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LITERATURE REVIEW Open Access

PARTICULATE MATTER AS A DRIVEN FACTOR COVID19 TRANSMISSION AT OUTDOOR: REVIEW

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Abstract

Introduction: *Coronavirus Disease 2019 (Covid19) is an infectious disease caused by SARS-CoV-2 (Severe Acute Respiratory Syndrome-related Coronavirus) which attacks the respiratory tract, with mild to severe symptoms. The virus can infect the body through mucous membranes on the face with droplet transmission. Air pollution is thought to contribute to Covid19 events which can worsen the situation of people with Covid19. The aims of this literature review is to analyze Particulate Matter (PM) as environmental factors that contributes Covid19, so it is expected to be a study in terms of prevention and prevention in the field of environmental health.* ***Discussion:*** *PM is thought to have contributed to an increased risk of mortality and morbidity in Covid19 events. PM which has toxic properties can enter the lungs and affect the physiological condition of the lung organs. The findings regarding the presence of SARS-CoV-2 virus RNA strengthen the suspicion that PM plays a role in Covid19 transmission. Several studies have found that there is a relationship between PM and Covid19. $PM_{2.5}$ which is smaller than PM_{10} has a higher ability to be a risk factor for ballast in Covid19.* ***Conclusion****: The results of this synthesis state that PM can be one of the driving factors of Covid19 transmission in air.*

INTRODUCTION

Coronavirus Disease 2019 (Covid19) is an infectious disease caused by the SARS-CoV-2 *(Severe Acute Respiratory Syndrome-correlated Coronavirus)* virus that attacks the respiratory tract and can cause mild to severe symptoms (1–3). Covid19 includes a new type of virus, since previously this virus is not identified to cause pain or death in humans. Coronavirus can be classified as zoonoosis that is the transmission of viruses between animals and humans. There are 4 genome on coronavirus, namely: *Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus.*

Until now found two types of coronavirus identified can cause disease in humans with severe symptoms as *Middle-East Respiratory Syndrome* (MERS-CoV) and *Severe Acute Respiratory Syndrome* (SARS-CoV). The first time the Covid19 case was found in Wuhan city located in Hubei Province, China on December 31, 2019 with 59 cases of respiratory disorders of pneumonia that resulted in 7 critical people. Then on 27 January 2020 found a new fact that there has been limited transmission of family contacts confirmed by the WHO in the city of Wuhan, China and other countries.

Covid19 in humans can cause impaired infections in the respiratory with mild to severe symptoms. These symptoms usually appear 2 to 14 days after the body is exposed to viruses. This virus incubation period lasts 1-14 days. The transmission of this virus occurs from *human to human transmission* (4). The virus can infect the body through the eyes, nose and mouth (mucous membranes on the face) through droplet transmission.

The Covid19 case data per June 25, 2020 reported from the World Health Organization (WHO) website received results that there were 9,296,202 positive confirmed cases around the world with a death rate of 479,133 (5). This case has occurred in 216 countries in the world. Data in Indonesia as released by the Ministry of Health noted that there were 50,187 cases of Covid19, 2,620 people died and 20,449 were declared cured.

Air pollution containing the particulate matter allegedly contributes to the Covid19 case, and can be a factor that exacerbate the condition of people with the Covid19. Previous studies have stated that there is a connection between the short-term particulate matter exposure in the ambient air against the increased risk of morbidity and mortality of cardiovascular and respiratory diseases around the world (6). The increase in risk can occur because the particulate matter contains toxic substances that enter the inhalation way until then will circulate in the blood flow and the target organs so that it can affect the health status of the person exposed. People infected with Covid19 may experience a severe health condition due to exposure to air pollution, which has been known as one of the causes of respiratory disease (7).

Particulate matter with the case of Covid19 is interesting to be discussed given the effects that are compromised in a short or long period of time to be attributed to the quality of human health. It is supported by the research that the high levels of PM_{10} and $PM_{2.5}$ particles exceeding the threshold limit in northern Italy are directly proportional to the high cases of Covid19. The study also explained that there is a correlation between increasing particulate matter concentration, high viral spread and visible mortality rate (8). The purpose of this literature review is to analyze particulate matter as an environmental factor that contributes to the case of Covid19, so it is expected that it can be a study in the prevention and countermeasures in the field of environmental health.

DISCUSSION

This article is a literature review compiled based on the results of a study on relevant articles according to variables and purposes of writing. Articles relevant to the purpose of writing in this article are obtained by searching through Google Scholar and Pubmed, according to variables that are then set as keyword, namely: particulate matter, transmission, air pollution, and Covid19. Based on the search done, there are 62 journals found. The author then resorted the 62 journals based on the status of the journal which has been through *pre-proof* review and journal results, thus finding the results of 38 journals that have been through review. 38 journal is then resorted according to the similar article or research criteria and obtained by the results of 9 appropriate journals to be reviewed.

Covid19 is identified by the SARS-CoV-2 virus and attacks breathing as the target organ. Viruses that initially attach to the mucous membranes in the face enter into the body into the host body cell by passing the Protein S. Protein S will then bind to the enzyme ACE-2 *(Angiotensin Converting Enzyme 2)* which is a receptor in one of the coronavirus host. In addition, it is noted that the ACE-2 enzyme is identified in the oral nasal mucosa, lung, nasopharynx, skin, ileum, jejunum, spinal cord, spleen, thymus, kidney, liver, brain, enterocyte cells in jejunum, smooth muscle cells, endothelial artery cells, and pulmonary elveolar cells

Then, the translation of gene replication that comes from the virus RNA then replicates and transcription in the virus RNA. The lower airway is where the virus replication occurs followed by the response of

Table 1. Some Articles on Research Results Correlated to Particulate Matter Correlation wth Covid19 are Summarized in the Referral Journal List

Researchers	Title	Population	Method	Result
He Li et al, 2020, China	Air Pollution and temperature are associated with increased Covid19 incidence: a time series study	AQI, 4 ambient air pollutants, and five-variable meterology in Wu Han City and Xiao Gan	A-Cross sectional	AQI, PM 2.5, NO2, and temperature are variables that can increase the likelihood of transmission of Covid19.
Muhammad Farhan Bashir et al, 2020, California	Correlation between environmental pollution indicators and Covid19 pandemic: A brief study in Californian context	39.5 million people in California	A-Cross sectional	PM10 and PM2, 5 have a significant relationship to the case of the Covid19 incident in California. PM10 and PM 2.5 were major pollutants found in California so the authors recommended a policy on measuring air quality, including from the manufacturing area.
Bo Wang et al, 2020, China	An effect assessement of Airborne particulate matter polution on Covid19: A multi study in China	72 cities in China	A-Cross Sectional	There is a significant relationship between PM 10 and PM 2.5 against the confirmed Covid19 case, where it is known that the effect at PM 2.5 is higher than PM10.
Yongjian Zhu et al, 2020, China	Association between short-term exposure to air pollution and Covid19 infection: Evidence from China	120 cities in China	A-Cross Sectional	There is a significant associative relationship between PM10 and PM 2.5 against confirmed Covid19 cases. PM10 and PM 2.5 exposure to high concentrations in short periods of time relate to increased risk of Covid19 infections
Xiao Wu et al, 2020, United States	Exposure to air pollution and Covid19 mortality in the United States: a nationwide cross sectional study	3087 people in US	A-Cross sectional	The increase of 1ug/m3 PM 2.5 relates to an increase of 8% of the cases of Covid19 deaths small increases in long-term exposure at PM 2.5 caused a major increase in the level of mortality of Covid19
Ying Jiang, 2020, China	Effect of ambient air pollutants and meteorogical variables on Covid19	3 Cities in China	Retrospective cohort	There is a positive association relationship between Covid19 against PM 2.5, while for PM10 it is known to have a negative association with the incidence of Covid19. PM10 may reduce the incidence of Covid19 while the PM 2.5 is the opposite.
Leonardo Setti et al, 2020, Italy	SARS-CoV-2 RNA Found On Particulate Matter Of Bergamo In Northern Italy	Bergamo, Italia	A-Cross Sectional	The findings of SARS-CoV-2 RNA at the PM10 particulate concentrations in Bergamo located not far from the epicenter of the Covid19 in Italy could confirm that the virus could be carried over as detected on the PM10.
Leonardo Setti et al, 2020, Italy	Searching For SARS-COV-2 On Particulate Matter: A Possible Early Indicator Of Covid19 Epidemic Recurrence	Some cities in the world	A-Cross Sectional	The discovery of RNA SARS-CoV-2 at PM10 particulate concentrations in air samples in several cities in the world can serve as an initial indicator of potential Covid19 deployments by air.
Luigi Martelletti & Paolo Martelletti, 2020, Italy	Air Pollution and the Novel Covid19 Disease: a Putative Disease Risk Factor	Italia Utara	A-Cross Sectional	The high of PM10 and PM 2.5 particles above the threshold, in northern Italy is directly proportional to the high cases of Covid19. There is a correlation between increasing PM concentration, high viral spread and visible mortality rates.

the innate and specific immune system. This Virus is also not only to replicate on the respiratory system alone, but also on erythrocytes of the intestine so that it can cause diarrhea symptoms. But until now there is no report of the Covid19 case with transmission through feces or diarrhea (9).

The clinical signs and symptoms of people infected with Covid19 are as follows: fever of more than ≥ 38 °c, dry cough (67.8%), easy to feel tired (38.1%), cough with phlegm (33.7%), shortness of breath (18.7%), pain in muscles and or joints (14.9%), pain in the throat (13.9%), Headache (11.6%), chills (11.5%), Nausea vomiting (5%), Nasal congestion (4.8%), Diarrhea (3.8%), swelling of the eyelid (0.8%) (10).

These signs and symptoms are generally found in infected people. But these symptoms are not experienced by everyone. There are people who are infected with Covid19 without any symptoms or known as asymptomatic people (OTG). The existence of OTG can cause a vigilance because unconsciously OTG can just transmit the illness to the healthy person.

Covid19 causes mild to severe interference. Disorders that can be classified as severe ganggaun include organ disorders, septic shock, and pneumonia resulting in fatality (11). The fatality of the Covid19 can occur if it is not immediately resolved to the fullest extent. Patients with Covid19 should get a special intensive treatment in the hospital to monitor their health condition and provide medication therapy, in addition to preventing the widespread transmission of the surrounding environment.

Covid19 is also known to have higher risk factors in elderly groups. Elderly are more susceptible to infected Covid19 because in the elderly there are combidities

and decreased physiological function and also immune function (12). Covid19 that attack people with congenital diseases or comisbid conditions such as hypertension, renal failure, stroke, asthma, and diabetes mellitus will be a serious problem. This is because Covid19 will be a contributing factor to the comisbid conditions suffered.

According to epidemiology, explained that there is a triangle of epidemiology that affects a condition of pain or death, namely the host, agent and environment. The theory expressed by H. L Blum also explains that environmental factors have a role in determining the degree of public health, in addition to other factors such as genetics, behaviour and health care. Similarly, in the case of Covid19, environmental factors play a fairly important role that needs to be identified to take appropriate and optimal prevention and countermeasures.

Some environmental factors that allegedly contributed to the transmission of Covid19 include temperature in ambient air, air pollution, particulate matter, humidity, and weather. Although the transmission of Covid19 has not been thoroughly studied but the fact that there is an increase in the Covid19 parallel to the increase of AQI (decrease air quality), $PM_{2.5}$, and NO_2 as well as the temperature drop (13).

Particulate matter or commonly called PM is a complex mixture of particles of very small size and drip fluid. Acid components such as nitrate and sulphate are the concentrations contained in the PM, alongside other organic chemicals as well as dust and soil particles. Based on the source of PM can be classified into two, primary and secondary. The primary matter (PM) is particulate matter which is generated directly from the source, whereas secondary matter particulate is formed due to the complex physical and chemical reactions (14-15).

PM can be classified as primary particles emitted into the atmosphere through industrial activities, road traffic, road dust, sea sprays, and wind blown soil, they also contain carbon and organic compounds, metal and metal oxides and ions. Secondary particles are formed through the chemical transformation of gases. Examples: SO_2-Sulphate, NOx-Nitrates, NH_3-Ammonium ions, organic aerosol secondary. PM is known as a major contributor to the adverse health effects of air pollution (16).

The source of PM in developing countries is much broader than the source of PM in developed countries, it is due to the rapid transition between rural economy and urban. The sources of PM in urban and rural areas have a difference, including because there are still many people in rural areas who cook with solid fuel such as wood, while urban communities tend to use fossil fuels.

The main sources of pollution in developing countries especially Africa, Latin America and Asia are oil, biomass and coal (17). The PM source of motor vehicles occurs in both industrial and developing countries. Still found vehicles that largely have not fulfilled net emission standards, especially in developing countries that result in high levels of environmental pollution due to the emission of motor vehicles.

Based on the magnitude of the particle, the EPA grouped the PM into two categories (16): 1) The coarse-inhalation particle, which can be found on the site of highways and induction with high dust production, measuring greater than 2.5 micrometers and diameter less than 10 micrometers. 2) fine particles, which are commonly found in smoke and fog, are 2.5 micrometers in diameter and smaller. These particles can be transmitted directly from sources such as forest fires and can be formed from gases emitted in power plants, industries and emissions from automobile exhaust gases that react in the air. The size, concentration and length of exposure on the PM that is inhalation in humans will have different health impacts.

The particle size can directly relate to the potential for the onset of a health problem. The particles less than the same diameter as 10 micrometers are feared to have a serious impact on health, because the particles of these sizes are classified as particles capable of entering the lung organs after passing through the nose and throat. PM display with a magnitude of less than or equal to 2.5 mm can be a factor in the cause of the disease that affects the heart and lung organs in acute, including myocardial infarction, thrombosis and cardiac failure (18). Consequently, after inhalation these particles can affect the performance of the heart and the lung organs.

The Ontario Ministry of Environment has reported that the toughest effects of $PM_{2.5}$ have led to the effects of diseases such as asthma, the heart, and the lungs as the most vulnerable organ exposed to PM. Approximately 28% of diseases and deaths in some developing countries are caused by airborne particles (19). WHO's research results have also shown that more than 7 million deaths are correlated to the impact of the PM. India reported that air pollution is the cause of 10,000 – 30,000 deaths annually due to acute and chronic health issues relating to $PM_{2.5}$ and PM_{10} (17).

There are 85% of the world's population living in an unsafe area in the WHO mapping. This is due to the high air pollution in the area that exceeds the secure limit, causing 5.5 million people to die prematurely. So, it

can be known that the role of PM not only interferes with living creatures, but also disrupts the atmosphere and radiation balance (20).

PM is said to be dangerous due to complex composition, besides its strong suspensing. PM has been shown to transmit viruses in various respiratory diseases. One is the concentration of $PM_{2.5}$ which is corcorrelated with the risk of influenza disease in the flu season in Beijing, China (21). Research has mentioned that in a relatively long period of time, influenza viruses as well as several other viruses are able to survive in the air after sticking to the PM, thus bringing out the possibility of transmission of the virus through the air.

Current research does not yet prove in detail how air pollutants can help transmit the transmission of Covid19, but thus the research results have shown that the concentration of $PM_{2.5}$ correlates with the case of Covid19 positively. So based on the results of the study raises the alleged that $PM_{2.5}$ can potentiate or increase the potential transmission of SARS-CoV-2 in two ways (22) namely: 1) $PM_{2.5}$ acts as a human respiratory barrier that results in the dysfunctional respiratory conditions, thus providing the possibility to expose deeper respiratory tissues to foreign pathogens. 2) PM can form a condensation nucleus as a place of sticking to the virus, it occurs because with a small realistic size so that PM $_{2.5}$ is more harmful to humans because it can penetrate the drain and towards alveoli directly.

Particulate Matter as a driving factor in the case of Covid19 due to transmission in the air can occur due to the presence of SARS-CoV-2 virus at the concentration of PM. The Covid19 disease that attacks the lung and airway organs as the target organ has the same entry path as the particles of the PM, which is through the inhalation path. It allows the inclusion of particles that coincides with the SARS-CoV-2 virus.

Aerosols in recent times were confirmed as one of the Covid19 transmission routes that could be modified by the level of pollution of PM in air (23). The results of the research conducted in 72 cities in China found positive correlations between the $PM_{2.5}$ and PM_{10} cases with the Covid19 case by taking into account the population migration factor and the meteorological factor (24). These results give the conclusion that it is possible that the PM pollution in the air affects the transmission of Covid19.

The study was similar to SARS and influenza-focused research conducted in 47 cities in China that found that $PM_{2.5}$ambient can increase the risk factors of influenza exposure in China for days in relatively low temperature conditions. Studies conducted on SARS in five areas increased with the increased air pollution index or Air Pollution Index (API) and the patient mortality rate in regions with higher APIS increased compared to other regions. It gives the possibility that SARS-CoV-2 can be transmitted by aerosols so that with higher PM levels can increase the transmission of Covid19 (23).

PM has been conducted in some research as the cause of death and the presence of increased risk of disease transmission in communities in areas with high pollution levels. Research conducted in the Americas found that 1 $\mu g/m^3$ in the exposure of $PM_{2.5}$ in the long term relates to an increase of 0.73% in all causes of death in the population ages > 65 years (25). Previous studies mention that exposure to air pollution increases the severity of transmission during the outbreak. Another type of coronavirus on the SARS outbreak still associated with the Covid19 in 2003 gave reports that there was an increase in the fatalities of SARS disease in area with high and moderate air pulosi levels in the long term of respectively 71% and 126% compared to areas with low pollution levels.

The long-term exposure of particulates has long been associated with the inpatient rate due to pneumonia associated with a $PM_{2.5}$ exposure, this takes place in a relatively long period of time. The existence of long-term pollution exposure will further increase the likelihood of poor respiratory conditions in a region. A pandemic case in a while ago, one of the H_1N_1 pandemic in 2009 had demonstrated a particular interconnectedness of particulate matter exposure with the case of death in the case. In addition, the data on the past records were found a Spanish pandemic influenza case correlation with air pollution due to burning coal in 1918 (26).

PM pollution is one of the potential health risks to damage the human immune system through decreased pulmonary macrophage function to effectively attach the immune system to infections in some time, which will correlate with the impetus factor of the Covid19. Pulmonary macrophages have a very important function in pathogenic phagocytosis, so that the presence of it will be able to improve the invasive ability of SARS-CoV-2 (27).

PM in the air that can induce respiratory inflammation and affect a person's breath so that it will be able to exacerbate one's health condition. Severe inflammation found in the lungs after exposure to $PM_{2.5}$ is influenced by Angiotensin-Converting Enzyme 2 (ACE-2) which demonstrates a significant increase in the lungs after exposure to $PM_{2.5}$.

The interesting thing is that the recent report mentions that domain binding receptors of the SARS-CoV-2 can be recognized by the extracellular peptidase domain of the ACE-2 which is predominantly expressed

in the transient secretory cell type in subsegmental bronchial branches (28). This indicates the possibility of an increased invasion of SARS-CoV-2 in the lungs through the ACE-2 (29) line. The flow of cases based on some of the studies explains why PM was positively correlated to the increased risk of Covid19 despite further research on the matter, but the basic concept of the mindset by looking at some cases through the study that has been proven to prove the possibility.

Previous studies mention that particulate matter exposure both PM_{10} and $PM_{2.5}$ in the short and long term have the possibility of lowering the functioning of the lung organs (28-29). The inhalation of the exposed PM may result in inflammation of the cells in the lungs, thus affecting some or all of the performance of the lung organs. When the appropriate action is not performed and lasts for a relatively long period of time, it will increase the risk of pulmonary organ fatalities. This also applies if the PM exposure exceeds the recommended threshold or its concentration is high.

Particulate particles on the PM containing certain chemical compounds can release toxic molecules (31). Such molecules can be in the form of pathogenic microorganisms, spores or particles containing viruses (32). If pathogenic microorganisms and other toxic molecules enter the lungs, there is a physiological disorder in the organ.

Particulate matter is known to be able to enter the bronchus and alveoli in the pulmonary lungs (33). Particulate Matter can also enter through coronary arteries, the lymphatic system and can result in a seriousness in almost all organs and affect human health (34). Microorganisms of adequate size for inhalation (inhaleable) concentrations of Particulate Matter such as including fungi and bacteria will be a risk factor that can decrease health conditions. The presence of pathogenic microorganisms in the body will cause pathogenic microorganisms and decrease body immunity.

The concentration of particulate matter with the increase in some diseases indicates a significant correlation (35). High concentrations in particulate matter and severe air pollution levels can provide a negative effect on the Covid19 virus infection. Exposure to atmospheric contamination containing PM_{10} and $PM_{2.5}$ allowed to be a risk factor that could be worsening Covid19 (35-37).

Research in Bergamo, Italy showed that viruses could be carried away and detected on the PM_{10} (39). The SARS-CoV-2 Virus has a size of 60-149 nm to be carried away by PM_{10} and adheres to the mucous membranes and then enters the airway. The findings of SARS-CoV-2 RNA at the PM_{10} particulate concentrations of the air samples could be used as a potential indicator of the Covid19 (40) spread.

Based on research it is known that there is a strong link between the cases of Covid19 deaths with particulate matter in China. Exposure from $PM_{2.5}$ and PM_{10} may improve the patient's condition, thereby increasing the risk of death, which is relevant to the previous study of SARS caused by SARS-CoV which is associated with SARS-CoV-2 as the cause of Covid19, it is due to the ACE-2 receptor equation contained in the two viruses. Research on areas that have data on mortality in China regarding SARS mentions that PM_{10} has a role in increasing the risk of mortality by 84% compared to areas that are not exposed or low exposure (27).

Previous research has also emphasized to bring PM_{10} and $PM_{2.5}$ sooner or later can give damage to one's lungs. This can be due to the effect of the PM exposure to a person's respiratory pathways that increase the inflammation of the respiratory pathways (39). The deaths of the Covid19 majority were in critical condition so that it emerged likely and hypothesized that $PM_{2.5}$ and PM_{10} were correlated to the patient's prognosis and patient severity from mild to severe levels.

Another study in California mentioned that there was a significant link between $PM_{2.5}$ and PM_{10} against the Covid19 case, which refers to the quality of air in California with particulate matter indexes that include high standards including the manufacturing and industrial areas. A correlation test was conducted to evaluate the correlation between environmental pollution determinants and the Covid19 outbreak in California using secondary data obtained from the CDC (*Center of Disease Control*) and the EPA (*Environmental Polution Agency*).

Based on the use of the *Spearman* correlation test and *Kendall* test to analyze the correlations of $PM_{2.5}$, PM_{10}, VOC, Pb, SO_2, NO_2, and CO. With Covid19 cases in California. Results show that environmental pollutants such as PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO have significant correlates with the COVID-19 epidemic in California. PM_{10}, $PM_{2.5}$, SO_2, CO, and NO_2 have a significant correlation to the total cases and total deaths in the state in the correlates of *Spearman* and *Kendall.* However, the magnitude of the correlation coefficient PM_{10}, $PM_{2.5}$, SO_2, Pb, and NO_2 was higher in *Spearman* correlation test. These results indicate that environmental pollutants are significantly corcorrelated with Covid19 cases and deaths in California (41).

The impact of $PM_{2.5}$ with a rate of 1 $\mu g/m^3$ has an association with a 15% increase in the mortality rate of Covid19 (42). Death-rate analysisis caused by Covid19 in China with spatial correlation suggests that higher concentrations of $PM_{2.5}$ and PM_{10} had a positive

correlation with the deaths of Covid19. Other studies have also mentioned that there is a patient's prognosis caused by PM. It was evidenced by the study in Italy, China, and India that supported the invention (41).

Research in China has been the result that a $PM_{2.5}$ effect has a more dominant effect when compared to PM_{10} (29). The risk of getting Covid19 may increase with the exposure of $PM_{2.5}$ size is relatively smaller and easier to get into the airway than PM_{10} so that $PM_{2.5}$ will be more dominant in the cause of health effects.

In the United States, the exposure of $PM_{2.5}$ has long been associated with cardiovascular and respiratory combids which are known to increase the risk of death in patients with Covid19 (41). It encourages the hypothesis that the effects caused by the Covid19 at varying severity are affected by the inflammation associated with pre-existing PM that interferes with the patient's respiratory system. This further strengthened the previous studies, mentioning that the existence of air pollution has been influential in cases of infectious diseases including Covid19 (42).

The time span of display of PM allegedly associated with an increased risk for the infected Covid19 (42). High concentrations of both $PM_{2.5}$ and PM_{10} in a relatively short period of time will affect the health status and risk of the Covid19 infected. This is in line with research in the United States stating that any increase of 1ug/m^3 $PM_{2.5}$ relates to an increase of 8% of the cases of Covid19 deaths (25). It is further noted that $PM_{2.5}$ is inversely proportional to PM_{10} in the incidence of Covid19. The research shows that PM_{10} has a negative association correlation to the incidence of Covid19 and the otherwise positive association correlation is owned by $PM_{2.5}$ (27).

Based on some of the above studies it can be noted that studies in some countries with a fairly high Covid19 case of China, United States and Italy can be identified as having a significant correlation to Particulate Matter with the Covid19 case. This is in line with previous studies indicating that Particulate Matter has a connection to the occurrence of diseases caused by viruses with the transmission of people to people such as influenza and measles in some countries including the United States (43–47). So it can be said if there is a potential that Particulate Matter can be one factor of the Covid19 pandemic.

Studies conducted in several regions in Indonesia have found that when air pollution conditions remain as it is today, the average population of Indonesia has lost 1.2 years of their life expectancy. This is due to the concentration of fine particle elements ($PM_{2.5}$) that fail to meet the WHO guidelines. It can get worse in some areas in Indonesia such as Jakarta which can reduce the life expectancy of the population of 2.3 years and some areas in Sumatra that are in high pollution condition can cut the life expectancy from 4 to 5.6 years if there is no change in $PM_{2.5}$ (48).

The bad pollution condition can certainly be the cause of a more massive transmission of Covid19 when there is no proper strategy in addressing air pollution during a pandemic. Although there has been no studies on the PM with the Covid19 in Indonesia, but referring to some studies that have been discussed previously in some countries that identified the case of the high Covid19 in the world then the same can happen in Indonesia.

The cases of Covid19 relating to the PM allow for a more massive transmission so that a controlling strategy is required. The control strategy that can be taken among them is to improve the monitoring of the PM concentration in the air, and if the concentrate is known to be at the threshold of tolerance, there must be interventions aimed at lowering the value of the concentration.

The government is certainly expected to apply strict regulations in regulating environmental pollution so as to maintain the environment to remain healthy for the community. The management of waste from the activities of the industry and the community in daily life need to be reemphasized, in addition it is required mapping the region to see areas with high and low PM pollution. It is used to make regulations and handling policies based on region conditions.

The limitations in the study article are that this article describes the PM as the driving force of the Covid19 transmission in the air with a secondary database obtained from the relevant article sources in English, it is due to the lack of research in Indonesia regarding PM with the transmission of Covid19. In addition, there are limitations on some sources of scientific articles on this research, which have an association with the scaffolding factor on the research, but it is trying to be controlled by involving several factors to suppress the existence of the Scafu factor. Another thing is the article used in the review of this article is the result of the research where the Covid19 still occurs so that the need of advanced research to further clarify the flow of transmission Covid19 in the air through the PM.

Excellence in this review article is the absence of a review article on the PM in support of the tranmission Covid19 in the air so that it could be the basis of research development in Indonesia regarding the PM and Covid19.

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CONCLUSION

Covid19 is one of the infectious diseases caused by the SARS-CoV-2 virus which attacks the human respiratory tract. Covid19 in humans can cause impaired infections in the respiratory with mild to severe symptoms. The transmission of this virus occurs from human to human transmission through droplet. Air pollution is thought to contribute to the Covid19 case and can be a factor that worsens the condition of the person with the Covid19. Based on previously known studies if Particulate Matter exposure of both PM_{10} and $PM_{2.5}$ sizes have the possibility of lowering the function of the lung organs.

Particulate matter particles containing certain chemical compounds can release toxic molecules in the form of pathogenic microorganisms, spores or particles containing viruses. The presence of pathogenic microorganisms in the body will cause pathogenic microorganisms and decrease body immunity. Studies in some countries with a fairly high Covid19 case that is China, United States and Italy can be identified that there is a meaningful correlation between Particulate Matter and the Covid19 case. The case of Covid19 relating to Particulate Matter, allows for a more massive transmission, so it is necessary to control strategy. The control strategy that can be taken in between is to improve the monitoring of Particulate Matter concentrations in the air.

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