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The Potential Human Health Risk By Ambient Air Pollution at Campus X of University Y in Yogyakarta

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***Abstract*—Background: One of the enormous contributions of human activity in determining air quality from motorized vehicles activity in public places especially educational facilities. The Campus has the potential to be polluted by primary pollutants such as Particulate Matter (PM 10) and NO2. The results of monitoring ambient air quality by the DIY Provincial Environment Agency for parameters PM 10 and NO2 at several points representing the campus in Yogyakarta City showed that there was a significant increase in the concentration of NO2 and PM 10. This study aimed to determine the potential risk of ambient air pollution to human health especially high-risk population in university X. Methods: The type of study used observational analytic research. The collected samples were 6 samples of air pollutants from 3 station sampling site and subject sampling technique used purposive sampling with 32 respondents based on inclusion criteria were activities around the research location, a minimum work period of 1 year that consist of 22 parking attendants and 10 security guards. Results: Health complaints often suffered by respondents, namely chest pain by 29%, shortness of breath 32.3% and limb movements disorders 9.7%. The concentration of PM 10 and NO2 was found to be highest at the Station II (west parking basketball court) from 10:00 to 11:00 in the morning. The average concentration of PM 10 and NO2 was 152.67 µg /m3 and 45.83 µg /m3 respectively. Conclusion: PM 10 has exceeded the guideline standard of ambient air quality because of the vehicles activity. Hence, the potential risk to human strongly associated with long-term PM 10 exposure likely respiratory tract. The regulation needed to control air pollution through environmental monitoring, use the self-protection equipment, and routine medical check-up to the worker on campus.**

Keywords—air pollution, human health, particulate matter, university X

I. INTRODUCTION

Air pollution is currently a global environmental problem that is of concern to all countries in various parts of the world. The problem of poor air quality is being faced by developing countries like Indonesia. Air is an important factor in life, but in this modern era the development of the physical development of cities and industrial centers, as well as the development of transportation, has caused air quality to change [1]. Environmental Statistics of the Special Region of Yogyakarta in 2015/2016 reported in the Central Bureau of Statistics of DIY Province showed that the most common pollution in 2014 was air pollution, which occurred in 415 villages, increased to 65.75 percent that is, from 127 villages in 2011 it rose to 415 villages in 2014 [2]. This data illustrated that air quality in the Special Region of Yogyakarta is decreased.

Rapid economic growth is always supported by the availability of transportation facilities and infrastructure to make it easier for humans to access various purposes to meet their daily needs. Based on data from the Yogyakarta Special Region Police [2] in 2014-2015 showed that the number of motorized vehicles in 2015 was 2,196,620 vehicles and increased 4.80 percent compared to the previous year. The type of passenger car motor vehicles experienced the highest increase of 6.39 percent, followed by an increase in the number of load cars and motorcycles, 5.83 percent and 4.62 percent respectively. The development of the number of motorbikes for the city of Yogyakarta alone was 3.08% compared to the previous year so that it was categorized as the city with the highest number of vehicles in the Special Province of Yogyakarta.

One of the enormous contributions of human activity in determining air quality is the activity of motorized vehicles in public places such as educational facilities. The campus is one place that has the potential to be polluted by primary pollutants such as Particulate Matter (PM 10), and NO2. The increase in the number of cities polluted by PM 10 in Southeast Asia according to WHO report [3] was 55% in the last 5 years. Meanwhile, in Indonesia, the total emission load of motor vehicles contributes around 71% of pollutants of nitrogen oxides (NOX) and 70% pollutants of particulates (PM 10) [3].

The results of the monitoring of ambient air quality by the DIY Provincial Environment Agency for PM 10 and NO2 parameters at several points representing the campus in Yogyakarta City and the research location were the STTL Yogyakarta front points, which were 118.20 µg / m3 and 22.63 µg / m3 respectively. in 2015 and monitoring points at the UGM Faculty of Engineering Yogyakarta, Jl. Grafika No. 1 is 49.39 µg / m3; 22.67 µg / m3 in 2014 increased to 55.14 µg / m3; 26.10 µg / m3 in 2015, as well as a monitoring point for the Derma Series Charity Princess Dormitory, Jl. Kusumanegara 152 Muja Muju, Umbulharjo, Yogyakarta which is 48.14 µg / m3; 36.49 µg / m3 in 2014 and 60.35 µg / m3; 26.22 µg / m3 in 2015. The data shows that there is a

significant increase in the concentration of NO2 and PM 10 pollutants on the campus environment [4].

Increasing the concentration of the smallest air pollutant even though it is still below the threshold, but the health risks due to the exposure that occur continuously can cause clinical manifestations in the form of chronic health problems or long-term, especially in the respiratory tract. Therefore, this study aimed to determine the potential risk of ambient air pollution to human health especially high-risk population in university X.

The location of campus X in the city area is certainly very interesting to examine how the air quality conditions, especially in the parameters PM 10 and NO2. It is estimated that the vehicle is a source of pollution in University X.

II. METHODS

A. *Research Type*

The type of study used observational analytic research, namely not doing the treatment on research subjects in order to provide a clearer picture of the problem in the subject.

B. *Sampling Technique*

There was 6 samples of air pollutants from 3 station sampling site at Campus X University Y. Air sampling instrument from environmental quality laboratory UII namely Gas Sampler Impinger for testing samples of NO2 air parameters, PM 10- High Volume Air Sampler for testing PM 10 samples. The subject sampling technique used purposive sampling with 32 respondents based on inclusion criteria were activities around the research location, a minimum work period of 1 year that consist of 22 parking attendants and 10 security guards.

C. *Data Analysis*

The presentation of the data results analysis obtained from the field and laboratory is presented in the table then described in narrative form. The univariate analysis describes the characteristics of each research variable that produces a frequency distribution and percentage of each variable.

III. RESULT AND DISCUSSION

The activity of motorized vehicles in the university or campus environment contributes to the increase of air pollution, especially PM 10 and NO2. As we know, the increase in the number of students every year correlated with the number of vehicles daily used. This problem will impact on people who have long activities on campuses, such as security guards and parking attendants. Exposure to air pollution will have an impact on the health of the employee especially if there is no mask.

A. *Result*

In the 2016/2017 academic year, there were 6093 people including 5736 students, 264 lecturers, and 93 employees.

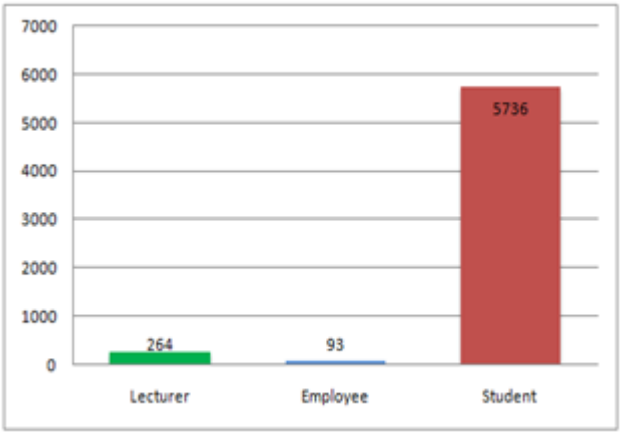

Fig. 1. Picture: Graph of the Number of Academic Offices of Campus 3 University X In 2016/2017 Academic Year

TABLE I. DISTRIBUTION OF RESPONDENTS BY TYPE OF OCCUPATION AND HEALTH PROBLEMS ON SECURITY GUARDS AND PARKING OFFICERS AT CAMPUS X OF UNIVERSITY Y IN YOGYAKARTA

Variable	Respondent	
	N	Percentage(%)
Work type		
security guards	10	31,2
parking attendants	22	68,8
Total	**32**	100
Health Complaints		
Chest pain		
a. Yes	9	29
b. No	23	71
Total	**32**	100
Shortness of breath		
a. Yes	10	32,3
b. No	22	67,7
Total	**32**	100
Limb movements disorders		
a. Yes	3	9,7
b. No	29	90,3
Total	**32**	100

Source: Primary Data, 2018

The proportion of respondents as parking attendants was more, which was 68.8%. In addition, in Table 1 shows that Health complaints often suffered by respondents, namely chest pain by 29%, shortness of breath 32.3% and limb movements disorders 9.7%.

TABLE II. THE AIR QUALITY CONCENTRATIONS OF PM 10 AND NO2 BASED ON SAMPLING STATION AT CAMPUS X OF UNIVERSITY Y IN YOGYAKARTA

Sampling Station	Concentrations of PM 10 (µg/m^3)	Concentrations of NO_2 (µg/m^3)
1	140	40
II	184	51.7
III	134	45.8
Average	152.67	45.83
Guideline* Standard	150	150

Source: Primary Data, 2018
*) Decree of the Governor of the Special Region of Yogyakarta Number 153 OF 2002 concerning Ambien Air Quality Standards of the Special Region of Yogyakarta

Table 2 shows that PM 10 and NO2 concentrations were found to be highest at the sampling station II (west parking basketball court) from 10:00 to 11:00 a.m. The average air quality concentration of PM 10 has exceeded the ambient air quality standard [11] because these influenced by the contribution of the distribution of PM 10 concentration at the station II. Whereas the concentration of NO2 is still below the standard 150 µg/m3.

B. Discussion

Increased concentration of PM 10 and NOX is caused by the time that air sampling of many students coming out of the parking lot coincides with the exiting hours of learning in the classroom and trees far enough from the sampling point so that the open ground allows air to move freely and the residue from motorized vehicles is difficult to absorbed by plant tissue or leaves on trees around it and very few trees. Based on Decree of the Governor of the Special Region of Yogyakarta Number 153 Of 2002 pollutant concentrations were exceeded the air quality standard of 150 µg /m3 PM 10 [11].

Motorized vehicles are the main source of NO2 and PM 10 pollution on campus three areas. This is based on the average academic community of University X having motorized vehicles. The position of Campus 3 of University X which is quite close to the residents' village and good access to vehicles will also enable the influence of air quality around the campus. Based on the source, the biggest air pollution comes from motor vehicle exhaust fumes. Vehicles with gasoline engines emit a wide variety of air pollutant such us PM 10 and NO2 [12] have increased atmospheric pollutant emissions [13]. Motor vehicles account for nearly 100 percent of lead, 70.50 percent of carbon monoxide, 8.89 percent of nitrogen oxide, 18.34 percent of Hydrocarbon, and 1.33 percent of particles [7].

The same thing is confirmed [1] from the last 10 years, there has been a rapid increase in the number of motorized vehicles, especially by the increase in motorbikes, which reached 30%. Approximately 70% are distributed in urban areas. Growth of motorized vehicles that emit and pollute the air around us.

Research conducted in the city of Padang showed that there were no significant differences in PM10 concentrations in institutional, commercial and industrial areas. This is because these three regions are urban areas, namely areas with many and various activities such as transportation, trade activities (commercial), institutions and industrial activities. When compared with PM10 concentrations in the domestic region, which are non-urban areas, the ratio is between 3.5-3.7, which means that the concentration of PM10 in urban areas has increased by more than 3.5 times PM10 concentration in non-urban areas [8].

The results of previous studies on the Medan-Binjai road, the number of vehicles passing by as many as 55089 units and NOx emissions from motor vehicles produced were 0.014 tons [9]. Whereas for PM10 levels in the air at the same location in the afternoon exceeds the ambient air quality standard that is equal to 162µg / Nm3 and there are respiratory problems in the community at that location [10]. Based on Government Regulation No. 41 of 2009 concerning Air Pollution Control, the ambient air quality standard is 150 µg / Nm3.

Epidemiological studies rely primarily on spatial variation of the air pollutants to estimate the associations between exposure to air pollutants and health effects [22]. Exposure to PM 10 in particular, pose a health risk because it is more likely to be inhaled because the fraction PM 10 is easily inhaled and reach the lung alveoli [14]. Particulate matter (PM) is a key indicator of air pollution brought into the air by a variety of natural and human activities. As it can be suspended over a long time and travel over long distances in the atmosphere, it can cause a wide range of diseases that lead to a significant reduction in human life. The size of particles has been directly linked to their potential for causing health problems. Small particles of concern include "inhalable coarse particles" with a diameter of 2.5 to 10µm and "fine particles" smaller than 2.5µm in diameter. As the source-effect relationship of PM remains unclear, it is not easy to define such effects from individual sources such as long-range transport of pollution. Because of the potent role of PM and its associated pollutants, detailed knowledge of their human health impacts is of primary importance [20].

Another health risk of the NO2 gas inhalation which can reduce resistance to infectious diseases, increase the incidence of disease pulmonary edema when exposed for 48-72 hours, the formation of Met-Hb, eye irritation when NO2 forms a dense vapor, increase the incidence of irritation of the respiratory tract, and affect lung function capacity when inhaled in the long term, even nervous system disorders that result in convulsions [15]. Other scientific evidence is also able to explain the relationship of short-term exposure to NO2, ranging from 30 minutes to 24 hours, can harm the respiratory system include inflammation of the airway in the normal/healthy and increased respiratory symptoms, especially asthmatics. Individuals who spend time near the highway and the sources of pollution NO2 exposure frequency is much higher than that away from the highway [16]. Although this study describes NO2 still below of air quality guidelines, it not mean become safety.

There is no evidence of a safe level of exposure which no adverse health effects occur, with recent long-term studies are showing associations between PM and mortality at levels well

below the current annual WHO air quality guideline level for PM 10. The reductions in population exposure to air pollution expressed as annual average PM 10 have will increase life expectancy and improvements to respiratory health [17]. PM 10 are particularly deleterious to human health. Air pollution PM is an important environmental health risk factor for several respiratory and cardiovascular morbidity and mortality. Song et al. Shows that obstructive improvement-deaths from lung disease in China, America The country, and the European Union are associated with an increase of 10 micrograms per cubic meter of PM10 pollutants [23]. Further, PM is inextricably linked with genotoxicity and mutations. Literature review of the cellular and molecular basis of adverse effects associated with PM [18].

The number of studies has found an association between air pollution and several adverse health impacts. These impacts such us subclinical effects to premature death, and include notably the following consequences: increased respiratory (rhinopharyngitis, bronchial hypersecretions); decrease ventilatory function (lower breathing capacity, coughing); eye irritation; increased cardiovascular morbidity [21]. The increased concentration of dust particulates in the air contributes human health hazards involving acute respiratory disorders such as sinusitis, bronchitis, asthma and allergy and damage to the defensive functions of alveolar macrophages leading to increase respiratory infections [19]. Research conducted in Jinan, China, shows that ambient exposure to PM10 can increase mono-drug resistance and poly-drug resistance in handling TB cases. The dominant positive association for PM10 was observed from 90days exposure to 540days [24].

The intervention action become moving towards a healthier environment depends on achieving the right public attitude and behavior by optimizing the air pollution monitoring, forecasting and reporting information systems. Translating the correct scientific evidence into realistic and effective regulatory policies has the potential to reduce air pollution and improve the public health status [18]. Finally, management and existing technologies and policy options to reduce or mitigate the adverse health impacts of PM pollution is discussed as an eco-sustainable approach [19].

IV. CONCLUSION

The average air quality concentration of PM 10 has exceeded the ambient air quality standard of 150 µg /m3. Pollution is caused by the number of motorized vehicles that leave and enter the campus. Hence, the potential risk to human-related with long-term PM 10 exposure likely respiratory tract. Air pollution control needs to be done through environmental monitoring and use self-protection equipment and routine health checks for the worker on the university..

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