Eco. Env. & Cons. 28 (January Suppl. Issue) : 2022; pp. (S62-S67)
Copyright@ EM International
ISSN 0971–765X

http://doi.org/10.53550/EEC.2022.v28i01s.008

Investigation of indoor spider plant (*Chlorophytum comosum*) affecting the carbon monoxide and carboxyhemoglobin reduction

Rizky Rahadian Wicaksono[1,2], Marsha Savira Agatha Putri[1]*, Antariksa[2,3], Marjono[2,3] and Ummu Maflachatus Sholichah[1]

[1]Department of Environmental Health, Faculty of Health Science, Universitas Islam Lamongan, Veteran No. 53 A Lamongan, Indonesia
[2]Multidicipline Post Graduate Program, Brawijaya University, Malang, Indonesia
[3]Department of Architecture, Brawijaya University, Malang, Indonesia
[4]Department of Mathematics, Brawijaya University, Malang, Indonesia

(Received 10 August, 2021; Accepted 7 September, 2021)

ABSTRACT

The spider plant (*Chlorophytum comosum*) was effectively reducing the carbon monoxide indoor and carboxyhemoglobin level of the smokers. The high concentrations of CO can cause death in humans who are exposed to both active smokers and passive smokers. We use spider plants in this study to determine the effect of increasing the number of that plants in reducing CO indoor and COHb levels. This study started from respondend determination, blood sampling, measure the CO level indoor, before and after smoking. This study was conducted in March 2021. The respondents used in this study were 7 respondents who participated in the blood sampling procedure and were active smokers aged 33-50 years. Respondents smoked indoors for 5 minutes with 1 cigarette. The Spider plant used in this study was 5 until 15 plant pots. Data analysis was obtained from the results of measuring CO indoor which was measured 3 times taking sample points before and after the respondent smoked using the Lutron GCO 2008 CO Meter. Blood samples were taken by the midwife indoor. This research was conducted indoor size 7 x 7 meters (Figure 1). The number of ventilation is 2 windows beside the door and 2 windows at the back with an entrance, 7 chairs and 7 tables for smoking respondents. We measured the CO level indoor directly using CO meter and COHb level from the respondent's blood using spectrophotometer in Health Science Laboratory, Lamongan Islamic University. Then, we analyzed the measurement results using data plot and linear regression using Microsoft Excel to identify the associations between CO level among the number of spider plant, COHb level, age, smoking intensity, and nutritional status. The result showing that spider plants can reduce CO levels indoor 65% and also can reduce COHb level 75%.

Key word : *Spider Plant, Carbon monoxide, Carboxyhemoglobin, Indoor*

Introduction

Air pollution can occur everywhere, it can be from outdoor pollution from vehicle emissions, industry, shipping, and indoor pollution, for example from the buildings, schools, and offices (Sofia *et al.*, 2020). This is due to the presence of toxic gases derived from carbon monoxide (CO) in the air from vehicle

fumes and cigarette smoke (Raub *et al.,* 2000). CO level in the air is a gas that can be inhaled into the lungs and transported by the blood circulation which can block the entry of oxygen needed by the body (John and Feyisayo, 2013). This situation occurs because CO in the air also reacts metabolically with the blood (Sørheim *et al.,* 1997). This can happen because CO in the air has metabolic toxic properties and reacts metabolically with the blood to become carboxy hemoglobin (COHb) (Yulda *et al.,* 2020). This bond is much more stable than thebond in oxygen with blood O2 (oxy hemoglobin). This situation can cause blood to more easily bind CO in the air and cause the vital function of blood as a carrier (O2) to be disrupted (Varon *et al.,* 1999). The addition of the amount of carboxy hemoglobin (COHb) in the blood can cause theflow of oxygen in the blood to be hampered (Wong *et al.,* 2000). The presence of COHb reduces the ability of the blood to transport oxygen to body tissues. As a result, the oxygen supply in the tissues is reduced and hypoxia occurs (Naniek and Ratni, 2012) One of the most common pollutants found in enclosed spaces is (CO) which is an inorganic gas resulting from combustion (Ngah *et al.,* 2013). The main source of CO in a closed room comes from cigarette smoke (Raharjo *et al.*, 2018). Cigarette smoke is one of the air pollutants originating from human activities which is very dangerous for both active smokers and passive smokers (Alberts, 1994). Various efforts can be made to control indoor air pollution, namely environmental pollution control technology by using plants (Nevers, 2010). Such as using spider plant (*Chlorophytum comosum*), which is an ornamental plant belonging to the Liliaceae family, morphologically it has a ribbon leaf shape, green leaves with a combination of white on the edges, elongated leaves with a width of approximately 4 cm, trunks with a height ranging from 10 cm. Parisian lilies are one of the plants that are tolerant and have the potential for phytoremediation of air pollutants (Wang *et al.,* 2011). From the previous research, the spider plants can absorb CO outdoor by 41.47% (Naniek and Ratni, 2012). Based on the above background, this research aims to Investiga tethe use of indoor spider plant (*Chlorophytum comosum*) affecting the carbon monoxide and carboxy hemoglobin reduction.

Materials and Methods

This study started from respondent determination, blood sampling, measure the CO level indoor, before and after smoking. This study was conducted in March 2021. There spondents used in this study were 7 respondents who participated in the blood sampling procedure and were active smokers aged 33-50 years. Respondents smoked indoors for 5 minutes with 1 cigarette. The Spider plant used in this study was 15 plant pots. Data analysis was obtained from the results of measuring CO in cigarette smoke in the room which was measured 3 times taking sample points before and after the respondent smoked using the Lutron GCO 2008 CO Meter tool. Blood samples were taken by the midwife indoor. This research was conducted indoor size 7 x 7 meters (Figure 1). The number of ventilation is 2 windows beside the doorand 2 windows at the back with an entrance, 7 chairs and 7 tables for smoking respondents.

This research was conducted and approved by the ethics committee of the institution or institution in accordance with the policy of the Declaration of Helsinki. This research have been reviewed and approved by the university ethics committee (Litbang Pemas Universitas Islam Lamongan number 0402/UN.V.95/ST/XI/2020). Before the blood sampling was conducted, we did the medical screening between 10 research participants. Then, we have 7 research participants which meet the medical criteria, which is physically healthy (blood pressure less than 120/80 mm gh; heart rate 60 to 100 beats per minute, body temperature from 97°F (36.1°C) to 99°F (37.2 °C); and not have smoking 3 days before blood sampling. The identity of research participants was kept secretly. Blood sampling was taken from the respondent or research participant as much as 0.05 ml by the midwife as the competent medical worker. Blood sampling was carried out before and after the respondents smoked each treatment to increase the number of Spider plants 0, 5, 10, 15 plants using a syringe, tourniquet, alcohol cotton, vacuum tube EDTA K3. The measurement of the respondent's blood COHb level was taken from mixing 0.1 ml of blood with 10 ml of 10% ammonia dilution with 150 ml of Aquades water to 20 ml per 7 blood samples before and after smoking with sodium dithionite added, then put into a cuvette and then measured. using the Spectrofometer at the Laboratory of Envi-

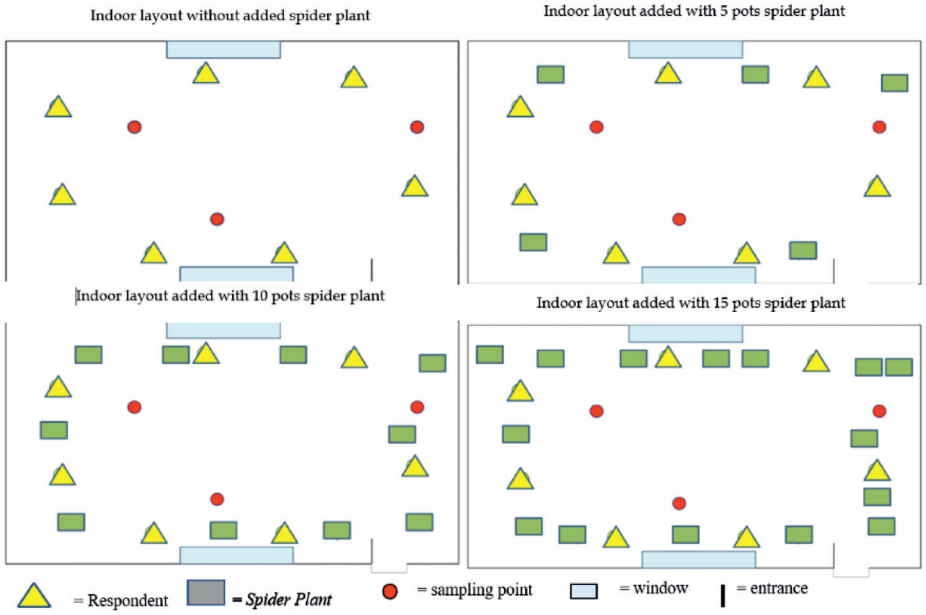


Figure 1. Indoor layout

ronmental Health, Islamic University of Lamongan, the data that has been obtained will be analyzed using Microsoft Excel 2013.

Results and Discussion

Respondent characteristics

This study used a sampling method of CO measurement in the room provided and COHb measurements were carried out by taking respondents' blood samples before and after smoking. There were seven respondents who participated in this study to follow the blood sampling procedure.

Republic of Indonesia

Based on Table .1, seven respondents were aged between 33 and 50 years. All Respondent male. The smoking intensity of the respondents ranged from 3 cigarettes to 10 cigarettes per day. The nutritional status of the respondents was determined by BMI. BMI data is calculated based on the data of the respondent's weight and height. BMI data obtained from respondents starting from the smallest 22 to the largest 28, so it can be concluded that more respondents have normal weight and have adequate nutritional status.

CO indoor level measurements

The Figure 1 shows the difference between high and low levels of CO in the indoor environment before and after the addition of Spider Plant was applied before and after the respondent smoked in the room.

Figure 1 (A) shows that measurements without

Table 1. Respondent Characteristic

Respondent	Age	Gender	Smoking intensity (roll/day)	Body Mass Index (BMI) Weight (kg)	Height (kg)	BMI ( )	Nutrition status*
R1	33	Male	6	70	1.70	24,2	Normal
R2	38	Male	3	72	1.60	28,1	Obese
R3	42	Male	10	73	1.62	27,8	Obese
R4	44	Male	5	55	1.58	22,0	Normal
R5	46	Male	6	60	1.70	20,7	Normal
R6	49	Male	3	80	1.67	28,6	Obese
R7	50	Male	10	70	1.63	26,3	Obese

*) Nutritional status is assessed based on the provisions of the Ministry of Health of the

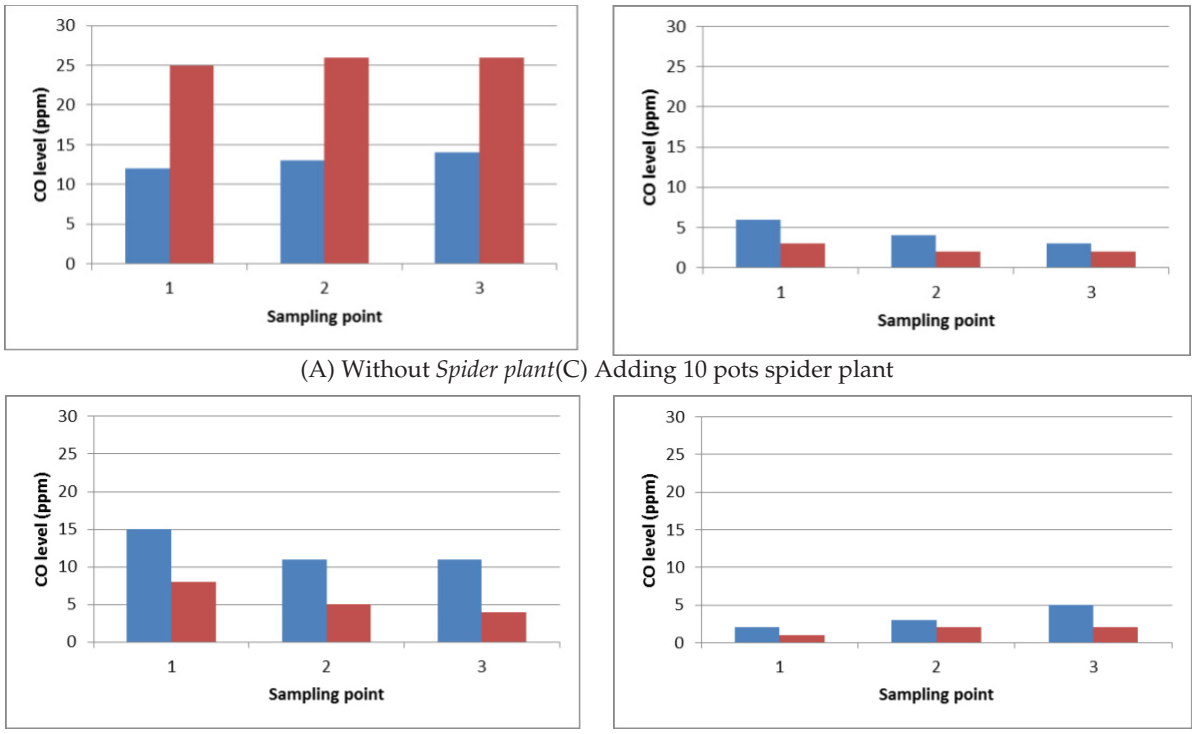


Figure 2. Measurement of CO levels from indoor smoking activity

plants showed that the level of CO level in cigarette smoke indoor was measured before smoking: 13 ppm and after smoking: 26 ppm. In this case, it states that CO levels indoor was increasing because of smoking activity. (B) Measurements with adding 5 pots spider plant shows the CO level indoor before smoking: 15 ppm and after smoking: 1 ppm. It can be interpreted that the Spider plant canreduce CO levels. (C) the measurement of adding 10 pots spider plants in room CO levels showed the value before smoking; 6 ppm and after smoking: 2 ppm. In this case the Spider plant can reduce CO levels. (D) Measurement of 15 pots spider plant shows the CO number before smoking 5 ppm and after smoking 1 ppm. In this case, it shows that Spider plant canreduce CO levels. According to (Le *et al.*, 2020) states that smoke from cigarettes can affect air quality. In this case, it can be seen that the higher the ppm value obtained after smoking, the more CO levels indoor will be. However, the previous study was succesfully proofing that the spider plant can reduce 41.47% CO levels indoor from smoking activity (Suhaimi, 2017).

Figure 3 describes the results of measuring CO levels indoor before and after thes pider plants addition. The addition of 5 and 10 plants shows that the measurement results were lower after smoking at the measurement at point 3; 2 ppm. And on the graph of the addition of 15 plants the measurement results were lower after smoking at the measurement at the 3rd point; 6 ppm.

COHb measurements

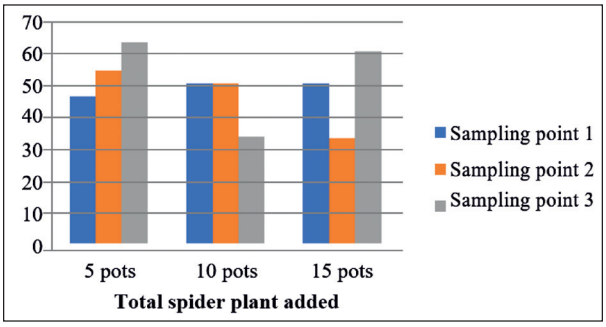
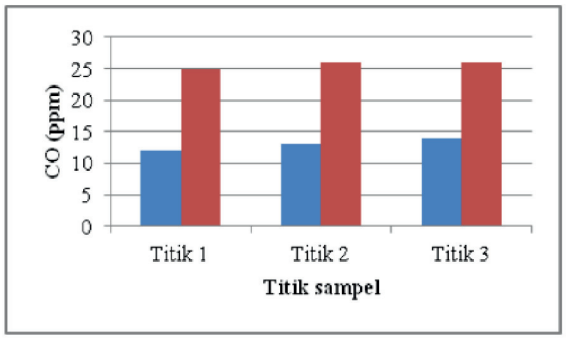


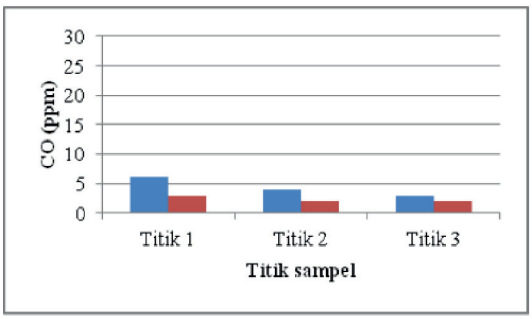
Fig. 3. The decreasing percentage of CO levels indoor

The Tigure 3 shows the difference between high and low levels of COHb before and after the addition of Spider Plant was applied before and after the respondent smoked in the room.

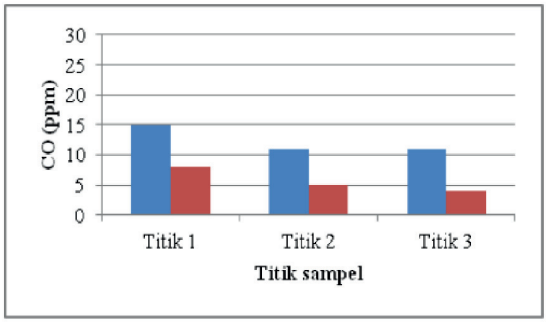
Figure 4 (A) is the result of treatment without plants showing that the COHb level inthe respondent's blood which has the highest increase is R4 from a value of 0.701 before smoking to a value of 2.341 after smoking with a difference of 1.64. While the lowest increase in R5 before smoking with a value of 2.366 and after smoking 2.388 with a difference of 0.794.(B) is the result of the treatment of 5 plants showing that the COHb level in the respondent's blood which has the highest increase is R2 from a value of 2.675 before smoking to a value of0.717 with a difference of 1.958 after smoking. While the smallest decrease in R1 before smoking with a value of 2.728 and after smoking 2.233 with a difference of 0.495. In this case,it can be said that plants can reduce CO levels in cigarette smoke in a closed room so that itcan affect COHb levels in the respondent's blood. (C) is the result of the treatment of 10 plants showing that the COHb level in the respondent's blood which has the highest increase is R3 from a value of 1.087 before smoking to a value of 0.378 after smoking with a difference of0.709. Meanwhile, the lowest decrease in height was in R1 before smoking with a value of 0.506 and after smoking 0.422 with a difference of 0.068. (D) is the result of the treatment of15 plants showing that the COHb level in the respondent's blood which has the highest increase is R4 from a value of 1.156 before smoking to a value of 0.406 after smoking with adifference of 0.750. Meanwhile, the smallest decrease in height was at R7 before smoking with a value of 0.621 and after smoking 0.498 with a difference of 0.123. In this case it can be said that plants can reduce CO levels of cigarette smoke in a closed room so that it affects the low value of COHb in the respondent's blood. According to [16] which explains that the higher exposure to CO gas, itcan cause the body to be easily exposed to CO gas and can cause blood COHb levels to increase. Also the study conducted by [17], environment with a decrease in CO levels of 8-10 % will affect the decrease in COHb levels and [18] that the Sansevieria plant



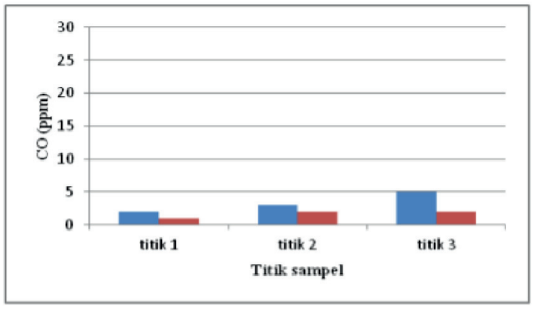
(A) Without *Spider plant*



(C) Adding 10 pots spider plant



(B) Adding 5 pots spider plant



(D) Adding 5 pots spider plant

Note :

Before smoking

After smoking

Fig. 4. Measurement of respondent's COHb levels

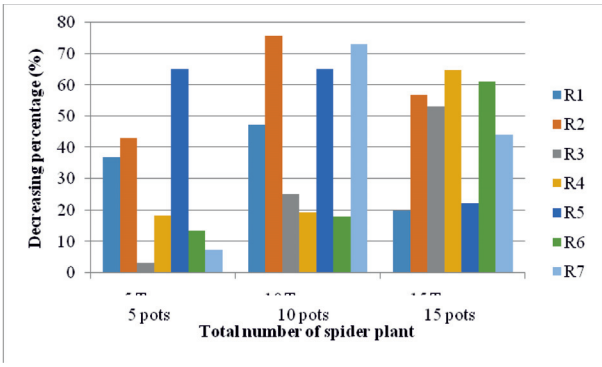


Fig. 5. The decreasing percentage of COHb reduction

which has similar character with spider plant can reduce carbon monoxide in cigarette smoke as much as 0.4%.

From the results of Figure 5, the respondent's blood before and after being given the addition of Spider Plant treatment. The graph above shows that the addition of Spider Plants can affectthe decrease in COHb levels in the respondent's blood. However, when viewed from each respondent's presentation in the 3 applications of adding Spider plants, there was still a large difference in the decrease, which means that the fewer and the more additions of Spider Plants did not affect the decrease in COHb.

Conclusion

The addition of spider plant was succesfully reduce the indoor CO level 65% and also can reduce COHb level 75%.

Acknowledgements

We are thank you for Universitas Islam Lamongan for giving us funding support for this research.

Conflict of interest

This study declared no conflict of interest

References

Alberts, W. M. 1994. Indoor air pollution: No, no2, co, and CO2. *Journal of Allergy and Clinical Immunology*. 94(2): 289–295.

Carlisle, A. J. and Sharp, N. C. C. 2001. Exercise and outdoor ambient air pollution. *British Journal of Sports Medicine*. 35(4) : 214–222.

De Nevers, N. 2010. *Air Pollution Control Engineering*. Waveland press

Hoskins, J. A. 2003. Health effects due to indoor air pollution. *Indoor and Built Environment*. 12 (6) : 427–433.

John, K. S. and Feyisayo, K. 2013. Air pollution by carbon monoxide (CO) poisonous gas in Lagos Area Southwestern Nigeria. *Atmospheric and Climate Sciences*. 2013

Lam, N., Nicas, M., Ruiz-Mercado, I., Thompson, L. M., Romero, C. and Smith, K. R. 2011. Non-invasive measurement of carbon monoxide burden in Guatemalan children and adults following wood-fired temazcal (sauna-bath) use. *Journal of Environmental Monitoring*. 13(8) : 2172–2181.

Li, L., Lin, Y., Xia, T. and Zhu, Y. 2020. Effects of electronic cigarettes on indoor air quality and health. *Annual Review of Public Health*. 41 : 363–380.

Naniek, B. R. A. C. D. and Ratni, J. A. R. 2012. Tingkat kemampuan penyerapan tanaman hias dalam menurunkan polutan karbon monoksida,

Ngah, M. A., Ahmad, A. and Samad, A. A. 2013. A Low Cost Method to Analyse Concentration of Carbon Monoxide (CO). *Jurnal Teknologi*. 73(3).

Raub, J. A., Mathieu-Nolf, M., Hampson, N. B. and Thom, S. R. 2000. Carbon monoxide poisoning—a public health perspective. *Toxicology*. 145(1) : 1–14.

Sofia, D., Gioiella, F., Lotrecchiano, N. and Giuliano, A. 2020. Mitigation strategies for reducing air pollution. *Environmental Science and Pollution Research*. 27, (16) : 19226–19235.

Sørheim, O., Aune, T. and Nesbakken, T. 1997. Technological, hygienic and toxicological aspects of carbon monoxide used in modified-atmosphere packaging of meat. *Trends in Food Science & Technology*. 8(9) : 307–312.

Suhaimi, M. M. 2017. Effectiveness of Indoor Plant to Reduce CO2 in Indoor Environment. In *MATEC Web of Conferences*. 103 : 05004.

Varon, J., Marik, P. E., Fromm Jr, R. E. and Gueler, A. 1999. "Carbon monoxide poisoning: a review for clinicians. *The Journal of Emergency Medicine*. 17(1) : 87-93.

Wang, Y., Tao, J. and Dai, J. 2011. Lead tolerance and detoxification mechanism of *Chlorophytum comosum*. *African Journal of Biotechnology*. 10(65) : 14516–14521.

Wicaksono, R. R. 2018. Faktor yang Berhubungan dengan Kadar COHb pada Petugas Parkir Plaza X Surabaya. *Jurnal EnviScience (Environment Science)*. 1(1).

Wong, K. L., Limero, T. F. and James, J. T. 2000. Toxicological approach to setting spacecraft maximum allowable concentrations for carbon monoxide.

Yulda, A., Achmadi, U. F. and Arminsih, R. 2020. Analysis of Carbon Monoxide (CO) in Blood or Carboxyhemoglobin (COHb) on Psychological Stress in Public Transport Drivers (City Transportation)(Case Study in Depok in 2019). *Indian Journal of Public Health Research & Development* 11(3).