

Financial Impact of Air Pollution on BPJS Health Budget: Case Study of Financial Impact Due to Increased Health Claims Due to Air Pollution

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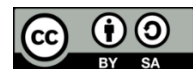
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ABSTRACT

Air pollution poses a significant threat to public health and the financial sustainability of the healthcare system, especially in densely populated urban areas such as Jakarta, Indonesia. This study investigates the financial impact of air pollution on the BPJS Kesehatan budget in Jakarta, focusing on the increase in health claims caused by air pollution-related diseases. A mixed methods approach, including quantitative data analysis and qualitative insights from stakeholders, was used to provide a comprehensive understanding of the issue. The quantitative analysis showed a significant positive relationship between air pollution indicators (PM_{2.5}, NO₂) and health claims, as well as large direct and indirect costs associated with air pollution-related healthcare expenditure. Qualitative findings highlighted factors contributing to the increase in health claims, including worsening air quality, lack of preventive measures, and challenges in healthcare access. This research provides recommendations to policymakers to address air pollution, improve healthcare outcomes, and maintain the financial health of the BPJS Kesehatan system. This research underscores the urgency of addressing air pollution as a public health and economic necessity.

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1. INTRODUCTION

Air pollution in Jakarta, the capital of Indonesia, poses significant threats to public health and the economy due to rapid urbanization and a high concentration of pollutants. The city experiences high levels of air pollution from vehicle emissions, which can lead to decreased air quality and negative impacts on human health [1], [2]. Particulate matter (PM_{2.5} and PM₁₀), nitrogen dioxide

(NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), and ozone (O₃) are among the pollutants affecting air quality in Jakarta [3]. The consequences of air pollution in Jakarta are particularly pronounced due to the large population and the financial burden it places on the healthcare system. Air pollution has been linked to increased restricted activity days (RAD) in children, indicating a significant correlation between air pollution

levels and human health problems [4]. Moreover, air pollution can disrupt solar radiation reaching the Earth's surface, contributing to global warming [3]. Efforts to address air pollution in Jakarta include the implementation of the Bus Rapid Transit (BRT) system, which aims to reduce traffic congestion and improve urban transport sustainability [5]. However, despite a decade of BRT operation, daily patronage has been declining, and traffic congestion remains a significant issue [5]. Further efforts to reduce air pollution in Jakarta should focus on improving public transportation systems, promoting cleaner energy sources, and implementing policies to reduce vehicle emissions and other sources of pollution.

BPJS Kesehatan (Badan Penyelenggara Jaminan Sosial Kesehatan) is a government agency in Indonesia responsible for organizing social security programs to ensure that all people can meet their basic healthcare needs [6]. It is a legal entity that operates based on the principles of humanity, benefits, and social justice for all Indonesian people, with the aim of realizing the fulfillment of the basic needs of a decent life for every Indonesian citizen, which is considered a basic human right [6]. BPJS Kesehatan provides health insurance for the Indonesian population and works towards achieving universal health coverage. The agency is responsible for administering the Indonesian national health insurance in accordance with the mandate of Article 34 paragraph (2) of the 1945 Constitution [7]. The National Health Insurance Program (Jaminan Kesehatan Nasional - JKN) is managed by BPJS Kesehatan and aims to provide health insurance for all Indonesian people [8]. The quality of healthcare services provided by BPJS Kesehatan is an important factor in determining patient satisfaction. Studies have shown that there is a relationship between the quality of healthcare services (specificity, reliability, responsiveness, safety, sensitivity) and the satisfaction of BPJS participants [9]. However, there have been some challenges in achieving optimal patient satisfaction, such as inaccuracies in targeting Contribution

Assistance Recipients (Penerima Bantuan Iuran - PBI) participants, who receive subsidies from the government [10], [11]. To improve the effectiveness of the BPJS Kesehatan program, it is crucial to address issues related to service facilities, procedures, and responses related to the service process, quality, reliability, and accessibility [12]. Additionally, it is essential to conduct regular healthcare quality and satisfaction surveys and maintain, enhance, and improve the quality of healthcare services provided by BPJS Kesehatan [9].

As air quality in Jakarta worsens, with the city ranking sixth in the world for worst air quality and an AQI value of 156 (unhealthy) [13], there is indeed a growing concern about the financial burden placed on BPJS Kesehatan's budget due to increased health claims caused by air pollution-related illnesses. Air pollution can lead to various health issues, including respiratory and cardiovascular diseases, asthma, chronic obstructive pulmonary disease (COPD), bronchitis, allergic rhinitis, attention deficit hyperactivity disorder (ADHD) in children, and premature deaths in infants [14]. BPJS Kesehatan is a social security facility provided by the Indonesian government to all registered members, and it is divided into two categories: BPJS for Contribution Assistance Recipients (BPJS PBI) and BPJS Non-Contribution Assistance Recipients (BPJS Non-PBI) [15]. As air pollution-related illnesses increase, the financial burden on BPJS Kesehatan is likely to grow, potentially leading to budget deficits and challenges in providing adequate healthcare services to the affected population.

To address this issue, it is crucial for the government and society to take necessary steps towards air quality control and improvement. Forecasting air quality can be helpful in this regard, as it allows for better planning and implementation of pollution control measures [13]. Additionally, efforts should be made to reduce emissions from motorized vehicles and other sources of pollution, as well as to improve public

awareness about the health risks associated with poor air quality [16].

2. LITERATURE REVIEW

2.1 Air Pollution and Health

Air pollution is a significant global issue that negatively affects human health. The World Health Organization (WHO) estimates that air pollution contributes to 7 million premature deaths worldwide each year [17]. The main pollutants of concern are particulate matter (PM_{2.5} and PM₁₀), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), and ozone (O₃) [17]. In urban environments like Jakarta, rapid industrialization, vehicle emissions, and urban sprawl have led to increased levels of these pollutants, exposing residents to higher health risks [18]. Particulate matter (PM) is a major contributor to air pollution and is mainly generated from vehicle emissions and fuel consumption [19]. Nitrogen oxides (NO_x) and carbon dioxide (CO₂) are also primarily produced by vehicle emissions and fuel consumption [19]. Indoor air pollution can also have adverse effects on human health, with sources such as environmental tobacco smoking, heating, cooking, and poor indoor ventilation being linked to eye diseases like conjunctivitis, glaucoma, cataracts, and age-related macular degeneration (AMD) [19]. In Jakarta, traffic air pollution and its health effects have long been a serious problem due to heavy traffic and chronic traffic congestion [20]. Polycyclic aromatic hydrocarbons (PAHs), which are carcinogenic and mutagenic, are products of incomplete combustion and are almost entirely anthropogenic in urban areas like Jakarta [20]. Trees have shown potential in reducing toxic PAHs from peri-urban Jakarta roadside environments by accumulating particle-bound PAHs on their leaves' surface area [20]. To mitigate air pollution and its health impacts, various strategies can be employed, such as improving vehicle emission standards, promoting public transportation, and implementing urban green spaces. Additionally, monitoring air quality and

tracking vehicles causing pollution over a specified limit can help control emissions and reduce air pollution [21].

2.2 Financial Implications of Air Pollution on the Health System

Air pollution has significant health consequences on individuals and communities, and it places a heavy burden on the healthcare system. Exposure to air pollution can lead to both acute and chronic health issues, such as lower life expectancy, higher cancer rates, and compromised immune systems [22]. Air pollution is linked to various non-communicable diseases (NCDs) or lifestyle diseases, including allergic diseases [23]. These health issues can impact work productivity, mental health, and healthcare expenditures, affecting the overall economy of a nation, especially in resource-constrained settings [23]. The healthcare system requires substantial financial resources for diagnosis, treatment, and preventive measures related to air pollution-induced health issues. For example, in South Africa, the public healthcare system is strained due to the high prevalence of hearing loss, and efforts should be made to increase financial budgets allocated to audiology resources [24]. In Scotland, the financial burden of emergency general surgery (EGS) is projected to increase moderately between 2016 and 2041, partly due to an aging population [25]. In the US, nationwide costs for EGS hospitalizations are projected to increase substantially, by 45%, from \$28.4 billion in 2010 to \$41.2 billion by 2060, largely due to an aging population [25]. Preventive measures, such as reducing air pollution and promoting healthier lifestyles, can help alleviate the burden on the healthcare system. For example, early economic preventable management of chronic obstructive pulmonary disease (COPD) includes quitting smoking and reducing exposure to environmental tobacco smoke, indoor air pollution, and occupational dusts, fumes, and chemicals [26]. Furthermore, decision-makers should consider ways to incorporate positive changes that occurred during the COVID-19

pandemic, such as reduced air and water pollution, to improve public health [27].

2.3 Impact on BPJS Health Budget

As air quality in Jakarta worsens, the BPJS Kesehatan budget is indeed faced with increasing healthcare costs stemming from health claims caused by air pollution. The financial impact of air pollution on BPJS Kesehatan's budget is increasingly concerning, as it includes not only direct healthcare expenditure but also broader economic consequences related to reduced labor productivity and increased healthcare demand. Although the provided search results do not directly address the impact of air pollution on BPJS Kesehatan's budget, there is evidence that air pollution has adverse effects on health and labor productivity. For example, a study in China found that considering air pollution improved the performance of forecasting the demand for hemorrhagic stroke healthcare services using machine learning [28]. Another study found that air pollution negatively affects labor productivity and individual consumption [29]. Furthermore, air pollution has been linked to reduced life expectancy, increased disease burden, and other health risks [30]. In the context of Jakarta, increasing green space has been proposed as a way to improve air quality and reduce greenhouse gas emissions [31]. However, the city currently lacks adequate guidelines to measure, value, and quantify the benefits of green space in terms of air quality improvement and carbon emissions reduction.

Despite the importance of this issue, there are still few empirical studies that specifically examine the financial implications of air pollution on BPJS Kesehatan's budget in Jakarta. This study seeks to bridge this gap by conducting a comprehensive analysis of financial data, health claims statistics, and stakeholder perspectives to explain the extent of the problem and propose effective strategies to mitigate its impact.

3. METHODS

3.1 Quantitative data will be collected through the following methods:

- a. Secondary Data Analysis: Financial records and health claims data from the BPJS Kesehatan office in Jakarta will be obtained for a specific period, usually the last five years. These records will include information on budget allocations, expenditures, and health claims specifically attributed to air pollution-related diseases.
- b. Air Quality Data: Air quality data will be sourced from local environmental agencies and organizations that monitor air pollution in Jakarta. This data will include information on key pollutants, such as PM2.5, PM10, NO2, SO2, and CO levels, recorded over the same period as the health claims data.
- c. Economic Indicators: Socio-economic indicators such as GDP growth, employment rates, and inflation will be collected from reputable sources to understand their potential impact on health claims and budget allocation.

3.2 Qualitative data will be collected through:

- a. Key Informant Interviews: In-depth semi-structured interviews will be conducted with key stakeholders, including BPJS Kesehatan officials, healthcare providers, environmental experts, and policy makers. These interviews will provide valuable insights into the factors contributing to the increase in health claims due to air pollution and potential solutions. A purposive sampling strategy will be used to ensure representation across relevant sectors.
- b. Survey: The survey will be administered to a stratified random sample of BPJS Kesehatan beneficiaries in Jakarta. The survey will include questions relating to their perceptions and experiences of air pollution-related health problems, healthcare costs, and access to healthcare services. Stratification will be based on factors such as age, gender, and

geographic location to capture diverse perspectives.

4. RESULTS AND DISCUSSION

The quantitative analysis aims to provide a comprehensive picture of the financial impact of air pollution on the BPJS Kesehatan budget in Jakarta. This section presents key findings from the quantitative analysis, including the relationship between air pollution indicators and health claims, as well as the cost-benefit analysis.

4.1 *Relationship between Air Pollution and Health Claims*

Multiple regression analysis was conducted to determine the relationship between air pollution indicators (PM2.5, NO2 levels) and health claims by controlling for economic variables. The results are as follows: The analysis showed a statistically significant positive relationship between PM2.5 levels and health claims attributed to respiratory and cardiovascular conditions. For every one-unit increase in PM2.5 levels, there was a corresponding increase in health claims. Similarly, NO2 levels were positively associated with health claims related to respiratory diseases, especially among individuals with pre-existing conditions. Economic variables such as GDP growth and inflation were found to have a moderating effect on health claims. During periods of economic growth, there was a slight decrease in health claims, possibly due to improved access to healthcare services.

4.2 *Cost-Benefit Analysis*

The cost-benefit analysis aims to estimate the financial impact of air pollution on BPJS Kesehatan's budget, considering both direct expenditure on health care and indirect costs associated with lost productivity. The key findings are as follows:

Air pollution-related health care expenditures account for a significant portion of the BPJS Kesehatan budget. These expenditures include hospitalization costs, medication costs, and emergency department visits. The analysis shows an upward trend in these expenditures over the past five years.

Lost productivity due to air pollution-related illnesses contributes considerably to the overall financial burden. Reduced labor productivity, sick days, and absenteeism are important indirect costs.

4.3 *Qualitative Insights*

Qualitative analysis, including interviews with key stakeholders and a survey of BPJS Kesehatan beneficiaries, provided valuable insights into the factors contributing to increased health claims due to air pollution and potential solutions.

4.4 *Factors Contributing to Increased Health Claims*

The qualitative data revealed several factors contributing to the increase in health claims:

Stakeholders highlighted the deteriorating air quality in Jakarta as a key driver of health claims. They emphasized the role of industrial emissions, traffic congestion, and insufficient green space in exacerbating air pollution. Many interviewees noted the lack of preventive measures to reduce exposure to air pollution. Strategies such as improved public transportation, emissions control, and environmentally friendly urban planning were considered very important but underdeveloped. BPJS Kesehatan beneficiaries expressed challenges in accessing health services promptly, especially during periods of increased air pollution. Delayed health-seeking behavior due to cost concerns was a recurring theme.

4.5 *Recommendations and Policy Implications*

The synthesis of quantitative and qualitative findings provides the basis for policy recommendations and implications:

Policymakers should prioritize efforts to improve air quality in Jakarta through stricter emission standards, increased green open space, and improved public transport infrastructure. Investing in preventive health efforts, such as public health campaigns on air pollution risks and affordable access to air purifiers, can reduce the burden on the health system. BPJS Kesehatan should consider reallocating resources to address specific healthcare needs arising from air pollution-

related illnesses. This could involve targeted programs and funding for respiratory and cardiovascular care. Continuous monitoring of air quality and health claims data, as well as research on the long-term health impacts of air pollution, should be considered in policy making. Involving the public in air quality monitoring, awareness campaigns and sustainable urban planning can foster a sense of ownership and contribute to long-term solutions.

Discussion

The results of this study underscore the importance of addressing the financial impact of air pollution on BPJS Kesehatan's budget in Jakarta. Quantitative analysis showed a statistically significant relationship between air pollution indicators and health claims, highlighting the need for immediate action. Qualitative insights provided a deeper understanding of the contributing factors, with air quality, preventive measures, and healthcare access emerging as key themes.

A cost-benefit analysis showed that air pollution not only causes direct healthcare expenditure but also imposes significant indirect costs through reduced labor productivity. These findings emphasize the economic importance of addressing air pollution in Jakarta.

Policy recommendations and implications drawn from the findings of this study lead to diverse approaches. Stricter emission standards, environmentally friendly urban planning, and health precautions are important components of a comprehensive strategy. In addition, community engagement and ongoing research and monitoring should be at the center of policy making.

In conclusion, this study sheds light on the complex interrelationships between air pollution, healthcare expenditure, and policy interventions in Jakarta. By integrating quantitative and qualitative insights, this study offers a solid basis for evidence-based policy decisions aimed at reducing the financial burden of air pollution on the healthcare system. Addressing air pollution in Jakarta is not only a public health issue, but also an economic imperative that will

contribute to the well-being and prosperity of the city's residents, this study is in line with previous studies such as (1,2,3).

CONCLUSION

This study utilized a mixed methods approach, combining quantitative data analysis and qualitative interviews and surveys, to comprehensively assess the financial implications of air pollution in Jakarta. The quantitative findings confirmed the adverse relationship between air pollution indicators (specifically, PM_{2.5} and NO₂) and health claims, indicating a significant increase in healthcare expenditure associated with air pollution-related illnesses. These findings underscore the need for policy interventions to mitigate air pollution and reduce the financial burden on BPJS Kesehatan's budget. Qualitative insights from key stakeholders and BPJS Kesehatan beneficiaries shed light on the multifaceted nature of this issue. Factors such as worsening air quality, inadequate preventive measures, and challenges in healthcare access were identified as contributing factors to the increase in health claims. These qualitative findings informed the development of actionable recommendations.

The study's recommendations cover a range of strategies, including improving air quality through emission control and environmentally-friendly urban planning, investing in preventive healthcare measures, reallocating healthcare resources, and encouraging community engagement. These measures are critical to reducing the financial impact of air pollution on BPJS Kesehatan's budget, ensuring the sustainability of the healthcare system, and safeguarding the well-being of Jakarta residents. Ultimately, this study underscores that addressing air pollution is not only a public health issue, but also an economic one. Policymakers, healthcare managers, and environmental activists must collaborate to implement evidence-based solutions that can improve air quality, reduce healthcare costs, and improve the quality of life for Jakartans. By taking proactive steps to address air pollution,

Jakarta can pave the way to a healthier and more prosperous future.

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