DIOXIDE (NO2) IN AIR AMBIENT TO STREET VENDORS IN PASAR PAGI AREA SAMARINDA

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ABSTRACT
One of the main source of air pollutions is motor vehicles or transportations. As for the pollutants which resulted from the process of engine ignition that uses fuels such as CO, NO2, SO2, dan HC gas. Both CO and NO2, gives negative effects through the inhalation process and is capable of causing inhalation injury. This research is a descriptive research which uses Environmental Health Risks Analysis (EHRA) Approach, to analyze risks exposure of Carbon Monoxide and Nitrogen Monoxide to street vendors in Pasar Pagi Area with total 30 persons. The results of the research shows that the concentration amount of CO is 1,512 mg/m3 with intake exposure CO<RfC (7,667mg/kg/day) and the concentration amount of NO2 is 0,028 mg/m3 with intake exposure NO2<RfC (0,02 mg/kg/day). Nilai RQ 1 at the exposure of CO and NO2 which signify there is no health risks of non carcinogenic on the exposure duration realtime and lifetime with total 30 persons of street vendors (100%), but there are complaints of eye irritations (76,6%), cough (56,7%), Headache/Dizziness (33,3%), Asphyxiate (16,7%), and nausea (10,0%). It can be concluded that the risks which emerged from the exposure of CO and NO2 is still in the safe limits.

Keywords: Carbon Monoxide (CO), Nitrogen Monoxide (NO2), Street Vendor

1. INTRODUCTION

One of the main sources of air pollution is motor vehicle activity or transportation. Combustion process by engines that use fossil fuels to produce CO, NO2, SO2, and HC (Mukono, 2008). Exposure to CO (Carbon Monoxide) gas that exceeds normal concentrations can cause health problems such as cardiology, hematology, neurology and respirology disorders (Rivanda, 2015). If NO2 is inhaled it will enter the deeper respiratory tract of mucous membranes and pulmonary tissues, then it will enter through the bloodstream (Hikmiyah, 2018). Both pollutant gases, both CO and NO2 have a negative impact especially on the respiratory tract because it enters through the inhalation process and can cause inhalation injuries.

Based on data from the Regional Revenue Agency of East Kalimantan Province in 2018 the number of motor vehicles in Samarinda city in the last three years increased by 637.936 units in 2016, increased in 2017 by 671.000, and continued to increase in 2018 by 706.375 units (Badan Pendapatan Provinsi Kalimantan Timur, 2018). Along with the increasing number of motor vehicles in Samarinda City will have an impact on the volume of vehicles on the road traffic so

that this can lead to an increase in pollution caused by gas emissions resulting from the combustion of motor vehicles on the highway.

According to air quality monitoring data by the Samarinda City Environment Office (2019) shows different concentrations of CO and NO2 at two sampling locations in the Intersection Pasar Pagi Samarinda in June 2019 and October 2019. The measurement concentration in period I of Pasar Pagi Samarinda Intersection was 4.405 µg/Nm3 for CO and 19,34 µg/Nm3 for NO2 and period II amounted to 2.226 µg/Nm3 and 25,10 µg/Nm3. The figures show that CO and NO2 concentrations are still below ambient air quality standards based on PP No.41 of 1999 of 30.000 µg/Nm3 (CO) and 400 µg/Nm3 (NO2). Although it is still below quality standards and still safe from air pollution, it is necessary to be aware of the properties of CO gas and also NO2 which has a bad impact on the respiratory system.

The concentration of NO2 which is below the air quality standard value ambient does not mean it can be declared safe from health risks. According to Darmawan's research on ARKL levels of NO2 as well as health complaints on toll ticket collectors, the concentration of NO2 at 3 times the measurement at different hours does not exceed the quality standard, but on the results ARKL calculation shows as many as 2 respondents have a value of RQ<1 and 15 respondents who have RQ>1. Health complaints that occur 4 respondents were coughing, red eyes, sore eyes, dizziness, and out of breath (Darmawan, 2018).

The street vendor is a profession of choice for the community especially the lower middle economy in Samarinda city in making a living. Most street vendors are near the highway that is traversed by motor vehicles for a long time, so it becomes one of the high-risk communities because it is located at the source of exposure.

The Pasar Pagi area is a commercial area where there are a number of other facilities such as Mesra Indah mall, restaurants and various kinds of other shops. This area is one of the economic centers of Samarinda City to meet daily needs. Such conditions cause the flow of traffic becomes heavy, namely from 09.00 to 12.00 pm due to vehicles of visitors who are on the side of the road, city transportation that waits and lowers passengers and street vendors who sell on the road body.

This research is aimed at street vendors, so as to prevent the deterioration of the health quality of street vendors, it can be done risk analysis of exposure to CO and NO2 in street vendors. The purpose of this study was to determine the level of non-carcinogenic health risk from carbon monoxide (CO) and nitrogen dioxide (NO2) in ambient air in street vendors at Pasar Pagi Samarinda Area.

2. MATERIALS AND METHODS

This type of research is a descriptive study which uses Environmental Health Risks Analysis (EHRA) Approach. Execution time the research was conducted in July - August 2020 on 30 traders street vendors that sell in the Jendral Sudirman area and KH Abdul Khalid area.

The variables measured in this study consisted of CO concentration obtained through ambient air measurement by NDIR method and NO2 concentration obtained through ambient air measurement by Griess Saltzman method using Spectrophotometer conducted by Baristand Industri Samarinda officer, non carcinogenic intake and CO and NO2 risk.

The intake calculation uses the formula:

$$I_{nk} = \frac{(C * R * t_E * f_E * D_t)}{(W_b * T_{avg})} \tag{1}$$

Remarks:
I   = intake, mg/kg/day
C   = concentration of risk agent, mg/M3
R   = intake rate, M3/hr
tE   = length of exposure, hours/day
fE   = frequency of exposure, day/year
Dt   = duration of exposure,years
Wb   = weight, kg
Tavg = average time period

The health risk is expressed as Risk Quotient (RQ, level risk) for non-carcinogenic effects and Excess Cancer Risk (ECR) for carcinogenic effects. Calculated by the formula:

$$RQ = \frac{I_{nk}}{Rfc\ or\ RfD} \tag{2}$$

Description:
RQ   = Risk Quotient
Ink   = intake non-carcinogenic

RfC   = Reference Concentration (for inhalation exposure)

3. RESULT AND DISCUSSION

Based on Tabel 1 CO and NO2 concentration measurement results in Jendral Sudirman Area and KH Abdul Khalid Area obtained results of 1,512 mg/m3 dan 0,028 mg/m3.

The concentration measurements result obtained were lower than at the time of measurements carried out by the Samarinda City Environment Office in 2019 amounting to 4.405 g/Nm3 for CO and 19,34 g/Nm3 for NO2 and period II of 2.226 g/Nm3 and 25,10 g/Nm3. This is because when the research was conducted in the state of WFH (Working From Home) due to the Covid-19 pandemic so that the increase in the number of vehicles on the highway decreased.

The location point of the highest concentration of CO is on KH Abdul Khalid Area which is 2,245 mg/m3, while at the highest concentration of NO2is on Jendral Sudirman Area which is 0.03616 mg/m3, both concentrations are still below the quality standards set by Government Regulation No. 41 of 1999. The concentration value can be influenced by high transportation on the highway and meteorological factors such as humidity, temperature, sunlight, and air movement.

This is reinforced in ramayana research shows the relationship between moisture and CO concentration is directly proportional that if the humidity value is high then the value of CO concentration will be high, and if the humidity is low then the concentration of carbon monoxide will be low (Ramayana and Istirokhatun, 2013). Darmawan stated there is a tendency of NO2 levels to the increased air temperature will increase the level of gas and particles that exist. When the humidity increases, the decreased air temperature also has an impact on the measured amount of NO2 (Darmawan, 2018) and in Serlina (2020), there is an influence between the measured concentration of NO2 and meteorological factors which includes temperature, relative humidity, precipitation and wind speed.

Based on the distribution of data contained in Table 2 that the characteristics of the street vendors respondents in this study were seen from aspects of gender, age, weight, and patterns of exposure

(exposure time, duration of exposure and frequency of exposure). In this study, respondents of street vendors totaling 30 people with the age range of 25-65 years, the most distribution was found in the age group >45 years. A person's age will affect the body's resistance to exposure to chemicals or toxic substances (Mahawati, et al., 2006).

The gender of respondents in this study was mostly women (66.7%), one of the factors that can affect impaired lung function is gender. Alchamdani states that women have a small volume of lungs so that the intake of chemicals received through the inhalation pathway is less, compared to men. However, female respiratory organs are more sensitive when exposed to air pollutants such as NO_2, SO_2, benzene, toluene, ethylbenzene and o/m/pxylene (Alchamdani, 2019).

The weight distribution of the most respondents in the group was 61kg-80kg (50.0%). In the ARKL research weight loss affects the amount of intake received. In accordance with Darmawan's research result is weight inversely proportional to the amount of intake (Darmawan, 2018). It can be concluded that the greater the weight of street vendors, the smaller the intake of air pollutants CO and NO_2 received.

Most health complaints came from the age group of >45 years, which often experienced complaints of eye irritations and coughs. This is supported by Darmawan (2018), namely with the age of a person will be followed also by a decrease in all functions of the body organs so that in the elderly there will be a decrease in endurance or susceptible to disease. And in the study Dewanti's showed that the concentration of CO is still below the quality standard but on the examination of COHb levels in the blood shows the majority of blood COHb levels fall into the high category of >3.5%. The majority of respondents with high blood COHb had complaints of dizziness, had no complaints of visual impairment, had complaints of impaired concentration, had no complaints of nausea, never vomited, and had no complaints of shortness of breath. Where such complaints can be a sign or symptom caused by continuous exposure by CO and NO_2 pollutants (Dewanti, 2018).

In Table 3 the most street vendor exposure patterns at exposure time, exposure frequency, and exposure duration are working for ≤8 hours/day, 334 days/year, and >10 years. The amount of

intake value is directly proportional to the value of pollutant concentration, exposure time, frequency of exposure, and inhalation rate, which can be interpreted as the greater the value, the greater the intake of a person.

In risk analysis, if the longer a person works then the more risk of exposure to the dangers posed by the work environment. According to Lovita in Darmawan (2018), the length of a person's working life can increase the risk of developing respiratory diseases. This indicates that the longer a person's work will be the longer the exposure to pollutant gases.

Based on Table 4 and Table 5 the calculation of CO and NO_2 intakes in this study is calculated based on real time and lifetime intake (projection of the next 30 years). Intake in realtime is the intake received by a person or respondent by kilograms of body weight by the day from the beginning of work until the time of research conducted. While lifetime intake is the estimated intake received by a person or respondent by kilogram of body weight by day in the future, for pollutants with non-carcinogenic effects is 30 years later.

Based on the results of exposure intake of CO and NO_2 in real time and lifetime in street vendors showed not yet RfC value (Reference of Concentration or dose response) amounting to 7,667 mg/kg/day of exposure for CO and 0.02 mg/kg/day of exposure for NO_2. From the calculation is known that the exposure time and duration of exposure affects the value of intake, the longer the working period of street vendors, the greater the intake value and the risk to obtain adverse health effects will be higher. Body weight also affects intake, the greater a person's weight is also the safer the person is from exposure to air pollutants.

From the results of the calculation can be seen that the number of intake levels of CO and NO_2 inhaled every day is still small and below the ambient air quality standard, but if the level is inhaled every day for a long time it will affect the amount of intake of CO and NO_2.

Based on the calculation of non-carcinogenic risk levels (RQ) in real time and lifetime can be seen in Table 6 that all respondents have a value of non-carcinogenic RQ exposure CO and NO_2 ≤ 1 which means safe if inhaled. From these calculations, it can be concluded that there is no risk of non-carcinogenic health of CO and NO_2 exposure to street vendors based on the duration of real time and lifetime exposure in Pasar Pagi Area Samarinda.

Risk management is carried out in the presence of health risks or expressed in RQ > 1 by taking into account the amount of intake from risk agents based on body weight and can be calculated safe concentration determination (C), determination of safe exposure time (tE), determination of frequency of safe exposure (fE), and determination of safe exposure duration (Dt). The calculation of major health risks of CO and NO2 exposure to street vendors in the Pasar Pagi Area on real time and lifetime exposure has not shown any non-carcinogenic risk (RQ ≤ 1) so risk management is not required as a follow-up. However, based on data on health complaints through direct interviews to street vendors obtained results that showed as many as 23 respondents (76.7%) felt complaints of eye irritations, then the second most common was coughing as many as 17 respondents (56.7%) while the third most common complaint was headache / dizziness as many as 10 respondents (33.3%), complaints of shortness of breath experienced as many as 5 respondents (16.7%) and the least perceived complaint was nausea of 3 responden (10.0%). This could be due to other risk agents whose doses are more dominant in the air or the combination effect between CO and NO2 with other risk agents that have the same effect.

To overcome the complaints felt by street vendors can be preventive in the form of the use of personal protective equipment (PPE) especially masks for daily work activities, so as to reduce exposure to risk agents through the inhalation process.

Then can do prevention in the form of self-preventive efforts or self-protection to maintain endurance. Furthermore, to maintain the concentration of CO and NO2 remains below ambient air quality standards by conducting regular inspections of vehicle exhaust emissions. And to reduce and keep air pollutants below ambient air quality standards is to care for and add plants that are already around Pasar Pagi Samarinda. In accordance with Izzah's research that planting trees tightly can withstand the movement of wind that carries CO pollutants so that more pollutants can be reduced by adsorption by leaves and the presence of green road vegetation can effectively decrease the spread of CO concentration by 8.5% compared to open green lines (Izzah et al., 2019).

4. CONCLUSION

From the results of the study, it was concluded that the calculation of CO and NO2 exposure intake did not show any risk to street vendors and the value of RQ ≤ 1 in CO and NO2 exposures meant that there was no non-carcinogenic risk in real time and lifetime durations. However, health complaint data based on interviews with 30 street vendors showed complaints of coughing, shortness of breath, headaches/dizziness, nausea and eye irritations. This can be caused by other risk agents whose dosage is more dominant in the air or the combination effect between CO and NO2 with other risk agents that have the same effect.

To reduce adverse effects for the environment and people who are at high risk of exposure to pollutants in the air can be done by procuring plants that can reduce the level of air pollution around Samarinda Morning Market, such as ornamental plants tongue-in-law (Sansevieria sp), lilies paris (Spider plant), and ivory betel (Scindapsus aureus). It is recommended for street vendors to make various preventive efforts. For example, eating foods rich in vitamins A, C, and E, and the use of masks.

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