International Journal of Advanced Health Science and Technology
Multidisciplinary : Rapid Review : Open Access Journal e-ISSN:2808-6422; p-ISSN:2829-3037

RESEARCH ARTICLE OPEN ACCESS

Manuscript received May 18, 2022; revised August 20, 2022; accepted August 12, 2022; date of publication August 25, 2022
Digital Object Identifier (**DOI**): https://doi.org/10.35882/ijahst.v2i4.136

How to cite: Maksuk, Intan Kumalasari, and Sherli Shobur, "Health Risk Assessment of Human Exposure to Dust Exposure on Communities Around Weaving Industry in Palembang, Indonesia", International Journal of Advanced Health Science and Technology, vol. 2, no. 4, pp. 174–281, Augustus. 2022.

Health Risk Assessment of Human Exposure to Dust Exposure on Communities Around Weaving Industry in Palembang, Indonesia

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"This work was supported in part by Poltekkes Kemenkes Palembang."

ABSTRACT Air pollution due to industrial activities is increasing worldwide, including in Indonesia. Particulate Matter (PM) is one of the air pollutant parameters that can cause health problems, especially respiratory problems in communities living at the weaving industrial area. The aimed of this study was to analyze the environmental health risk of human exposure due to dust exposure in communities around the weaving industry center. This research was an observational study using an environmental health risk analysis approach. Dust parameters were measured in as many as ten indoors and five outdoors around the weaving industry. The dust parameters measured were PM 2.5, PM 10, and Total Solid Particulate (TSP) concentration indoor and outdoor around the weaving industry areas. Dust measurements were carried out in the morning and afternoon using an Aerocet. The average results of dust measurement indoor were PM 2.5 (0.182 mg/m3), PM 10 (0.443 mg/m3), TSP (0.556 mg/m3), while for outdoor PM 2.5 (0.185 mg/m3). PM 10 (0.381 mg/m3), TSP (0.419 mg/m3). The average indoor of PM 2.5 intake was 0.013 mg/kg-day, PM10 (0.031 mg/kg-day), and TSP (0.038 mg/kg-day), and outdoor were PM 2.5 (for adult 0.064 mg/kg-day, for children 0.014 mg/kg-day), PM10 (for adult 0.132 mg/kg-day and for children 0.292 mg/kg-day), TSP (for adult 0.146 mg/kg-day and for children 0.322 mg/kg-day). All of them were more than Reference Concentration (RfC), and the Risk Quotient of PM10 and PM2.5 were more than 1. Exposure to PM10 and PM2.5 are unsafe or likely to result in non-carcinogenic effects on the residents in the next 30 years. The finding of this study is to provide information the dust concentration in the environment, the Risk Quotient of dust exposure in the communities around the weaving industry, and strategies for managing risks due to dust exposure in the traditional weaving industry center. Therefore, it is necessary to conduct a risk management scenario.

INDEX TERMS Health Risk Assessment, Dust Exposure, Weaving Industry

I. INTRODUCTION

Air pollution due to industrial activities is increasing worldwide, including in Indonesia. Air pollution is the most significant environmental risk factor [1]. Air pollution is one of the risk factors for morbidity and mortality worldwide. especially in developing countries [2]. Pollutants scattered in the environment have toxic properties that can harm organisms; one of these is dust. Dust is several small solid particles with a diameter of fewer than 500 micrometers which consist of a complex mixture of organic and inorganic-organic matter suspended in the air [3]. Particulate Matter (PM) is a mixture of solid particles found in the air measuring less than 10 micrometers and less than 2.5 micrometers. and it is one of six parameters of pollutants that have been established by National Ambient Air Quality Standards (NAAQS) [4].

Air pollution is a problem that often occurs in big cities in Indonesia. Climate change and decreasing air quality have also been felt in Indonesia, mainly in big cities such as Jakarta, Semarang, Bandung, Medan, and Surabaya. including Palembang [5]. Particulate Matter is an air pollutant emitted from both natural and anthropogenic sources. It can be inhaled and get deep into the respiratory system and cause serious health problems in humans [6]. It is a dangerous air pollutant of various sizes and can cause non-communicable diseases globally [7].

Previous studies have shown that Particulate Matter was related to several disease risk factors, including asthma, lung cancer, heart disease, myocardial infarction, stroke, and dementia, even as an important cause of morbidity and mortality [8]. [9]. The study in China reported that short-term exposure to PM10 and PM2.5 concentrations were significantly associated with asthma exacerbations in children [10], and long-term exposure to PM10 caused chronic obstructive pulmonary disease in Pisa. Italy [11]. In addition, exposure to high PM10 concentrations can increase the risk of allergies two times higher than exposure to low PM10 concentrations in adults [12]. Dust exposure is also related to respiratory complaints in the communities around the cement industry [13] and people living around the terminal [14]. Exposure to high concentrations of PM2.5 in residential areas causes a mortality risk for heart failure patients [15]. In the Netherlands, PM10 and PM 2.5 concentrations were related to all-cause and cause-specific mortality [16]. A study in Xian China reported that there were 7965 cases of death due to respiratory disorders; about 8.6% of deaths were associated with chronic lower respiratory disease, Influenza, and pneumonia, as well as other forms of respiratory disease, each associated with dust exposure [17].

In the study conducted in Hefei, China, increased concentrations of SO2, NO2, and PM10 were associated with increased respiratory disease mortality [18]. The concentration of PM2.5 indoors is also significantly associated with obstructive pulmonary symptoms in elementary school children in West Jakarta [19]. A prior study reported that dust exposure was associated with lung function capacity in people living on roadway, Semarang [20]. In addition, dust exposure can cause respiratory tract disorders of 64.3% in community at the Kairagi Satu Village in Manado [21]. Exposure to high concentrations of PM10 can cause a risk of respiratory problems of 41% in the human at Lubuk Kilangan District in Indonesia [22]. Dust exposure is not only a risk to adults but also to children [23].

Based on data in August 2019 that the average annual PM2.5 and PM10 concentrations in Palembang were 42.7 g/m3 and 45.94 g/m3. respectively [5]. In addition, dust measurements at Jakabaring Palembang terminal reported the average Total Suspended Particulate (TSP) [14]. Air pollution can cause respiratory disorders, including upper respiratory tract infections. This condition follows Indonesia's health profile data; in 2019, there were 154.573 cases of upper respiratory tract infections. and in 2020 there were 154.546 cases [24]. The number of upper respiratory tract infection cases is relatively high in South Sumatra Province; in 2019, as many as 49.158 cases; in 2020, as many as 25.366 cases; in 2021. as many as 32.336 cases, while in Palembang in 2020. it reached 11.261 cases [25].

One source of high dust concentrations is weaving activities, both traditional and modern. A study conducted at the textile industry Bogor, in Indonesia, found that the Total Suspended Particulate in ring spinning. blowing & carding exceeded the threshold limit value [26]. The study conducted in Pakistan found that the median cotton dust concentration was 0.6 mg/m3 in the weaving area [27].

Woven fabric is a traditional Indonesian woven cultural art produced in various regions, including Palembang. South Sumatera [28]. Palembang is one of the weaving-producing cities centered in the Weaving Industry Center. Tuan Kentang Village. The weaving industry area is located in Tuan Kentang Village, Jakabaring District in Palembang. close to the highway and very densely populated. In this area, there are several workshops for the traditional weaving process. This condition can cause dust exposure of human who live around the weaving industrial area and the weavers, so it is necessary to carry out dust measurements and environmental health risk assessments to predict dust exposure for the next few years.

Health risk assessment is necessary to prevent health problems, including respiratory disorders. Although guidelines for environmental health risk assessment have existed worldwide, including in Indonesia. they have not been implemented optimally [29]. [30]. In addition, data related to environmental monitoring results are only limited to the effects of research conducted by researchers and academics.

This research contributes especially to the human living around the weaving industry and owners of the weaving industry to identify dust risk agents, the level of risk and how to manage the risk of dust exposure in the weaving industry center. Therefore, the purpose of this study was to analyze the environmental health risk assessment of human exposure due to dust exposure in communities around the weaving industry center in Palembang.

II. METHODS

This study is an analytic observational study with a cross sectional design. The method used is an environmental health risk analysis approach; there are four stages: identification of risk agent, dose - response assessment, exposure assessment, and risk characterization. This research was conducted at the Tuan Kentang weaving industry center in Palembang from November 2019 to January 2020.

The data collected in this study are dust parameters, namely PM2.5, PM10, and Total Solid Particulate (TSP). Dust parameters were measured in as many as ten samples indoors and five outdoors around the weaving industry. The dust parameters measured were PM2.5, PM10, and TSP. The dust parameter was measured by BTKLPP Palembang officers in the morning until the afternoon, using an Aerocet 531S Particle Mass Profiler & Counter (Met One Instruments. Inc). The data were analyzed using the intake calculation formula, Risk Quotient and environmental health risk management scenarios.

This research has obtained an ethical approval from Poltekkes Kemenkes Palembang with a certificate number 010/KEPK/Adm2/VIII/2019.

III. RESULTS

The study results are explained based on four steps of environmental health risk analysis: identification of risk agents, dose-response assessment, exposure assessment, and risk characterization. The results of measuring PM 2.5, PM 10, and TSP concentration of the potential dose (intake), and Risk Quotient (RQ) were described in the table below.

A. IDENTIFICATION OF RISK AGENTS

Dust concentration was measured indoors and outdoors on three parameters, namely PM2.5, PM10, and TSP; the measurement results are presented in TABLE 1 and TABLE 2 below:

TABLE 1
The Results of Indoors Dust Concentration Measurement (PM2.5, PM10, TSP) in Weaving Industry Center (n=10)

Sampling Area	Dust Concentrations (mg /m3)		
	PM 2.5	PM 10	TSP
Workshop 1	0.214	0.546	0.784
Workshop 2	0.2276	0.4988	0.5598
Workshop 3	0.1913	0.4954	0.684
Workshop 4	0.1607	0.4003	0.4968
Workshop 5	0.1442	0.3168	0.3689
Workshop 6	0.1565	0.4765	0.6431
Workshop 7	0.1486	0.3982	0.5041
Workshop 8	0.1897	0.4354	0.5114
Workshop 9	0.1897	0.4354	0.5114
Workshop 10	0.2018	0.4351	0.4967
Mean±SD	0.182±0.0286	0.443±0.0645	0.556±0.118
Min-Max	0.144-0.228	0.317-0.546	0.369-0.784

Based on TABLE 1. the average of PM2.5. PM10, and TSP concentrations in the weaving workshop were 0.182 mg/m3. 0.443 mg/m3. and 0.556 mg/m3, respectively. These three parameters exceed the indoor air quality standard [31]. Based on TABLE 2. the average of PM2.5, PM10, TSP concentrations were 0.185, 0.381, 0.419 mg/m3 the dust exceed the ambient air quality standard. The concentrations of PM10 and PM2.5 were exceed the quality standard and pose a risk of causing public health problems, mainly respiratory disorders.

B. DOSE-RESPON ASSESSMENT

The next step after the identification of risk agents is dose-response assessment. The dose-response assessment focused on three dust parameters: PM 2.5, PM 10, and TSP. They were categorized as non-carcinogenic risk agents. Exposure to dust for a long time, both in public places and environment work, can cause respiratory complaints. Therefore, a dose-response assessment needs to be carried out in the weaving industry area.

TABLE 2
The Results of Outdoors Dust Concentration Measurement (PM2.5, PM10, TSP) around Weaving Industry Center (n=5)

Sampling Area	Dust Concentration Outdoor (mg/m3)		
	PM 2.5	PM 10	TSP
in Front of Workshop 1	0.2389	0.4405	0.4555
Workshop 2	0.1817	0.3856	0.436
Intersection of Workshop 3	0.1675	0.3628	0.4077
in Front of Workshop 6	0.1374	0.2799	0.3024
in Front of Workshop 8	0.2018	0.4351	0.4967

C. EXPOSURE ASSESSMENT

The next step is exposure assessment; several variables are used. namely dust concentration. inhalation rate. time exposure. frequency exposure. duration time. weight. and time average. This exposure assessment aims to obtain the value of the potential dose (intake).

The potential dose (intake) was calculated using the formula below [32]:

$$I = \frac{CxRxtExfExDt}{Wb\ x\ tavg} \quad (1)$$

The explanation of the equation (1) is as follows:

Intake (I)	:	The potential dose of the agent enters the body (mg/kg-day)
Concentration (C)	:	Dust parameters (PM2.5. PM10. TSP) in air (mg/m3)
Rate (R)	:	Average daily water consumption (for adult = 0.83 m3/hour). children = 0.5 m3/hour)
Time of Exposure (tE)	:	Exposure time daily for 24 hours for the residential area. 8 hours for work environment
Frequency of Exposure (fE)	:	Length of exposure daily for 350 days/year. in the workplace for 250 days/year
Duration time (Dt):	:	The duration of exposure to non-carcinogenic substances is 30 years (years)
Weight (Wb):	:	Average weight for asian (for adult =55 kg. children=15 kg)

Time of average (tavg) : the average exposure time to non-carcinogenic substances is 30 years each day (30 years × 365 days/year)

The calculation intake of indoor and outdoor dust concentrations (PM2.5, PM10, and RSP) are presented in TABLE 3 and TABLE 4:

TABLE 3
Potential Dose (Intake) of PM2.5, PM10, and TSP Concentration in Traditional Weavers

PM 2.5 (mg/kg-day)	PM 10 (mg/kg-day)	TSP (mg/kg-day)	Reference Concentration (RfC) (mg/kg-day) [4]
0.015	0.038	0.054	PM 2.5=0.01
0.016	0.034	0.039	PM 10= 0.014
0.013	0.034	0.047	TSP=2.42
0.011	0.028	0.034	
0.010	0.022	0.025	
0.011	0.033	0.044	
0.010	0.027	0.035	
0.013	0.030	0.035	
0.013	0.030	0.035	
0.014	0.030	0.034	

Based on TABLE 3. The average intake of PM 2.5, PM10, and TSP were 0.013 mg/m3, 0.031 mg/m3 and 0.038 mg/m3, respectively. The calculation results of PM2.5, PM10, and TSP concentration of intake in traditional weavers were less than RfC. The RfC of PM 2.5. PM 10. and TSP concentrations using the National Ambient Air Quality Standard (NAAQS) for Particulate Matter [4].

TABLE 4
Potential Dose (Intake) of PM 2.5, PM 10, and TSP Concentrations in Communities Around Weaving Industry Center

PM 2.5 (mg/kg-day)		PM 10 (mg/kg-day)		TSP (mg/kg- day)	
Adult	Children	Adult	Children	Adult	Children
0.0830	0.1833	0.1530	0.3379	0.1582	0.3494
0.0631	0.1394	0.1339	0.2958	0.1514	0.3345
0.0582	0.1285	0.1260	0.2783	0.1416	0.3128
0.0477	0.1054	0.0972	0.2147	0.1050	0.2320
0.0701	0.1548	0.1511	0.3338	0.1725	0.3810

Based on TABLE 4. the average intake of PM2.5, PM10 and TSP concentrations were found in adults at 0.064, .0132, 0.0146 mg/kg-day and in children 0.014, 0.292 and 0.322 mg/kg-day, respectively. Two of the three parameters calculated for the intake dose exceed the RfC, namely PM2.5 and PM10 parameters.

D. RISK CHARACTERIZATION

Risk characterization is the last step of a health risk assessment to determine a risk agent's Risk Quotient (RQ). The Risk Quotient was calculated for traditional weavers and people living in the weaving industrial area using the formula below [32]:

$$RQ = \frac{I}{RfC} \quad (2)$$

where R indicates rate in daily consumption, f indicates frequency of exposure, and C indicates concentration. The calculation of the Risk Quotient is presented in TABLE 5 and TABLE 6 below:

TABEL 5
Risk Quotient (RQ) of PM 2.5, PM10, and TSP Concentrations for Traditional Weavers

RQ of Dust Concentration		
PM 2.5	PM 10	TSP
1.475	2.687	0.022
1.568	2.455	0.016
1.318	2.438	0.019
1.107	1.970	0.014
0.994	1.559	0.011
1.078	2.345	0.018
1.024	1.960	0.014
1.307	2.143	0.015
1.307	2.143	0.015
1.391	2.142	0.014

According to TABLE 5, the average RQ of PM 2.5 and PM 10 were more than 1. It means that all weavers who work in the weaving industrial area with a weight of 55 kg are at risk of being in the weaving workshop with an inhalation rate of 0.83 m3/hour for 8 hours/day in 250 days/year for the next 30 years.

TABLE 6
Risk Quotient (RQ) of PM 2.5, PM10, and TSP Concentration Outdoors in Communities Around Weaving Industry Center

RQ of Dust Concentration					
PM 2.5		PM 10		TSP	
Adult	Children	Adult	Children	Adult	Children
8.3	18.3	10.9	24.1	0.07	0.14
6.3	13.9	9.6	21.1	0.06	0.14
5.8	12.8	9.0	19.9	0.06	0.13
4.8	10.5	6.9	15.3	0.04	0.10
7.0	15.5	10.8	23.8	0.07	0.16

Based on TABLE 6, the average RQ > 1 of PM 2.5 and PM10 concentrations, it means that was unsafe for adults and children exposed to dust for the next 30 years.

E. RISK MANAGEMENT

The results of the calculation of RQ PM10 and PM2.5 are more than 1. It is necessary to carry out a risk management scenario using the formula below [32]:

Acceptable Dust Concentration (ADC):

$$ADC = \frac{I \times Wb \times tavg}{R \times tE \times fE \times Dt} \quad (3)$$

Acceptable Inhalation Rate (AIR):

$$AIR = \frac{I \times Wb \times tavg}{C \times tE \times fE \times Dt} \quad (4)$$

Acceptable Frequency Exposure (AFE):

$$AFE = \frac{I \times Wb \times tavg}{C \times R \times tE \times Dt} \quad (5)$$

Acceptable Duration Time (ATE):

$$AFE = \frac{I \times Wb \times tavg}{C \times R \times tE \times fE} \quad (6)$$

The risk management scenario is presented in the Table 7 below:

TABLE 7
Risk Management Scenario of PM 2.5, PM 10 for Adult, Children, Traditional Weavers

Dust Parameter	ADC (mg/m3)	AIR (m3/hour)	AFE (days/year)	ADT (years)
PM 2.5 for Adult	0.184	0.83	349	23.9
PM 2.5 for Children	0.185	0.23	350	10.8
PM 2.5 for Traditional Weavers	0.189	0.72	216	6.9
PM 10 for Adult	0.380	1.71	349	20.6
PM 10 for Children	0.381	0.46	158	9.3
PM 10 for Traditional Weavers	0.450	1.71	212	28.8

Based on TABLE 7, the risk management scenario is carried out for PM 2.5 and PM 10 concentrations for RQ more than 1. Therefore, there are several risk management scenarios that are carried out, namely reducing the concentration of PM 2.5 and PM 10, inhalation rate, frequency of exposure, and duration of time.

IV. DISCUSSION

The study results showed that the PM2.5, PM10, and TSP concentrations exceeded the quality standard values. According to the study results in Bogor, the total dust concentration measurement results in ring spinning is 188.6 mg/m3 and in blowing & carding were 379.4 mg/m3. exceeding the threshold limit value [26]. The results of dust measurements in textile industry obtained an average of 0.395 mg/m3 [33].

The results of outdoor dust measurements were found to exceed the quality standard values. This study is in line to study that reported PM 2.5 and PM10 concentration at Lenteng Agung in Jakarta were more than the quality standard values, which was measured during the day and evening; this is related to respiratory complaints [23]. The study in Ambon showed that dust measurements result from 3 measurements at the same point showed the highest concentration during the day, while the lowest dust concentration was measured in the afternoon [34]. The study in Hanoi reported that the average dust concentrations. including PM 2.5, PM 10, and indoor TSP exceeded the quality standard values and outdoor dust concentrations [35].

The dose-response assessment focused on three dust parameters, namely PM 2.5, PM 10, and TSP. They were categorized as non-carcinogenic risk agents. Exposure to dust for a long time, both in public places and at the workplace, can cause respiratory complaints. This study is in line with a study in Jakarta that dust exposure is related to respiratory complaints [23]. This study is in line with a study in Jakarta that dust exposure is related to respiratory complaints [36].

In addition, a study conducted in Northwest Ethiopia reported a higher prevalence of respiratory symptoms in workers exposed to cotton dust than in workers who were not exposed, and there were more signs of respiratory tract irritation [27]. Dust exposure was also related to lung function disorders experienced by the traditional weaver in the Goyor Sarong Industry, Pemalang Regency [27]. Dust exposure was also related to lung function disorders experienced by the traditional weaver in the Goyor Sarong Industry, Pemalang Regency [37]. Dust exposure continuously in the spinning section of the Karanganyar Solo textile industry also causes lung function disorders [33]; in Bogor causes Acute Respiratory Infection (ARI) symptoms as many as 57.4% mild [26].

The calculation of the RQ of the three parameters found that PM2.5 and PM10 were more than 1. This study was not following the results of studies in Ambon City; the RQ of all air pollutant parameters is less than one or is not at risk for the next 30 years [34]. This study was similar to the results of research conducted in the terminal area close to schools with RQ> 1. and it is not safe for children who are in that school [38]. The study in Bone also is in line with this study; the RQ of TSP agents for adults is less than one. and it is not risky for adult populations for the next 30 years [39]. A Study in Maros. Indonesia. reported that the ecological risk value of PM2.5 concentration inhaled through the air or dermally through the skin in school children reported more than 1 [40]. In a similar study conducted in Iran. the hazard quotient (HQ) for PM2.5 and PM10 were calculated in the range of 0.82-18.4 and 0.16-3.28. respectively. which corresponds to an unacceptably high risk for human health [41].

The study results show that the RQ of PM2.5 and PM10 indoor and outdoor is more than 1. Therefore. it is necessary to implement an appropriate control strategy for this public health threat through risk management. Several risk management scenarios are carried out. namely reducing the concentration of PM 2.5 and PM 10. inhalation rate. frequency of exposure. and duration of time. This study is following research in Iran to reduce the adverse health effects of PM. namely by reducing dust exposure.

especially vulnerable people such as people with chronic lung and heart diseases. the elderly. and children during dusty days [42].

Air quality modelling for ambient health risk assessment PM10, PM2.5, and SO2 have been carried out in Iran to reduce the health effects of exposure to PM [43]. In Romania, risk management of dust exposure through implementing further mitigation measures to reduce health risks, especially in the case of sensitive population groups[44].

This study provides information to manage environmental health risks due to exposure to dust in the weaving industrial area. The research conducted by previous researchers only provided an overview of dust concentrations, calculated intake, and RQ with different locations from this study.

The limitations of this study are the airborne dust concentration was measured for one season, namely in summer, and an examination of health effects related to lung function did not conduct. The implication of this study was to provide the overview of indoor and outdoor dust concentrations, the intake and the Risk Quotient value are known to predict the risk of dust exposure for the next 30 years. Therefore, these findings are a step to anticipating respiratory diseases due to dust exposure as early as possible, and a strategy for managing risks due to dust exposure to the community and traditional weavers.

V. CONCLUSION

Exposure to PM10 and PM2.5 is not safe or is likely to result in non-carcinogenic effects on communities around the weaving industry for the next 30 years. The finding of this study is to provide information the dust concentration in the environment, the Risk Quotient of dust exposure in the communities around the weaving industry, and strategies for managing risks due to dust exposure in the traditional weaving industry center.

Therefore, it is necessary to carry out risk management to adopt suitable controlling strategies for this public health threat in the weaving industry. For further researchers, it is necessary to carry out health examination related to pulmonary function disorders in the community, especially for weavers at the center of the traditional weaving industry.

ACKNOWLEDGMENT

The authors would like to thank Poltekkes Kemenkes Palembang for funding this research and all parties involved in this research.

REFERENCES

[1] W. H. O. WHO. “Air Quality Guidelines. Global Update 2005. Copenhagen. WHO Regional Office for Europe.” *Increasing Phys. Act. Reduces Risk Hear. Dis. Diabetes. Geneva WHO*. 2006.

[2] K. Rumchev. Y. Zhao. and J. Spickett. “Health risk assessment of indoor air quality. socioeconomic and house characteristics on respiratory health among women and children of Tirupur. South India.” *Int. J. Environ. Res. Public Health*. vol. 14. no. 4. p. 429. 2017.

[3] W. H. O. WHO. “Ambient air pollution: A global assessment of exposure and burden of disease.” *Clean Air J.*. vol. 26. no. 2. p. 6. 2016.

[4] U. EPA. “Integrated science assessment for particulate matter.” *EPA/600/R-08/139F. Research Triangle Park. NC: US EPA*. 2009.

[5] KLHK. “Air Quality Conditions in Several Big Cities in 2019.” 2019.

[6] S. Bae and Y.-C. Hong. “Health Effects of Particulate Matter.” *J. Korean Med. Assoc.*. vol. 61. no. 12. pp. 749–755. 2018.

[7] R. D. Arias-Pérez. N. A. Taborda. D. M. Gómez. J. F. Narvaez. J. Porras. and J. C. Hernandez. “Inflammatory Effects of Particulate Matter Air Pollution.” *Environ. Sci. Pollut. Res.*. vol. 27. no. 34. pp. 42390–42404. 2020.

[8] J.-P. Myong. “Health effects of particulate matter.” *Korean J. Med.*. pp. 106–113. 2016.

[9] M. Loxham and M. J. Nieuwenhuijsen. “Health effects of particulate matter air pollution in underground railway systems – a critical review of the evidence.” *Part. Fibre Toxicol.*. vol. 16. no. 1. p. 12. 2019.

[10] J. Wu. T. Zhong. Y. Zhu. D. Ge. X. Lin. and Q. Li. “Effects of Particulate Matter (PM) on Childhood Asthma Exacerbation and Control in Xiamen. China.” *BMC Pediatr.*. vol. 19. no. 1. p. 194. 2019.

[11] S. Fasola *et al.*. “Effects of Particulate Matter on the Incidence of Respiratory Diseases in the Pisan Longitudinal Study.” *Int. J. Environ. Res. Public Health*. vol. 17. no. 7. 2020.

[12] A. Dėdelė. A. Miškinytė. and R. Gražulevičienė. “The Impact of Particulate Matter on Allergy Risk among Adults: Integrated Exposure Assessment.” *Environ. Sci. Pollut. Res.*. vol. 26. no. 10. pp. 10070–10082. 2019.

[13] M. Muliyadi and M. Sarjan. “The Effect of PM 10 Concentration With Some Health Complaints At PT Intimkara Ternate.” *MPPKI (Media Publ. Promosi Kesehat. Indones. Indones. J. Heal. Promot.*. vol. 3. no. 1. pp. 44–49. 2020.

[14] E. Sunarsih. S. Suheryanto. R. Mutahar. and R. Garmini. “Risk Assesment of Air Pollution Exposure (NO2. SO2. Total Suspended Particulate. and Particulate Matter 10 micron) and Smoking Habits on The Lung Function of Bus Drivers in Palembang City.” *Kesmas J. Kesehat. Masy. Nas. (National Public Heal. Journal)*. vol. 13. no. 4. pp. 202–206. 2019.

[15] C. K. Ward-Caviness *et al.*. “Associations between long-term fine particulate matter exposure and mortality in heart failure patients.” *J. Am. Heart Assoc.*. vol. 9. no. 6. p. e012517. 2020.

[16] N. A. H. Janssen. P. Fischer. M. Marra. C. Ameling. and F. R. Cassee. “Short-term effects of PM2. 5. PM10 and PM2. 5–10 on daily mortality in the Netherlands.” *Sci. Total Environ.*. vol. 463. pp. 20–26. 2013.

[17] K. K. Mokoena. C. J. Ethan. Y. Yu. K. Shale. and F. Liu. “Ambient air pollution and respiratory mortality in Xi’an. China: a time-series analysis.” *Respir. Res.*. vol. 20. no. 1. p. 139. 2019.

[18] F. Zhu *et al.*. “The short-term effects of air pollution on respiratory diseases and lung cancer mortality in Hefei: A time-series analysis.” *Respir. Med.*. vol. 146. pp. 57–65. 2019.

[19] G. J. T. Mulia. B. Wispriyono. H. Kusnoputranto. B. Hartono. and A. Rozaliyani. “Indoor Air Pollution and Respiratory Function on Primary School Students in West Jakarta. Indonesia.” *Open Public Health J.*. vol. 13. no. 1. pp. 190–195. 2020.

[20] N. Nurhidayanti. N. Nurjazuli. and T. Joko. “The Relationship between Dust Exposure and Lung Function Capacity in At-Risk Communities on Jalan Silingiwani–Walisongo. Semarang.” *J. Kesehat. Masy.*. vol. 6. no. 6. pp. 251–258. 2018.

[21] Y. P. Thaib. B. Lampus. and R. Akili. “The Relationship Between Dust Exposure and the Incidence of Respiratory Tract Disorders in the Community of Kairagi Satu Village 3 Manado City.” *J. Adm. PUBLIK*. vol. 4. no. 32. 2015.

[22] F. A. Riski. “Spatial Description of the Risk of Respiratory Disorders Due to Exposure to PM10 Dust in the Residential Area of Lubuk Kilangan District. Padang City in 2017.” 2017.

[23] A. H. R. Inaku and C. Novianus. “Effect of PM 2. 5 and PM 10 Air Pollution on Children’s Breathing Complaints in Children’s Open Spaces in DKI Jakarta.” *ARKESMAS (Arsip Kesehat. Masyarakat)*.

vol. 5. no. 2. pp. 9–16. 2020.
[24] Kemenkes RI. *Indonesia Health Profile 2020*. Kementerian Kesehatan Republik Indonesia. 2020.
[25] S. BPS. "Number of Disease Cases by Type of Disease (Case). 2019-2021." 2022.
[26] A. M. Basti. "Total Dust Particulate (TSP) and Symptoms of ARI on Spinning Department Workers in the Textile Industry of PT. Unitex Tbk Bogor." *J. Kesehat. Masy.*. p. 135. 2014.
[27] N. A. Ali. A. A. Nafees. Z. Fatmi. and S. I. Azam. "Dose-response of cotton dust exposure with lung function among textile workers: MultiTex Study in Karachi. Pakistan." *Int. J. Occup. Environ. Med.*. vol. 9. no. 3. p. 120. 2018.
[28] S. Shobur. M. Maksuk. and F. I. Sari. "Risk Factors for Musculoskeletal Disorders (MSDs) in Ikat Weaving Workers in Tuan Kentang Village. Palembang." *J. Med. (Media Inf. Kesehatan)*. vol. 6. no. 2. pp. 113–122. 2019.
[29] Kemenkes RI. "Pedoman Analisis Risiko Kesehatan Lingkungan." in *Ditjen P2P*. Ditjen P2P. 2012.
[30] WHO. *WHO Human Health Risk Assessment Toolkit: Chemical Hazards*. World Health Organization. 2010.
[31] Permenkes RI. "Pedoman Penyehatan Udara dalam Ruang Rumah. Peraturan Menteri Kesehatan Nomor 1077/MENKES/PER/V/2011." 2011.
[32] J. F. Louvar and B. D. Louvar. *Health and Environmental Risk Analysis*. vol. 2. Prentice Hall. 1998.
[33] I. Suryadi. A. P. Nugraha. N. Fitriani. and S. Rachmawati. "The Determinant Of Lung Function Dissorders Of The Textile Industry Spinning Section." *KEMAS J. Kesehat. Masy.*. vol. 17. no. 4. 2022.
[34] K. U. Rumselly. "Environmental Health Risk Analysis of Ambient Air Quality in Ambon." *J. Kesehat. Lingkung.*. vol. 8. no. 2. pp. 158–163. 2016.
[35] V. O. T. H. I. L. E. Ha. "Indoor and Outdoor Relationships of Particle With Different Sizes in an Apartment in Hanoi: Mass Concentration and Respiratory Dose Estimation." *Vietnam J. Sci. Technol.*. vol. 58. no. 6. p. 736. 2020.
[36] S. D. Wami *et al.*. "Cotton dust exposure and self-reported respiratory symptoms among textile factory workers in Northwest Ethiopia: a comparative cross-sectional study." *J. Occup. Med. Toxicol.*. vol. 13. no. 1. pp. 1–7. 2018.
[37] S. Sulistiyani and N. A. Y. Dewanti. "Risk of Lung Function Disorders in ATBM Weaving Workers in the Goyor Glove Industry. Pemalang Regency." 2019.
[38] R. Pangestika and I. R. Wilti. "Karakteristik Risiko Kesehatan Non-Karsinogenik Akibat Pajanan PM2. 5 di Tempat-Tempat Umum Kota Jakarta." *J. Kesehat. Lingkung. Indones.*. vol. 20. no. 1. pp. 7–14. 2021.
[39] A. R. Nurfadillah and S. Petasule. "Environmental Health Risk Analysis (SO2. NO2. CO and TSP) in The Bone Bolango Area Road Segment." *J. Heal. Sci. Gorontalo J. Heal. Sci. Community*. vol. 5. no. 3. pp. 76–89. 2022.
[40] A. Mallongi. A. U. R. Stang. and R. D. P. Astuti. "Analysis Of Health And Ecological Risks Due To Exposure To Particulate Matter (PM 2.5) And Occurrence Of Lung Disease Among School Children In Maros Province. Indonesia." *J. Southwest Jiaotong Univ.*. vol. 56. no. 4. 2021.
[41] G. Heydari *et al.*. "Levels and Health Risk Assessments of Particulate Matters (PM2.5 and PM10) in Indoor/Outdoor Air of Waterpipe Cafés in Tehran. Iran." *Environ. Sci. Pollut. Res.*. vol. 26. no. 7. pp. 7205–7215. 2019.
[42] A. Najmeddin and B. Keshavarzi. "Health Risk Assessment and Source Apportionment of Polycyclic Aromatic Hydrocarbons Associated with PM10 and Road Deposited Dust in Ahvaz Metropolis of Iran." *Environ. Geochem. Health*. vol. 41. no. 3. pp. 1267–1290. 2019.
[43] S. Yusef Omidi Khaniabadi. Pierre Sicard. Arash Omidi Khaniabadi. A. N. Mohammadinejad. Fariba Keishams. Afshin Takdastan. and A. D. M. & M. Daryanoosh. "Air Quality Modeling for Health Risk Assessment of Ambient PM10. PM2.5 and SO2 in Iran." *Hum. Ecol. Risk Assess. An Int. J.*. pp. 1–13. 2018.
[44] L. Levei *et al.*. "Temporal Trend of PM10 and Associated Human Health Risk over the Past Decade in Cluj-Napoca City. Romania." *Applied Sciences* . vol. 10. no. 15. 2020.

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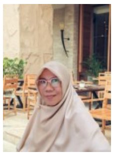

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