 3, the highest volume of vehicles occurred on Monday for light vehicles (LV), Tuesday for motorcycle (MC) while heavy vehicles (HV) with the largest volume on Friday. Motorized vehicles dominated the composition of vehicles for one week and heavy vehicles with the lowest composition.

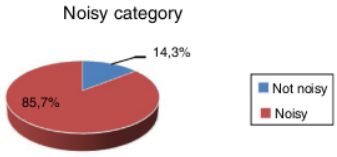

Figure 3 Noise influence.

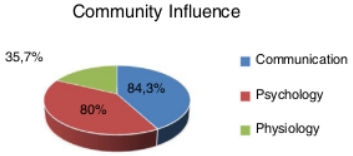

Figure 4 Community influence.

Noise level measurement
The results of the recapitulation study of noise levels got by using a sound level meter for a week with the highest level. We can see it that the mean peak noise during one week of research is around 80 dB, and the peak noise is on Sunday at 17.10–17.20 at 88.8 dB while the lowest is on Wednesday, which is 81.8 dB at 19.00–19.10, in Fig. 2.

Influence felt by the community
Fig. 3, respondents who feel noise disturbance (85.7%) while those who do not feel interference (14.3%). Whereas in Fig. 4, seen that communication disorders felt by the community (84.30%), which results in difficulties in capturing the conversation of others, do not understand what they convey and when speaking must shout. This can lead to disruption of work such as misunderstanding, which can indirectly reduce the quality and quantity of work. Next is psychological disorders (80%), namely disorders that attack a person's psychic or soul. This disorder, if it occurs, can trigger an increase in a person's emotions, which results in stress, thus potentially

Table 2 Recapitulation of vehicle volume calculations.

Day	Date	LV	HV	MC
Monday	December 2, 2019	11832	624	9986
Tuesday	December 3, 2019	8871	764	12703
Wednesday	December 4, 2019	7436	660	11996
Thursday	December 5, 2019	11538	651	10104
Friday	December 6, 2019	11642	796	10131
Saturday	December 7, 2019	10636	703	10583
Sunday	December 8, 2019	11327	676	10230
	7 days total	73282	4874	75705

Source: Field Data.

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Table 3 Validity test results.

Indicator	Correlation value (Pearson correlation)	r_{table}	Information
Communication failure			
Gk1	0.619	0.235	Valid
Gk2	0.447	0.235	Valid
Gk3	0.567	0.235	Valid
Gk4	0.771	0.235	Valid
Gk5	0.250	0.235	Valid
Gk6	0.555	0.235	Valid
Gk7	0.450	0.235	Valid
Gk8	0.525	0.235	Valid
Physiological disorders			
Gf1	0.612	0.235	Valid
Gf2	0.546	0.235	Valid
Gf3	0.453	0.235	Valid
Gf4	0.556	0.235	Valid
Gf5	0.654	0.235	Valid
Gf6	0.549	0.235	Valid
Gf7	0.24	0.235	Valid
Psychological disorders			
Gp1	0.649	0.235	Valid
Gp2	0.643	0.235	Valid
Gp3	0.645	0.235	Valid
Gp4	0.695	0.235	Valid

Source: SPSS data.

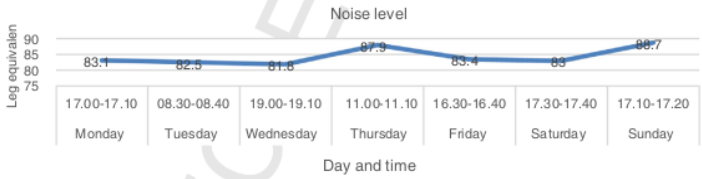

Figure 2 Recapitulation of peak noise levels.

Table 4 Reliability test results.

No	Variable	Guttman split-half coefficient	r_{table}	Conclusion
1	Noise and impact	0.784	0.235	Reliable

Source: SPSS data.

increasing blood pressure or hypertension. While physiological disorders (35.70%) which results in headaches, nausea, palpitations, feel rapid fatigue, and stomach aches.

Test the effect of noise and impact on society

Validity test. The validity test shows the results of data processing, and it turns out that variables for communication disorders, physiological disorders, psychological disorders, and noise are declaring validly. The screen shows that the correlation value (Pearson correlation) is greater than the table, so the question items declare validly and proceed with the reliability test. The results of the tabulate can be seen in Table 3.

Reliability test. Table 4 measurement of reliability with the Guttman split-half statistical test, shows that the value got is 0.784 greater than the r_{table} value of 0.235, so we can rely it on for research. The variable relationship test uses the Pearson correlation test to find out the closeness between the variables X and Y. The results of the data in Table 5.

The overall significance test $R = 0.452$ shows the relationship between the variables of communication disorders, physiological disorders, psychological disorders that simultaneously have a strong correlation; likewise, in Table 5.

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Table 5 Correlation test.

		Correlations			
		Communication disorders	Physiological disorders	Psychological disorders	Noise
Communication disorders	Pearson correlation	1	.394**	.594**	.401**
	Sig. (2-tailed)		.001	0	.001
	N	70	70	70	70
Physiological disorders	Pearson correlation	.394**	1	.423**	.146
	Sig. (2-tailed)	.001		0	.226
	N	70	70	70	70
Psychological disorders	Pearson correlation	.594**	.423**	1	.397**
	Sig. (2-tailed)	0	0		0.001
	N	70	70	70	70
Noise	Pearson correlation	.401**	.146	.397**	1
	Sig. (2-tailed)	.001	.226	.001	
	N	70	70	70	70

Source: SPSS data.
** Correlation is significant at the 0.01 level (2-tailed).

The results of Pearson correlation analysis show a strong relationship between noise to communication disorders of 0.401, while physiological disorders to noise there is no relationship equal to 0.146, and as for the relationship between psychological disorders to noise, there is a strong relationship of 0.397.

Conclusion

It can be concluded that the highest noise level on Sunday was 88.8 dB. This value exceeds the maximum quality standard that is the designation of the school area, which is 55 dB, offices are 65 dB, and the allotment of public facilities is 60 dB (the noise quality standard of Minister of Environment Decree No. 48 of 1996 applies). The impact of traffic noise on the people who live along the road is a psychological disturbance by 80%, physiological disturbance by 35.7%, and the highest is a communication disturbance by 84.3%. The results need to be socializing by the government to the people who live along highways that have high noise and impacts and find solutions for handling noise problems such as planting trees or making noise barriers.

Conflict of interest

The authors declare no conflict of interest.

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