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RISK OF ENVIRONMENTAL HEALTH RISK PARAMETERS NO$_2$ AND COMPLAINTS OF RESPIRATION ON PUBLIC TRANSPORTATION DRIVERS (NEW CAMPUS-CITY) IN KENDARI CITY

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Abstract

Background: For Kendari City, the NO$_2$ concentration in the air measured on Jl.Abdullah Silondae street still below the quality standard. However, the NO$_2$ concentration has increased and decreased based on the results of air monitoring from the Environment and Forestry Service regarding the Air Quality Index which is measured 2 times a year with NO$_2$ parameters in 2017, the first measurement is the value obtained of 1.58 µg / m3 and the second measurement. amounting to 1.57 µg / m3. In 2018 the NO$_2$ value in the first measurement was 4.2 µg / m3 and the second measurement was 5.23 µg / m3. Whereas in 2019 the NO$_2$ value in the first measurement was 5.8 µg / m3 and in the second measurement was 3.8 µg / m3.
Methods: This type of research is descriptive quantitative (Field Research and Laboratory Research). The population is the total number of public transportation and the number of drivers for the Baru-Kota Rayon 02 route, amounting to 154 public transportation units and 154 public transport drivers with the male gender. The samples are some of the public transport drivers for the New Kampus-Kota rayon 02 route.
Results: Nitrogen dioxide (NO$_2$) measurements were obtained96.85 µg / Nm3, 108.79 µg / Nm3 and 100.83 µg / Nm3 for 3 different locations. The highest respiratory complaints were cough symptoms for 47 people and the lowest was shortness of breath as many as 8 people.
Conclusion: Risk management is carried out by reducing exposure time, planting trees that can absorb air pollution, maintaining endurance, limiting the age of motor vehicles and using environmentally friendly fuels.

Key words: *Nitrogen dioxide, Air pollution, Environmental health*

INTRODUCTION

Air is an important requirement in human, animal and plant life(1). The air that was originally fresh is now changing along with the development of industrialization and modernization(2). This development certainly makes it easier for people to meet their needs and maintain the country's economic stability, but on the other hand this development actually endangers humans, the environment and other living things(3). The development of industrialization and modernization can cause air pollution which results in global warming, climate change and the emergence of new diseases(4).

Air quality is very much influenced by air pollution from vehicles (60%) and industry (20-30%), especially in big cities(5). As the main source of air pollution in urban areas, motorized vehicles have continued to experience an increase in demand in recent years. In 2016 to 2017 it reached 7.17% from the previous year and in 2018 it increased by 5.57%. The largest percentage of motorized vehicles is occupied by the capital city of Jakarta, where in 2016 there were 19,848 324 units, in 2017 there were 20,730,267 units and in 2018 there were 21,897,192 units. For Southeast Sulawesi, the number of motorized vehicles also continues to increase every year, recorded in 2016 the number of motorized vehicles was 1,478,725 units, in 2017 there were 1,532,732 units, in 2018 there were 1,612,811 units. Kendari City, the capital city of Southeast Sulawesi Province, has the largest population. It's the same with other cities, Kendari City is experiencing an increasing number of transportation needs. The number of vehicles, both cars and motorbikes in Southeast Sulawesi in 2015-2016 was 17,311 units and 2017 was 17,165 units(6).

In Indonesia, air pollution occurs in big cities such as Jakarta, Surabaya, Bandung and other big cities. However, nowadays, air pollution is not only happening in big cities but has also happened to other cities. The most important source of air pollution in Indonesia comes from motorized vehicle fumes, one of the obstacles to air exchange is caused by the number of motorized vehicles that are not balanced with the number of trees, besides that the high consumptive nature of society can affect the high level of air pollution(7).

The large number of vehicles can increase the number of pollutants in the air, especially those in Kendari City. This is important to study, especially for people who are often exposed. The groups that are at risk are those who are active around the road such as drivers, traders, police and others(8). One group of people who are at risk of being exposed to air pollution are public transport drivers. In addition to the work environment on the highway, this public transport driver works more than 8 hours per day so that he is easily exposed to air pollution.

Carbon monoxide (CO) and also nitrogen dioxide (NO_2) have specific effects on health. Air quality monitoring only looks at the level of pollutants in the area as one of the air quality monitoring information but cannot take into account the level of risk to health and estimate the effects of pollutant gases specifically(9). To be able to find out how much the health risk arising from polluting gases and risk management, this study uses an approach called Environmental Health Risk Analysis(10). Environmental health risk analysis is an analytical method that tries to see how much risk arises from exposure to these pollutants and the amount of intake that enters the human body causing specific effects on health and steps that must be taken in risk management so as to reduce the effects of these pollutants(11).

By looking at the current environmental conditions, especially air pollution, this has not caused a very specific effect so that the ARKL method can estimate the risk. A vehicle city with a fairly good level of air pollution will not always be good if the growth in the number of vehicles is increased and the presence of industrial centers so that this will increase the level of air pollution.

METHOD

This type of research is a descriptive quantitative research type (Field Research and Laboratory Research)(12). The population is the entire number of public transports and the number of drivers for the New campus-city Rayon 02 route totaling 154 public transportation units and 154 public transport drivers with the male gender. The air population is all the routes traversed by the new-city campus public transportation in Kendari City. The sample in this study were some of the public transport drivers for the Kampus Baru-Kota rayon 02 route with sampling techniques using Accidental Sampling and Probability Sampling(13)

RESULT

Table 1. Obtained the measurement results of nitrogen dioxide (NO_2) at location 1 with coordinatesS03058'22.28 "E122036'00.21" of 96.85 μg / Nm3.At location 2 with coordinates S03058'22.28 "E122036'00.21" of 108.79 μg / Nm3.At location 3 with coordinates S03058'22.28 "E122036'00.21" of 100.83 μg / Nm3.

Table 2. The duration of 8 hours of exposure was 3 people (2.70%), 8 people of 9 hours of exposure (7.21%), 25 people of 10 hours of exposure (22.52%), 7 people of 11 hours of exposure (6.31%), 12 people of 12 hours of exposure (22.52%), 26 people of 13 hours of exposure (10.81%), 12 people of 14 hours of exposure (10.81%) and 5 hours of exposure people (4,50%).

Table 3. The level of risk is calculated based on the duration of current exposure and projected over the next 30 years. Assuming that the data related to intake, namely nitrogen dioxide concentration, inhalation rate, frequency of exposure, body weight do not change for the next 30 years.

Table 4. There were 47 respiratory complaints with cough symptoms, 15 sneezing, 16 nasal congestion, 12 colds, 9 sore throats, 32 headaches, 29 unwell, 33 muscle pain, 12 fever and shortness of breath. breath as many as 8 people.

Table 1
Nitrogen Dioxide Concentration in Air, 2021

No.	Coordinate	Location	Yield (μg / Nm3)	TLV (μg / Nm3)	Method
1	S 030 58 '22.28 " E 1220 36'00.21 "	location 1	96.85	400	SNI 19-7119.1-2005
2	S 030 57 '52.12 " E 1220 31'7.29 "	location 2	108.79	400	SNI 19-7119.1-2005
3	S 030 59 '34.87 " E 1220 30'45.91 "	location 3	100.83	400	SNI 19-7119.1-2005

Source: Primary Data 2021

Table 2
Distribution of Length of Exposure Each Day, Year 2021

No.	Exposure (Hour / Day)	total	Percentage (%)
1	8	3	2.70
2	9	8	7.21
3	10	25	22.52
4	11	7	6.31
5	12	25	22.52
6	13	26	23.42
7	14	12	10.81
8	15	5	4.50
	Total	111	100

Source: Primary Data 2021

Table 3
Risk Quetion for Nitrogen Dioxide (NO2) Concentration in 2021

NO	NAME	Risk Quotien (RQ) (I / RfC) = 0.02		
		Point 1	Point 2	Point 3
1	Respondent 001	0.6522322	0.73264161	0.67903533
2	Respondent 002	0.4588213	0.51538642	0.47767637
3	Respondent 003	0.9810435	1.10198986	1.02135893
4	Respondent 004	0.8029374	0.90192623	0.83593365
5	Respondent 005	0.8947016	1.00500351	0.93146892
6	Respondent 006	0.5918408	0.66480492	0.61616215
7	Respondent 007	0.9109689	1.0232763	0.94840472
8	Respondent 008	0.4290278	0.48191977	0.44665842
9	Respondent 009	1.0136571	1.13862422	1.05531281
10	Respondent 010	0.7455847	0.83750293	0.7762241
11	Respondent 011	0.3670571	0.41230913	0.3821411
12	Respondent 012	0.9635248	1.08231147	1.00312038
13	Respondents 013	0.758707	0.85224298	0.78988565
14	Respondents 014	0.5836208	0.65557152	0.60760434
15	Respondents 015	0.5101014	0.57298843	0.53106373
16	Respondents 016	0.5208242	0.58503323	0.54222723
17	Respondents 017	0.6897336	0.77476634	0.71807786
18	Respondents 018	0.6503203	0.73049398	0.67704484
19	Respondents 019	0.5074963	0.57006219	0.5283516
20	Respondent 020	0.9324434	1.0473982	0.97076166
21	Respondent 021	0.8309177	0.93335606	0.86506381
22	Respondent 022	0.8404139	0.94402299	0.87495025
23	Respondent 023	0.5279588	0.59304738	0.549655
24	Respondents 024	0.711526	0.7992454	0.74076582
25	Respondents 025	0.7540629	0.84702637	0.78505073

NO	NAME	Risk Quotien (RQ) (I / RfC) = 0.02		
		Point 1	Point 2	Point 3
26	Respondents 026	0.758707	0.85224298	0.78988565
27	Respondent 027	0.7137221	0.8017122	0.74305213
28	Respondent 028	0.4668966	0.52445722	0.48608347
29	Respondents 029	0.4771742	0.53600187	0.49678343
30	Respondents 030	0.6366772	0.71516893	0.6628411
31	Respondent 031	0.8947016	1.00500351	0.93146892
32	Respondents 032	0.8754311	0.98335728	0.91140651
33	Respondent 033	0.6271745	0.70449477	0.65294795
34	Respondent 034	0.5005324	0.56223973	0.52110149
35	Respondents 035	0.6741865	0.75730249	0.70189181
36	Respondents 036	0.6506921	0.73091164	0.67743194
37	Respondent 037	0.6464722	0.72617153	0.67303866
38	Respondent 038	0.5667793	0.63665381	0.59007081
39	Respondent 039	1.032348	1.15961944	1.07477183
40	Respondents 040	0.9804829	1.10136016	1,0207753
41	Respondent 041	0.466598	0.52412178	0.48577258
42	Respondent 042	0.8129003	0.91311748	0.84630605
43	Respondent 043	1.0791478	1,21218885	1.12349482
44	Respondents 044	0.9104484	1.02269157	0.94786277
45	Respondents 045	0.7372052	0.82809034	0.76750022
46	Respondent 046	0.466598	0.52412178	0.48577258
47	Respondent 047	0.3871305	0.43485729	0.40303944
48	Respondents 048	0.3539479	0.39758381	0.3684932
49	Respondent 049	0.8129003	0.91311748	0.84630605
50	Respondents 050	0.5585651	0.62742694	0.58151906
51	Respondent 051	1.0376421	1.1655662	1.08028348
52	Respondent 052	0.6777531	0.76130886	0.70560504
53	Respondent 053	0.6506921	0.73091164	0.67743194
54	Respondents 054	0.4244515	0.47677929	0.44189407
55	Respondent 055	1.3444532	1,51020206	1.39970285
56	Respondents 056	0.3771134	0.42360527	0.39261072
57	Respondent 057	0.7542176	0.84720012	0.78521177
58	Respondent 058	0.7007453	0.78713562	0.72954209
59	Respondent 059	0.7181552	0.80669178	0.74766736
60	Respondents 060	0.758707	0.85224298	0.78988565
61	Respondent 061	0.7157613	0.80400281	0.74517514
62	Respondent 062	0.5407537	0.6074197	0.56297572
63	Respondent 063	0.6166559	0.69267934	0.64199704
64	Respondent 064	0.8430078	0.94693664	0.87765072
65	Respondent 065	0.5226455	0.58707897	0.54412329
66	Respondent 066	0.5505856	0.6184637	0.57321164
67	Respondent 067	0.7226436	0.8117336	0.75234028

NO	NAME	Risk Quotien (RQ) (I / RfC) = 0.02		
		Point 1	Point 2	Point 3
68	Respondent 068	0.6506921	0.73091164	0.67743194
69	Respondent 069	0.9466209	1.06332355	0.98552177
70	Respondents 070	0.5002464	0.56191845	0.52080372
71	Respondent 071	0.6777531	0.76130886	0.70560504
72	Respondent 072	0.4037628	0.45354005	0.42035521
73	Respondent 073	0.4199382	0.4717096	0.43719532
74	Respondents 074	0.5341502	0.6000021	0.55610085
75	Respondents 075	0.7003449	0.78668583	0.72912521
76	Respondents 076	0.7137221	0.8017122	0.74305213
77	Respondent 077	0.711526	0.7992454	0.74076582
78	Respondents 078	0.7104948	0.79808707	0.73969224
79	Respondents 079	0.6006389	0.67468767	0.62532179
80	Respondents 080	0.6897336	0.77476634	0.71807786
81	Respondents 081	0.5138799	0.57723279	0.53499753
82	Respondents 082	0.6411608	0.72020533	0.667509
83	Respondents 083	0.6565733	0.73751796	0.68355489
84	Respondents 084	0.3932754	0.44175979	0.40943689
85	Respondents 085	0.6366772	0.71516893	0.6628411
86	Respondents 086	0.3348156	0.37609279	0.34857465
87	Respondents 087	0.758707	0.85224298	0.78988565
88	Respondents 088	0.688232	0.77307962	0.71651456
89	Respondents 089	0.5729067	0.64353655	0.59644995
90	Respondents 090	0.3643581	0.40927745	0.37933124
91	Respondent 091	0.8129003	0.91311748	0.84630605
92	Respondent 092	0.6644999	0.74642171	0.69180716
93	Respondent 093	0.8702805	0.97757165	0.90604421
94	Respondents 094	0.5756259	0.64659109	0.599281
95	Respondents 095	0.5505856	0.6184637	0.57321164
96	Respondents 096	0.4668966	0.52445722	0.48608347
97	Respondent 097	0.914532	1.02727869	0.95211426
98	Respondents 098	0.4235274	0.47574131	0.44093203
99	Respondents 099	0.4863506	0.5463096	0.50633695
100	Respondents 100	0.7078958	0.79516761	0.7369864
101	Respondents 101	0.6477478	0.72760435	0.67436664
102	Respondents 102	0.5989792	0.6728234	0.62359393
103	Respondents 103	0.4129392	0.46384777	0.42990873
104	Respondents 104	0.5505856	0.6184637	0.57321164
105	Respondents 105	0.608542	0.68356514	0.63354971
106	Respondents 106	0.5935126	0.6666829	0.61790272
107	Respondents 107	0.7640126	0.85820272	0.79540932
108	Respondents 108	0.6513971	0.73170353	0.67816589
109	Respondents 109	0.8195525	0.9205898	0.85323163

NO	NAME	Risk Quotien (RQ) (I / RfC) = 0.02		
		Point 1	Point 2	Point 3
110	Respondents 110	0.6285147	0.7060001	0.65434314
111	Respondents 111	0.7017268	0.78823805	0.73056386

Source: Primary Data 2020

Table 4
Respondents' Respiratory Complaints in 2021

No.	Respiratory complaints	total
1	Cough	47
2	Sneezing	15
3	Nasal congestion	16
4	Cold	12
5	Sore throat	9
6	Headache	32
7	Unwell	29
8	Muscle ache	33
9	Fever	12
10	Hard to breathe	8

Source: Primary Data 2020

DISCUSSION

Nitrogen Dioxide (NO2)

Measurement of air quality in this study was taken during busy traffic hours with a location on the side of the highway. Measurements were carried out 3 times at different locations to better represent the conditions at the research location. Measurement of each concentration at location 1 starts at 13.00 WITA, measurement at location 2 starts at 15.00 Wita and at location 3 starts at 16.30 WITA. The measurement results for nitrogen dioxide at location 1 were 96.85µg / Nm3, at location 2 it was 108.79 µg / Nm3, and at location 3 it was 100.83 µg / Nm3. The average temperature at location 1 is 330C, location 2 is 320C and location 3 is 310C. With an average air temperature of 28.10C and an average humidity of 85%. With a rainfall of 8.8 mm and an average wind speed of 1 m / s. The results of measuring the concentration of Nitrogen dioxide at 1 hour measurement show low results when compared with the Ambient Air Quality Standard based on PP No. 41 of 1999 concerning air pollution control with a value of 400 µg / Nm3. The low concentration of nitrogen dioxide was caused by the presence of several trees that function as an absorber of air pollutants which affect the nitrogen dioxide concentration at the study site, especially at location 1 and location 2.

Nitrogen dioxide concentration is also influenced by the density of traffic around the study site. The higher the vehicle volume, the higher the NO2 concentration(14). Location 1 is a vehicle lane with a fairly dense level at the time of the study because at that time it is the time the ship's passengers disembark so that traffic jams occur at that location. The existence of trucks and other public transport cars that are quite congested and experiencing congestion has the potential to increase nitrogen dioxide. Vehicle speed affects the emission of nitrogen dioxide gas produced. As the vehicle speed increases, the nitrogen dioxide concentration will also increase, the change in nitrogen dioxide concentration is clearly visible when the car

is moving from medium speed to high speed. The age of the vehicle, engine maintenance, smooth traffic, how to drive, and differences in fuel use can all affect the concentration of nitrogen dioxide produced.concentration nitrogen dioxide the result is also estimated to be influenced by the existence of transportation activities (15).

At point 2 the situation around the research location is not crowded and there is a lack of human activity at that hour. The traffic density at location 2 occurs in the morning and evening so that the high concentration of nitrogen dioxide accumulates, which comes from the traffic density that occurs in the morning.

At location 3, the motorized vehicles are quite congested because that hour is the time to come home from work. The research location at point 3 is around a red light which automatically stops the vehicle with the engine still running, causing the nitrogen dioxide concentration to increase due to combustion in an incomplete engine.

Apart from traffic density factors, other factors that affect the concentration of carbon monoxide in ambient air are meteorological factors such as temperature, humidity, wind direction and speed, air pressure and rainfall. The research was conducted to coincide with the rainy season and the weather conditions were cloudy so that this affected the difference in concentration at each research point.

The temperature in the air affects the concentration of nitrogen dioxide gas. the higher the air temperature, the higher the NO_2 concentration. Decreased NO concentration$_2$occurs when the wind speed is high, and vice versa. the higher the wind speed, the NO concentration$_2$generated will be smaller because pollutants carried by the wind away from the measurement location. The effect of humidity on pollutant concentrations is that if the humidity increases, it can increase the concentration of pollutants in the ambient air(16).

The respiratory tract is a very influential organ when exposed to nitrogen dioxide. The maximum permissible concentration for occupational (work-related) exposure to nitrogen dioxide has been set at 8 ppm over an 8 hour period. However, even at much lower concentrations, nitrogen dioxide causes an increase in the incidence of acute bronchitis in children and an increase in airway resistance in adults.(17). Similarly, research conducted by Irawan in 2016 showed a positive relationship from the correlation analysis of NO_2 to the incidence of ARI(18). NO_2 gas with various exposures from 30 minutes to 24 hours will cause various adverse effects such as inflammation of the respiratory tract in healthy people and an increase in symptoms of respiratory disease in people with asthma(19).

Nitrogen dioxide gas (NO_2) is a gas that is toxic to humans and generally irritates the respiratory system. Even though the amounts are still far below the quality standard, if humans are continuously exposed to nitrogen dioxide (NO_2) gas in small amounts it can irritate the respiratory system. The organs of the body most sensitive to NO_2 gas pollution are the lungs. Lungs that are contaminated with NO_2 gas will swell so that the patient has difficulty breathing, then NO exposure at a level of 5 ppm for 10 minutes to humans can cause difficulty in breathing(20).

Risk characteristics

In accordance with the results of the calculation of the level of risk (RQ), it is obtained that new campus public transport drivers of working cities have an RQ <1 for the next 30 years on carbon monoxide exposure provided that carbon monoxide concentration, exposure time and body weight do not change for 30 years. the next year. This means that new-city campus public transport drivers in Kendari city are still in the safe category. For nitrogen dioxide exposure, the RQ calculation results for new-city campus public transport drivers in Kendari City, there are 15 drivers (13.5%) who are at risk due to nitrogen dioxide

exposure. For example, one respondent who weighs 38 kg, nitrogen dioxide concentration 0.10879 mg / m3, who works for 11 hours / day, 318 days / year and works for 3 years with an RfC value of NO_2 0,

$$I = \frac{0.10879 \frac{mg}{m^3} \times 0.83 \frac{m^2}{jam} \times 11 \frac{jam}{hari} \times 318 \frac{hari}{tahun} \times 30 \text{ tahun}}{38 \text{ Kg} \times (30 \text{ tahun} \times 365 \text{ hari})}$$

$$= 0.022722 \text{ mg / kg / day}$$

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

$$= \frac{0.022722 \frac{mg}{kg}/hari}{0.02 \frac{mg}{kg}/hari}$$

$$= 1.138624 \text{ mg / kg / day}$$

This means that the new-city campus public transport route with a NO_2 concentration of 0.10879 mg / m3 is not safe (non-carcinogenic) for public transport drivers with an inhalation rate of 0.83 / hour for 318 days / year who work 11 hours / day with heavy 38kg body in the next 30 years.

The large RQ value results in a high risk of poisoning to a person due to motor vehicle emissions. This risk can occur due to the accumulation of gas that enters the body which is increasing over time which will have an impact on their health(21).

Public transport drivers experience respiratory complaints. This is a disease that arises due to work done on the road so that public transport drivers are the workers most at risk of air pollution (NO_2).

Respiratory complaints are disturbances in the respiratory tract due to constant exposure to pollutants in the air. The longer the individual is exposed to air pollutants, the greater the likelihood of respiratory complaints(8). Based on the results of the study, public transport drivers experience respiratory complaints that come from disturbances in the work environment, namely public transportation routes in the form of gas, smoke, and dust in ambient air(22).

The production of mucus increases due to irritation from gases and particles that enter the respiratory tract. If excess mucus is formed, the normal cleansing process may not function properly. When this happens, the mucous membrane is stimulated and the mucus is coughed out as sputum which is commonly called a cough with phlegm(22). Sputum or phlegm is the secretions that are excreted from the lungs and throat through the mouth.

Shortness of breath is one of the factors that underlie the symptoms of respiratory distress(23). Air pollution causes several effects on the respiratory tract, namely the movement of cilia slows down and even becomes stopped, damage to bacteria-killing cells in the respiratory tract, excess mucus production which causes constriction of the respiratory tract, swelling of the respiratory tract, and increases cell growth so that the respiratory tract becomes narrow(24). This is what causes shortness of breath. Respiratory tract disorders are influenced by various factors caused by several factors from the individual, namely age, length of work, years of service, use of Personal Protective Equipment (PPE) in the form of masks and smoking habits.

Age is one of the characteristics of respondents who have a high risk of respiratory tract disorders. At that age, there is a decrease in the strength of the respiratory muscles and the chest wall, as a result the ability of the respiratory tract muscles to close and open during breathing increases in number. The longer a person is exposed to an air pollutant, the higher the risk of health problems, especially respiratory disorders. Substances that are inhaled in high concentrations and for a long enough time will endanger their health(25).

Someone who works outdoors and is in the vicinity of the pollutant source will be directly exposed to these air pollutants and experience health problems, so that someone who is exposed to continuous exposure will experience inflammation of the respiratory tract, respiratory tract irritation, coughing, difficulty breathing, causing or worsening respiratory diseases such as asthma

Another thing that affects the level of risk and respiratory complaints due to exposure to carbon monoxide and nitrogen dioxide is the use of personal protective equipment which is still lacking, in terms of the work that the respondents are doing requires them not to use personal protective equipment and car windows must be open so that the air is polluted. it will be easier to enter. In addition, the smoking habit of the respondents, who are mostly smokers, can increase the health risks that arise.

CONCLUSION

Risk management is carried out by reducing exposure time, planting trees that can absorb air pollution, maintaining endurance, limiting the age of motor vehicles and using environmentally friendly fuels. And it is hoped that public transportation drivers, especially new-city campus public transport drivers in Kendari City, reduce working time in order to reduce the risks that will occur and not smoke while doing their work and wear masks.

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