Levels of Particulate Matter 2.5 (Pm2.5) on Potential Respiratory Disorders in Traders Around the Road of Sultan Alauddin Makassar City

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ABSTRACT

Transportation-related air pollution is a significant contributor to total urban air pollution. Particulate matter 2.5 is a dangerous pollutant because it is very small in size, so it can reach the lungs and cause various diseases, especially respiratory disorders. This study aims to analyze the risk of PM2.5 levels in the air to traders along Jalan Sultan Alauddin Makassar City. The type of research used was descriptive observational, using the Environmental Health Risk Analysis (EHRA) method. The number of samples in this study were 84 traders. Analysis of data using univariate analysis. The measurement results showed PM2.5 levels at point I were 0.029 mg/m3, at point II was 0.027 mg/m3, at point III was 0.036 mg/m3, at point IV was 0.044 mg/m3, and at point V was 0.042 mg/m3. All measurement points still meet the requirements based on the Regulation of the Governor of South Sulawesi Selatan Number 69 of 2010. The highest exposure frequency was 365 and the lowest exposure was 245 days. The average duration of exposure of traders in the research location is 11.35 years and the average intake of traders is 0.0024 mg/kg/days. The conclusion of this study is that from 84 traders there are 3 traders who have an RQ value> 1 or are at risk.

Keywords*: Particulate Matter, Respiratory disorders, Traders*

INTRODUCTION

The problem of air pollution has long been a global problem, especially in developing countries. Pollutant elements in the air will affect health and the environment. Transportation-related air pollution is a significant contributor to total urban air pollution. The use of fossil fueled vehicles can produce pollutants in the form of gas and particulates (Faradibah & Juliany, 2016).

Particulate Matter 2.5 (PM2.5) is an environmental problem with a detrimental impact on humans, particulates that have a large diameter will be retained in the upper respiratory tract, while small ones will enter the lungs, and can be absorbed by the respiratory system. blood circulation which will then spread throughout the body (Gusti et al., 2018).

Several studies have shown that there is a relationship between PM2.5 and health problems and respiratory function. Research (Falahdina, 2017) shows that there is a risk of decreased respiratory function to regular traders who are exposed to PM2.5 with real-time exposure time and a lifespan of 30 years.

The increase in population growth will be directly proportional to the increase in population mobility so as to encourage a consumptive lifestyle towards technology and transportation, ownership of transportation facilities causes a high rate of growth in the number of vehicles and is not commensurate with the growth of roads so that it can cause congestion which can contribute to air pollution due to accumulation or stagnation of traffic flow at the point of congestion. Long queues of vehicles often occur at several points along the Sultan

Alauddin road due to the large number of vehicles entering and leaving the border. In addition, the existence of universities and shopping centers has always been a busy place for people to go so that the traffic flow along the road is always crowded with vehicles.

Traders along Jalan Sultan Alauddin are at risk of exposure to PM2.5 in the air due to the transportation sector. They work with environmental conditions in which they work is not considered and inadequate, for years in direct contact with pollutant substances and almost every day inhaling emissions from vehicles.

METHODS

The type of research was descriptive observational and the method of environmental health risk analysis (ARKL) which is to make direct observations on the object under study and calculate the amount of risk that can be caused to the exposed population so as to produce risk characteristics. This characteristic is the risk or impact of PM2.5 on the potential for respiratory disorders of traders along Jalan Sultan Alauddin Makassar City.

The independent variable is the level of particulate matter 2.5, the frequency of exposure and the duration of exposure, while the dependent variable is the risk (Risk Quotients/RQ).

Sample in this study is divided into two, namely environmental samples and traders' samples. The environmental sample in this study is the measurement of PM2.5 levels carried out at five points along Jalan Sultan Alauddin, while the sample is traders. The sample of traders in this study is a population that is expected to represent the state of the population. The sample size with a total population of 107 traders is determined based on the slovin formula, so the number of samples of traders to be studied is 84 traders:

Primary data from field observations, measurement of Particulate Matter 2.5 (PM2.5) levels, weighing traders' weight (kg) and conducting interviews with traders using a prepared questionnaire. Secondary data were obtained from books, journals and the results of previous studies related to the research. Processing and analyzing data by calculating intake to determine the level of risk (RQ) of PM2.5 levels to traders. It takes data on measurements of PM2.5 levels in the air, frequency of exposure (days/year), duration of non-carcinogenic exposure (30 years), length of time exposed (hours/day) and data on traders' weight. Calculation of the rate of intake (intake) as follows:

$$I = \frac{C \ x \ R \ x \ t_e \ x \ f_e \ x \ Dt}{Wb \ x \ tavg}$$

And then the risk characteristics (RQ) are calculated using the formula:

$$RQ = \frac{I}{RfC}$$

The risk level was said to be SAFE if the RQ 1 while the risk level was said to be NOT SAFE if the RQ value is > 1 (Director General of PP and PL, Ministry of Health, 2012). The processed data were analyzed univariately using SPSS and Microsoft Excel.

RESULTS

The research activity was carried out on Jalan Sultan Alauddin Makassar City, collecting data by observation and interviews using questionnaires to traders along Jalan Sultan Alauddin and measuring PM2.5 levels in the air.

Table 1
Results of Measurement of PM2.5 . Levels

Point	Location	PM2.5 . level mg/m3	Discription
I	In front of Pa'baeng-baeng market	0,029	Qualify
II	T-junction of Pettrani Street-Alauddin Street-Andi Tonro Street	0,027	Qualify
III	T-junction of Alauddin Street-Emmy Saelan Monument Street	0,036	Qualify
IV	In front of Muhammadiyah University	0,044	Qualify
V	Crossroads Alauddin Street-Mangkeri Street-Syekh Yusuf Street-Sultan Hasanuddin Street	0,042	Qualify

Tabel 2
Distribution of PM2.5 Concentration to the Risk (RQ) on Traders

Point	Concentration (mg/m^3)	RQ>1		RQ≤1		Total	
		n	%	n	%	N	%
I	0,029	0	0	33	39	33	39
II	0,027	0	0	22	27	22	27
III	0,036	1	1	10	12	11	13
IV	0,044	2	2	5	6	7	8
V	0,042	0	0	11	13	11	13
	Total	3	3	81	97	84	100

Tabel 3
Distribution of Exposure Frequency (fE) Against Risk (RQ) on Traders

Exposure Frequency (Day/year)	RQ>1		RQ≤1		Total	
	n	%	n	%	N	%
<363 days	0	0	32	38	32	38
≥363 days	3	4	49	58	52	62
Total (N)					**84**	**100**

Table 4
Distribution of Exposure Duration (Dt) Against Risk (RQ) on Traders

Exposure Duration (Years)	RQ>1		RQ≤1		Total	
	n	%	n	%	N	%
<7,5	0	0	42	50	42	50
≥7,5	3	4	39	46	42	50
Total (N)					**84**	**100**

Table 5
Distribution of Exposure Time (tE) to the Risk (RQ) on Traders

Exposure Time (hour/day)	RQ>1		RQ≤1		Total	
	n	%	n	%	N	%
<8	0	0	0	0	0	0
≥8	3	4	81	96	84	100
Total (N)					**84**	**100**

Table 6
Distribution of Body Weight (Wb) Against Risk (RQ) on Traders

Weight (Kg)	RQ>1		RQ≤1		Total	
	n	%	n	%	N	%
<58	2	2	47	56	49	58
≥58	1	1	34	40	35	42
Total (N)					**84**	**100**

DISCUSSION

PM2.5 . CONCENTRATION

Particulate Matter 2.5 (PM2.5) is fine particulate matter measuring <2.5 microns. PM2.5 is very dangerous because of its very fine size and can be deposited in the deepest part of the lungs because it cannot be filtered in the upper respiratory system. Size is an important

point of this pollutant, besides the composition of PM2.5 which can consist of various compositions of heavy metals and other carcinogenic substances that can harm the body.

In this study, no element identification or composition of PM2.5 was carried out because the elemental content in PM2.5 is very difficult to detect in a general way, an effective and accurate measurement method is needed for elemental measurement, one method that can be used to determine the PM2 element content. ,5 is the neutron activation analysis (AAN) method.

The main source of PM2.5 at the research site is fossil fuels, because Jalan Sultan Alauddin is a busy road with transportation, both public transportation and private transportation, resulting in congestion and congestion or traffic jams at several points of the road.

PM2.5 levels were measured directly at the study site. A total of 5 measurement points along Jalan Sultan Alauddin Makassar City, obtained different levels of each measurement point, and still below the required quality standard of 50 g/Nm3. Measurement of PM2.5 along Jalan Sultan Alauddin obtained results that still meet the requirements, this can be caused because there are still many green plants and trees that can function as air pollution absorbers (Pangestika, Rismawati and Wilti, 2021). In addition, meteorological factors such as wind direction and speed, temperature, and humidity as well as climate and rainfall can affect the concentration of pollutants in the air. Dust carried by the wind and will be able to move to another place. If the wind speed is slow, the dust will settle to the ground surface. Pollutants in the air will cause disturbance to human health which causes respiratory problems (Rafidah & Ardina, 2018).

After processing the data from interviews and filling out questionnaires with 84 traders as well as calculating the intake and the amount of risk, it shows that even though the concentration of PM2.5 is below the quality standard, there are still 3 traders who have an RQ value> 1 (risky), namely 1 person in the market. point III (0.036 mg/m3) and 2 people at point IV (0.044 mg/m3), this is in line with research conducted by (Wulandari et al., 2015) that although the concentration of PM2.5 is still eligible, it does not free the population from risk. The length of exposure or working period and concentration are closely related to impaired lung function because the longer the exposure lasts and is supported by a high concentration of particulate pollutants, the greater the number of particles that will enter the lungs. Other factors that affect the concentration of pollutants at the measurement location are wind direction, smoking habits and the use of PPE in the form of masks.

EXPOSURE FREQUENCY (FE)

The frequency of exposure is the number of days of exposure each year, calculated by the length or number of days exposed to PM2.5 in one year and minus the time left from the study site. The highest exposure frequency was 365 days while the lowest exposure frequency was 245 days.

Based on the results of the study, traders who have an RQ value> 1 are traders with an exposure frequency of 365 days, i.e. the higher the frequency of exposure, the higher the risk of exposure to PM2.5 in the workplace, according to Khairiah in (Sholihah & Tualeka, 2015), dust can cause damage and disturbance due to long exposure and contact with dust.

EXPOSURE DURATION (DT)

The duration of exposure is the number of years the exposure occurred. The average duration of exposure for traders on Jalan Sultan Alauddin is 11.35 years. The highest exposure duration is 41 years and the lowest exposure duration is 1 year, traders start to risk after the exposure duration is 30 years. In this study, the duration of exposure used was real-time exposure duration.

The longer the period or duration of a person's work in a dusty area, the higher the risk of exposure to dust that will affect health (Wulandari et al., 2015). Of the 84 traders interviewed, there are 3 traders who have an RQ value> 1 or are risky with a duration of exposure (long trading) 7.5 years. The duration of realtime exposure of traders with RQ>1 are 30 years and 41 years.

EXPOSURE TIME (TE)

Exposure time is the length or number of hours of exposure each day. Based on the research data obtained that the average trading hours of traders is more than 8 hours/day. The longer the hours of daily exposure to a risk agent, the greater the intake received and the higher the health risks associated with the risk agent (Ahmad, 2014).

BODY WEIGHT (WB)

Body weight was measured at the time of the study. The average weight value of traders is 58 kg, with the highest weight being 110 kg and the lowest weight being 36 kg. Based on the results of interviews with traders, it is known that from 84 traders, there are 49 traders who weigh <58 kg while 35 traders have a weight of 58 kg. Body weight is included in the calculation notation because it is related to intake (intake rate), time, frequency and duration of exposure so that it affects the high and low risk of PM2,5 exposure.

The higher a person's weight value, the lower the RQ value, this is in line with research conducted (Birawida, 2016) that the higher the respondent's weight, the lower the RQ value. Someone with a low body weight will easily experience toxicity than someone who has a higher weight.

INTAKES (I)

Intake is the amount of risk agent concentration (mg) that enters the human body with a certain body weight (kg) per day. The results showed that the average intake of PM2.5 levels for traders was 0.0024 mg/kg/day.

The results of the intake calculation show that the intake value increases along with the increase in the value of PM2.5 concentration in the area, this is in line with Falahdina's research (2017) which states that the amount of intake value is directly proportional to pollutant levels, frequency of exposure and inhalation rate. , so the greater the value, the greater a person's intake. The greater the intake, the higher the RQ value or risk (Rosalia et al., 2018), so that PM2.5 is at risk of causing health problems.

RISK MAGNITUDE (RQ)

Based on the results of interviews using questionnaires, from 84 traders there are 3 traders who have an RQ value> 1 and 81 people have an RQ≤1 value. The three traders have a large intake value, according to (Rosalia et al., 2018) the greater the intake, the higher the RQ value or risk. Things that affect individual intake are activity patterns such as frequency of exposure, duration of exposure, and length of exposure each day (long trading hours). While the trader's weight variable is inversely

proportional to the RQ (big risk), the lower the weight value, the easier it is to experience toxicity than someone who has a higher weight.

CONCLUSION

The results of PM2.5 measurements were carried out at 5 points along Jalan Sultan Alauddin, namely point I of 0.029 mg/m3, point II of 0.027 mg/m3, point III of 0.036 mg/m3, point IV of 0.044 mg/m3, and point V of 0.042 mg/m3. All measurement points still meet the requirements based on the Regulation of the Governor of South Sulawesi
Number 69 of 2010 concerning Quality Standards and Criteria for Environmental Damage, which is 50 g/Nm3.

1. The average PM2.5 intake for traders along Jalan Sultan Alauddin is 0.0024 mg/kg/day.
2. The highest frequency of exposure of traders is 365 days while the lowest frequency of exposure is 245 days.
3. The average duration of exposure of traders at the research site is 11.35 years. Duration.
4. The highest exposure was 41 years and the lowest duration of exposure was 1 year.
5. The magnitude of the risk (RQ) is expressed by RQ>1 (Unsafe) and RQ≤1 (safe). A total of 3 traders have an RQ value> 1 and 81 traders have an RQ≤1 value.

SUGGESTION

It is expected that the government will conduct periodic measurements of the concentration of pollutants in the air, including PM2.5. Carry out reforestation and development of green open spaces.

It is hoped that traders along Jalan Sultan Alauddin will realize the importance of using masks (N95). And people who use transportation to limit the age of vehicles and replace environmentally friendly fuels, can also reduce working hours.

For further researchers, it is expected to take measurements using a personal dust sampler in order to describe the levels of PM2.5 which are inhaled by the respondents every time and identify the constituent elements of PM2.5 and measure the meteorological factors that affect air pollution.

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