

Pollution and Stunting (Case Study at DKI Jakarta)

Dudi Duta Akbar

dudi.ddb@bsi.ac.id

Universitas Bina Sarana Informatika

ABSTRACT

Air pollution causes death, death due to illness, disability, or premature death in Jakarta. It is strongly associated with non-communicable diseases (NCDs), including chronic cardiovascular and respiratory diseases and lung cancer. Bad impact on human health. huge burden on the health sector and the country's economy. Children are at special risk from air pollution because of their organs, the relationship between air pollution and children's health and development has been proven. The impact of air pollution contributes to the prevalence of stunting. The results of this literature study found and at least estimated that air pollution has the potential to cause death, increased hospitalization due to cardio-respiratory diseases, and a greater increase in health problems, namely children every year in Jakarta. The total economic burden caused by air pollution is estimated at USD 2943.42 million (2.2% of its GDP) in 2019. Tracking provides the right evidence needed to guide city policy makers in prioritizing clean air actions to be taken to improve public health.

Key words: Air Pollution, Pollution and Stunting, Stunting Problem, DKI Jakarta

INTRODUCTION

The global evidence on the health impacts stemming from air pollution is consistent and clear that air pollution is a major threat to the health of more than 10.5 million people in Jakarta. Based on data from the Jakarta Provincial Environmental Agency, the annual ambient PM2.5 concentration in Jakarta is the highest among all urban centers in Indonesia. The World Health Organization (WHO) has stated that air pollution is one of the major environmental risks to health, causing morbidity and death, including cancer, cardiovascular disease and respiratory disease (Syuhada et al. 2023)

In 2019 the Global Burden of Disease (GBD) Study estimated that air pollution caused 5,054 deaths (or 54 per 100,000 people) and 168,000 died due to illness, disability or premature death in Jakarta. Air pollution is strongly associated with non-communicable diseases (NCDs), including cardiovascular and chronic respiratory diseases and lung cancer (Abbaftati et al. 2020), which has a negative impact on human health. huge burden on the health sector and the country's economy (Ministry of Health of Republic of Indonesia. n.d.). In Jakarta, NCDs accounted for 79% (36,000 deaths) of total deaths in 2019 (IMHE 2015).

Recognized by WHO as a “neglected health emergency for children worldwide”,

air pollution can be severe, especially for children living in low- or middle-income countries, where air quality levels far exceed WHO health-based guidelines (World Health Organisation (WHO) 2018). Children are at particular risk from air pollution because their organs (e.g. heart and lungs) and systems (e.g. respiratory and cardiovascular) are still developing. Additionally, they inhale more air per kilogram of body mass because they have a higher respiratory rate than adults (American Lung Association n.d.). There is also growing evidence linking air pollution to child stunting and adverse birth outcomes such as low birth weight and premature birth. Developmental setbacks in children resulting from these early life impacts have lasting impacts throughout their lives.

The impact of air pollution contributes to the prevalence of stunting. Bhagowalia found that building a kitchen in the living room increased the chances of stunting. Mishra and Retherford found the impact of solid fuel use on the prevalence of anemia and stunting among children. The negative health consequences of exposure to household air pollution also contribute to acute respiratory problems and cigarette smoke has a negative impact on fetal head size. Outdoor air pollution is associated with children's growth and cognitive and physical health. The dangerous gas emissions produced by the kiln have an impact on children who live near the kiln (Sinaga et al. 2022). Among the 13 types of factory work, working in a clay brick kiln is one of the largest sources of family income for villagers. Therefore, clay brick kilns are easy to find in villages throughout Indonesia. However, this will be a challenge for the Indonesian government in reducing the prevalence of stunting from 30.7% to 14.0% in 2024. In addition, the number of newborns with birth length less than 48 cm increased from 20.2% to 22, 7% (Sinaga et al. 2022)

The current literature review study fills the current information gap by examining more of the health impacts of air pollution and stunting on children, for example infant mortality, low birth weight, and premature birth, and so on. Apart from that, to understand the many problems related to pollution. The impact of air pollution contributes to stunting, potentially in developing countries and recognized by WHO as a "health emergency" worldwide, air pollution can be severe, especially for children living in low- or middle-income countries, where air quality levels are far from exceeds WHO health-based guidelines (*World Health Organisation (WHO) 2018*). This writing aims to identify problems and aims to reveal the relationship and impact on various things, where this will be explored using the PRISMA method. Understanding the problem of stunting is very necessary, considering the limited literature reviews relating to the impact of pollution and stunting on the problems that accompany it. This has an impact on the level of welfare of DKI Jakarta residents

LITERATURE REVIEW

Nutritional problems among children under five are still a major problem in the population order. Nutritional problems in toddlers include stunting, wasting and overweight (United Nations Children's Fund (UNICEF) 2020). Stunting is still a

major nutritional problem in developing countries like Indonesia. Stunting or chronic malnutrition is a nutritional problem caused by a lack of nutritional intake from food that lasts for a long time (Andriani, Rezal, and Nurzalmariah 2020). Short (stunting) toddlers are seen from body length or height that is less than -2 SD according to the WHO global reference for children compared to other children their age (Unicef and WHO 2013).

According to WHO, the prevalence of toddlers experiencing stunting in the world is 21.9%. Most of these stunted toddlers come from Asia (World Health Organization, 2020). Based on data from the 2021 Indonesian Toddler Nutrition Status Survey (SSGBI), the prevalence of stunted toddlers in Indonesia decreased from 2019 to 2021, namely from 27.67% to 24.4%. Handling the incidence of stunting is one of the national development priorities described in the 2020–2024 RPJMN, the government's target is to reduce the prevalence of stunting to 14% by 2024 (National Development Planning Agency, 2019).

Research by Siringoringo, et al suggests that the factors that influence the incidence of stunting in toddlers are age, birth length, adequate levels of protein, carbohydrates, vitamin A, calcium, zinc and iron. The level of protein adequacy is the main factor causing stunting in children. In an effort to reduce the prevalence of stunting, the government issued many programs to make it happen. The efforts made by the government are to prevent and reduce direct disturbances (specific nutritional interventions) to indirect disturbances (sensitive nutritional interventions). The priority targets of this effort are people involved in the First 1000 Days of Life (HPK), namely pregnant women, breastfeeding mothers and children aged 0–2 years. While the important targets are children aged 24–59 months, adolescents and women of childbearing age (Satriawan, 2018).

The relationship between air pollution and children's health and child development has been proven. Recently, several studies have found that household air pollution, indoor solid fuels, and kitchen smoke exposure negatively impact children's health including anthropometric measurements. A study conducted by Bobak et al. which revealed that the effect of air pollution on children's height begins at the age of 2 years and becomes apparent at the age of 7 years (Sinaga et al. 2022). The impact of air pollution contributes to 3–9% of stunting prevalence. Bhagowalia found that building a kitchen in the living room increased the likelihood of stunting (Sinaga et al. 2022).

In making policies, the government cannot rely on just one research result. However, data from several studies is needed which can be used as a background for policy making. Therefore, research is urgently needed that can present comprehensive facts regarding stunting prevention programs in Indonesia, so that this research is useful for the government in making policies regarding stunting prevention programs that are more precise and efficient. Systematic review research aims to identify published research results in order to interpret the data comprehensively (Rosmalina et al., 2018).

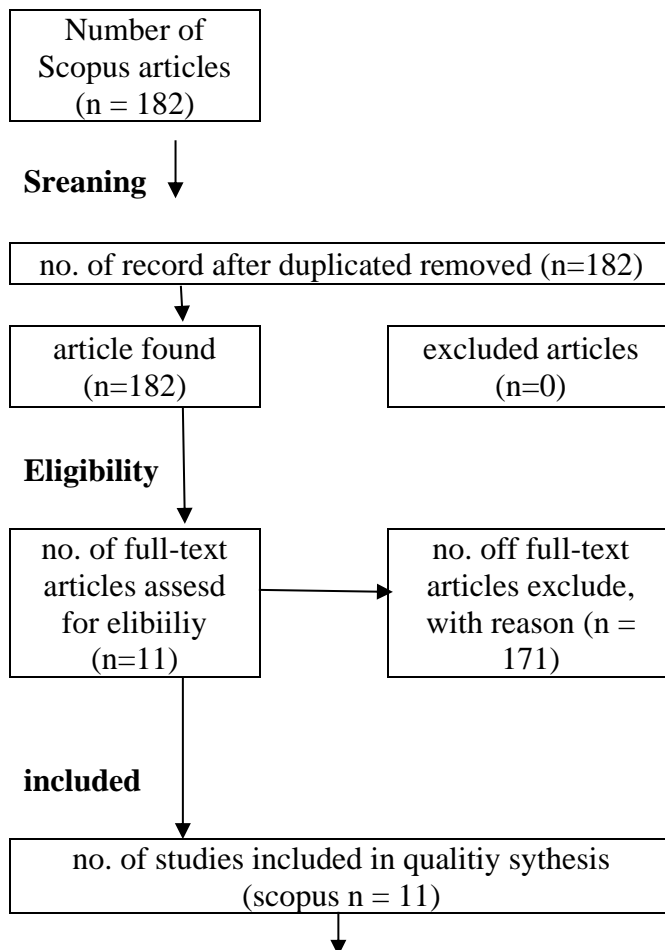
Previous Related Study

This literature review method is a systematic literature review, a literature review method to better understand the many discussions about pollution and stunting and the problems that accompany them. This study provides a systematic review to better characterize pollution and stunting using bibliometric data with keywords and then filtering, assessing, and synthesizing existing empirical studies. Identify previous research using the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) method (Moher et al. 2009).

Scope of Review

The scope of this systematic literature review is limited to empirical studies of stunting and pollution with 182 articles in the document, then excluded by the year category which is limited to, subject area, document by affiliation, document by year, document by author and the category of only articles in English.

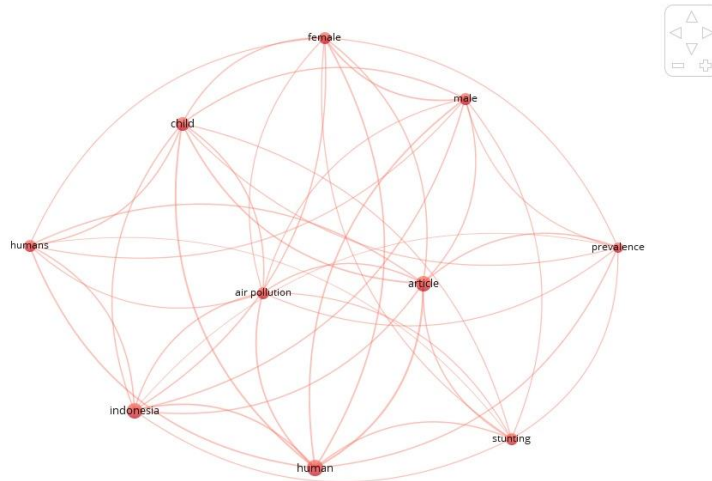
Identification



no. of studies included in quantitative synthesis
(meta_analysis) n = 8

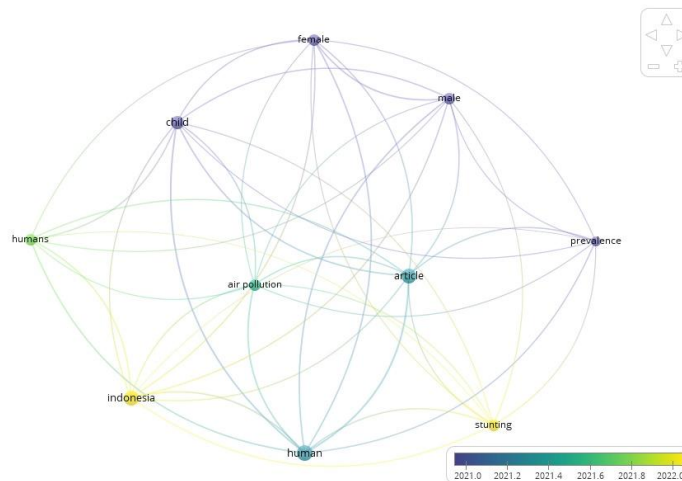
The search results obtained 182 documents, then by processing data or data analysis using Scopus, 11 documents were obtained, then by using Vos Viewer to see trends and similarities in keywords, 3 co-occurrences were obtained as follows.:

Figure 1
Network Visualization



The topic of discussion of pollution and stunting was found to be a specific discussion discussing this relationship related to human air pollution, namely men and women in Indonesia, related to existing stunting.

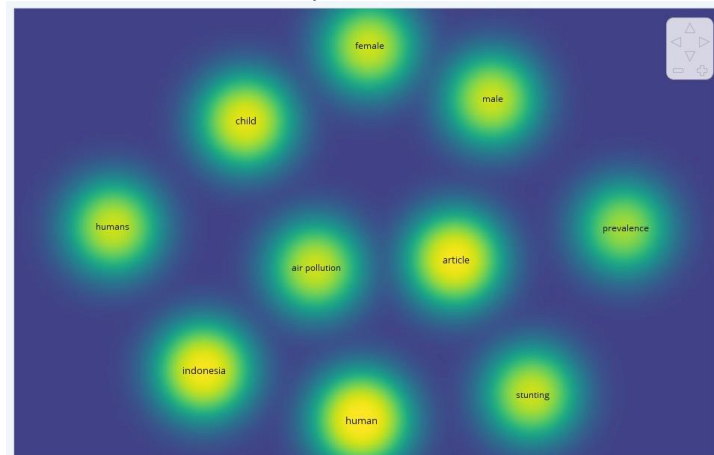
Figure 2
Overlay Visualization



The visualization above is based on the latest year which discusses pollution caps and stunting found in the period 2021 to 2022, the latest research closely discusses the keyword stunting in Indonesia, indicating an increase in the number of cases studied.

Figure 3

Density Visualization



Based on density visualization, there are many topics of discussion based on these keywords, namely humans in Indonesia and stunting, which has a high number of existing studies.

Figure 4.

Keywords that have the same topic of discussion

Create Map ×

Verify selected keywords

Selected	Keyword	Occurrences	Total link strength
<input checked="" type="checkbox"/>	human	7	37
<input checked="" type="checkbox"/>	article	6	31
<input checked="" type="checkbox"/>	child	5	28
<input checked="" type="checkbox"/>	female	4	25
<input checked="" type="checkbox"/>	indonesia	6	25
<input checked="" type="checkbox"/>	male	4	25
<input checked="" type="checkbox"/>	air pollution	4	23
<input checked="" type="checkbox"/>	humans	4	20
<input checked="" type="checkbox"/>	stunting	4	19
<input checked="" type="checkbox"/>	prevalence	3	17

The closeness of the topic regarding pollution and stunting is a minimum of three keywords in each article, the top 10 rankings are obtained, namely related to the keyword human with 7 occurrences, article categories. Meanwhile, the three largest are occupied by children from the closeness of keywords with the theme of stunting and pollution. Next is the Indonesian keyword co-occurrence, water pollution and stunting.

Document by subject area :

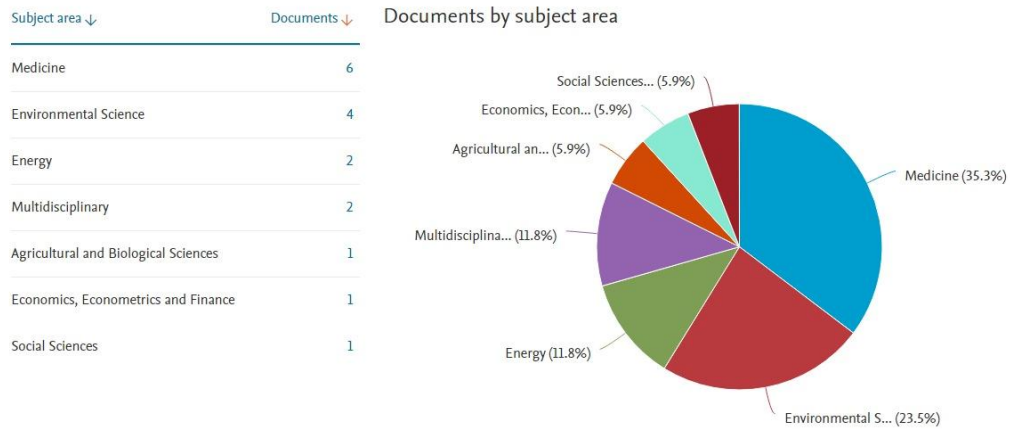
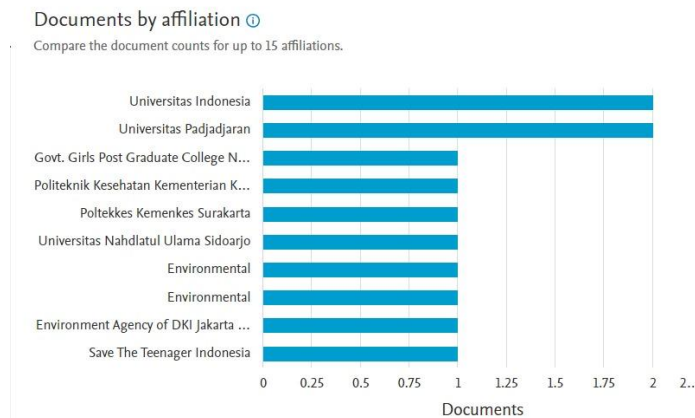


Chart 1



The top three sequences that have the highest relevance are:

Tabel 1

Document title	Authors	Source	Year	Citations
<input type="checkbox"/> 1 Article • Open access Length Attainment and Stunting Prevalence of Children aged 0–24 Months Living in the Area of Clay Brick Kilns in Pagar Merbau Sub District, Indonesia	Sinaga, H.T., Achmad, N., Manalu, M., Perangin-Angin, S., Doloksaribu, L.G.	Open Access Macedonian Journal of Medical Sciences, 10, pp. 155–160	2022	1
<input type="checkbox"/> 2 Article • Open access Cigarette Smoke Exposure and Stunting Among Under-five Children in Rural and Poor Families in Indonesia	Muchlis, N., Yusuf, R.A., Rusydi, A.R., ...Qanitha, A., Ahsan, A.	Environmental Health Insights, 17	2023	0
<input type="checkbox"/> 3 Article • Open access Cigarette smoke exposure and increased risks of stunting among under-five children	Astuti, D.D., Handayani, T.W., Astuti, D.P.	Clinical Epidemiology and Global Health, 8(3), pp. 943–948	2020	6

The order of the top three that have the highest relevance are: Eleven studies that were obtained for analysis, the increase in research each year is illustrated in the

graph below:

Figure 5

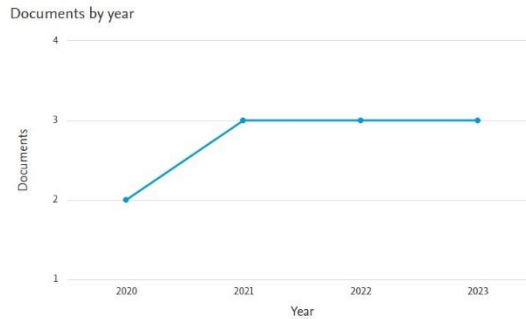


Figure 6

Year ↓	Documents ↑
2023	3
2022	3
2021	3
2020	2

Table 1.
Artikel to analyzed

The total number of articles analyzed was 11 articles, seen in the table below

Publication Year	Author	Title
2022	Setyari, N.P.W.; Sukadana, I.W.; Saskara, I.A.N.; Suasih, N.N.R.	The Impact of Clean Water Access on Children's Performance in Indonesia
2020	Folayan, M.O.; El Tantawi, M.; Schroth, R.J.; Kemoli, A.M.; Gaffar, B.; Amalia, R.; Feldens, C.A.	Association Between Environmental Health, Ecosystem Vitality, and Early Childhood Caries
2021	Mecheva, M.D.V.; Rieger, M.; Sparrow, R.; Prafiantini, E.; Agustina, R.	Snacks, nudges and asymmetric peer influence: Evidence from food choice experiments with children in Indonesia
2022	Sinaga, H.T.; Achmad, N.; Manalu, M.; Perangin-Angin, S.; Doloksaribu, L.G.	Length Attainment and Stunting Prevalence of Children aged 0–24 Months Living in the Area of Clay Brick Kilns in Pagar Merbau Sub District, Indonesia
2022	Khalil, L.; Abbas, S.; Hussain, K.; Zaman, K.; Salamun, H.; Hassan, Z.B.; Anser, M.K.	Sanitation, water, energy use, and traffic volume affect environmental quality: Go-for-green developmental policies

2023	Syuhada, G.; Akbar, A.; Hardiawan, D.; Pun, V.; Darmawan, A.; Heryati, S.H.A.; Siregar, A.Y.M.; Kusuma, R.R.; Driejana, R.; Ingole, V.; Kass, D.; Mehta, S.	Impacts of Air Pollution on Health and Cost of Illness in Jakarta, Indonesia
2021	Purwanto, S.K.; Sinaga, O.	Exploring the relationship between fossil fuel energy consumption, renewable energy consumption and human capital index: A study from Thailand
2020	Astuti, D.D.; Handayani, T.W.; Astuti, D.P.	Cigarette smoke exposure and increased risks of stunting among under-five children
2021	Murtyas, S.; Kusumaningdyah, N.H.; Toosty, N.T.; Hagishima, A.	Relation between occupants' health problems, demographic and indoor environment subjective evaluations: A cross-sectional questionnaire survey study in Java Island, Indonesia
2023	Farahdiba, A.U.; Warmadewanthi, I.D.A.A.; Fransiscus, Y.; Rosyidah, E.; Hermana, J.; Yuniarto, A.	The present and proposed sustainable food waste treatment technology in Indonesia: A review
2023	Muchlis, N.; Yusuf, R.A.; Rusydi, A.R.; Mahmud, N.U.; Hikmah, N.; Qanitha, A.; Ahsan, A.	Cigarette Smoke Exposure and Stunting Among Under-five Children in Rural and Poor Families in Indonesia

METHOD

Design and Samples

Identify previous research using the Preferred Reporting Items for Systematic Reviews and Meta Analysis (PRISMA) method (Moher et al. 2009). Inclusion Criteria and Exclusion Criteria. Article inclusion criteria used: 1) Articles that describe stunting and air pollution 2) Articles published in English. 3) Published in 2020-2023 by the Scopus publisher manager.

Instrument and Procedure

Search Flow. The search was carried out using the database <https://www.scopus.com/> with the keywords the AND impact AND of AND air AND pollution AND stunting AND PUBYEAR > 2019 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all")) , there were 182 English articles published in journals which is indexed by Scopus. The articles that appear are then sorted so that no articles with the same title are found. Then the articles were sorted based on predetermined inclusion and

exclusion criteria. Articles to be analyzed specifically for the Indonesian context, with the keywords the AND impact AND of AND air AND pollution AND stunting AND PUBYEAR > 2019 AND PUBYEAR < 2024 AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (OA , "all")) AND (LIMIT-TO (AFFILCOUNTRY , "Indonesia")). There were 11 articles discussing topics based on the keywords air pollution and stunting in DKI Indonesia and some in Jakarta.

Data Analysis

Article extraction. The articles that have been obtained are then analyzed. analysis of articles based on the year of publication from 2020 to 2023, document by affiliation, then document by author, article author, year of publication of article, number of samples used, measurement tools used, results of research conducted, and article database.

RESULT AND DISCUSSION

In this study, the long-term impact of air pollution is defined as the health burden caused by annual exposure to air pollution. The health outcomes treated included adverse effects on children and total mortality, including six deaths from any cause.

Short Term Impact of Air Pollution

Short-term impacts are defined as the health burden caused by changes in air pollution exposure in the short term (in days). In this study, total daily hospitalizations due to cardiovascular and respiratory diseases associated with short-term air pollution exposure were estimated. Daily hospitalization data in 2018 was obtained from the Health and Social Security Agency. Next, categorize the causes of hospitalization into larger groups, namely for cardiovascular disease and for respiratory disease. Daily exposure to air pollution is associated with more than 5000 hospitalizations a year. Exposure to PM_{2.5} could result in nearly 3,500 people being hospitalized; 87% of PM_{2.5}-related admissions were due to cardiovascular disease. On the other hand, exposure to high levels of O₃ can cause more than 1500 hospitalizations among people aged 65 years and over, of which 83% are due to cardiovascular disease (Syuhada et al. 2023).

Economic Losses Health Impacts of Air Pollution

The total cost per year of health impacts due to air pollution reaches around USD 2943.42 million, equivalent to 2.2% of DKI Jakarta Province's GRDP. The findings from this research show that economic losses due to deaths and diseases related to PM_{2.5} and O₃ are around 2.2% of the GDP of Jakarta Province. This is lower than the national estimate calculated by the World Bank, which estimated economic losses from PM_{2.5}-related health damage in 2019 at USD 220 billion (6.6% of Indonesia's GDP) which found economic losses at USD 96.4 billion (or 3.5% of the Indonesian economy) in 2015. However, a more prominent problem is the permanent impact of several health impacts. The study highlights that the city of

East Jakarta had the highest economic losses, namely USD 790.94 million in 2019, in line with the severity of the health impacts. The death cost of around 11 billion Rupiah is about a quarter of the total death cost in the entire Jakarta Province. The city of East Jakarta also has the highest stunting and hospitalization costs, which require more attention. There is limited local evidence about the burden of air pollution and the associated monetary costs in Jakarta (Syuhada et al. 2023).

Outdoor and indoor pollution

Next is the relatively few studies that have focused on the relationship between outdoor pollution and height gain in children. In the findings, to assess the negative impact of smoke that produces heavy particles on the growth duration of children under 2 years. The study found that only at certain ages, especially 0–12 months, children can reach the median WHO age standard for height. The average birth length of children in both study areas was normal (>49 cm). That is, even though the mother has been contaminated with heavy particles from outdoor pollution and does not have a negative impact on the growth and development of the baby. However, by 12–24 months of age, the negative impacts of outdoor pollution may already be present.

Stunting relevance to smoking

Other research shows that the high prevalence of children who live with parents who smoke and fathers who smoke are exposed to smoking the most, followed by relatives such as older brothers or neighbors. The high prevalence of smoking can contribute to an increase in the prevalence of stunting. This is because cigarettes or other tobacco products can contribute a lot to household expenses among low-income families.

The findings conclude that the high prevalence of children in rural areas and poor families living with smoking parents and smoking fathers accounts for the majority of exposure to cigarettes. In addition, most children live exposed to cigarette smoke for a long time, more than 3 hours per day at home. Independent predictors of stunting in children under 5 years are fathers who smoke, are exposed to cigarette smoke for more than 3 hours a day and use traditional or kretek cigarettes. Significant tobacco control policies should be promoted and implemented to reduce the potential long-term impact of smoking mothers or fathers on future generations.

CONCLUSION

The results of this literature study found and at least estimated that air pollution has the potential to cause more than 10,000 deaths, more than 5,000 hospitalizations due to cardio-respiratory diseases, and more than 7,000 health problems in children every year in Jakarta. The total economic burden caused by air pollution was estimated at USD 2943.42 million (2.2% of its GDP) in 2019. By using local data to measure and assess the health and economic impacts of air pollution in Jakarta, both figures death and adverse effects on health. impact on children, our research provides the timely evidence needed to guide city policymakers in prioritizing clean

air actions that should be taken to improve public health. Estimates of future productivity loss caused by stunting indicate high economic losses. Urban conditions are a big problem that needs to be addressed to achieve sustainable development goals (SDGs); with a special focus on good health and well-being, the need to promote decent living standards, long and healthy lives, and education. Therefore, a more aggressive approach to pollution control is urgently needed.

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