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Analysis of the Association between Education and Public Understanding of Air Pollution in Serang City

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Keywords

Air pollution; Correlation analysis; Education level; Public understanding; Serang City

Abstract

Air pollution is an important environmental and public health issue in urban areas, including Serang City. This study aimed to analyse the association between education level and public understanding of air pollution. A quantitative approach was applied using a validated and reliable questionnaire administered to 400 respondents in Serang City. The instrument consisted of nine items measured on a five-point Likert scale. Validity and reliability were assessed using Pearson correlation and Cronbach's alpha, respectively, and the data were analysed using the Spearman Rank correlation test. The results showed no significant association between education level and public understanding of air pollution. These findings indicate that formal education alone does not determine public understanding of air pollution. Therefore, efforts to improve public understanding should extend beyond formal education through accessible environmental information, public education, digital platforms, and community-based initiatives.

INTRODUCTION

Air pollution is defined as the presence of pollutants in the atmosphere at concentrations or for durations exceeding natural background levels, thereby posing adverse effects on environmental quality and human health. It is recognised as a major global public health concern, contributing to an estimated 6–7 million premature deaths annually due to exposure to ambient and household air pollution (WHO, 2024). Among the various air pollutants, fine particulate matter (PM2.5), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) are of particular concern because they can penetrate the respiratory system and reach the lower respiratory tract and lung tissues. Prolonged exposure to these pollutants has been associated with an increased risk of chronic health conditions, particularly cardiovascular and respiratory diseases (Manisalidis et al., 2020). High levels of air pollution are associated with an increased risk of health problems, particularly respiratory diseases, notably acute respiratory infections (Paudi & Bidi, 2025). Long-term exposure to air pollution, especially particulate matter (PM2.5), is linked to increased mortality risk and various chronic conditions that negatively affect quality of life (Orellano et al., 2024). These conditions indicate that air pollution is not only an environmental issue but also a serious global public health concern.

In general, air pollution in urban areas is primarily attributed to various anthropogenic activities, including motor vehicle emissions, industrial processes, and open waste burning (Faridawati & Sudarti, 2021). These activities generate a range of hazardous pollutants, including carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and particulate matter, which can significantly reduce air quality (Sulistiani & Kanda S., 2024). In Indonesia, this condition is further increased by population growth and regional development, which drive industrial expansion and land-use changes, thereby contributing to environmental degradation (Masyruroh & Binyati, 2021). Consequently, air pollution remains one of the major environmental

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health issues in Indonesia, particularly in urban areas experiencing rapid growth in transportation and urbanisation (Arif, 2025). Therefore, effective air pollution control is essential for protecting environmental quality and promoting public health.

Serang City, the capital of Banten Province, is experiencing increasingly complex air pollution challenges alongside the expansion of urban activities. These challenges are associated with several factors, including increasing transportation volumes, industrial expansion, and land-use changes that have contributed to the reduction of green open spaces. Such conditions may affect both environmental quality and public health, as reflected in increased perceptions of heat and dust exposure and respiratory health disturbances among local communities (Hasna et al., 2025). In addition, domestic activities, particularly open waste burning, remain an important source of air pollution in residential areas and may contribute to elevated pollutant concentrations (Faridawati & Sudarti, 2021). These findings suggest that local air pollution is influenced by the interaction between broader urban factors, such as urbanisation and industrialisation, and local-scale factors, particularly community practices and behaviours. Public response is a crucial factor, as the success of environmental policies largely depends on public support and behavioural changes in everyday life (Harring et al., 2017). This response is influenced by the level of public understanding of air pollution issues. In line with this, Chen et al. (2024) found that individuals with higher levels of environmental understanding tend to be more willing to actively participate in air pollution control efforts. In this context, public understanding becomes an important factor in supporting the success of air pollution control initiatives. Individuals with a better understanding are more likely to be aware of the impacts of air pollution and to support environmental policies. Public understanding of air pollution is also related to individuals' ability to access, process, and interpret environmental information.

One of the factors frequently considered in socio-environmental studies is education level, as, theoretically, formal education provides individuals with broader access to information and enhances critical thinking skills. In theory, education level plays a role in increasing individuals' cognitive capacity to understand information and in shaping more rational perspectives in responding to environmental issues. Individuals with higher levels of education generally have greater capacity to evaluate information and develop a more comprehensive understanding of environmental issues. However, advances in information technology have broadened access to knowledge, suggesting that the relationship between educational attainment and environmental understanding may not be linear and warrants further empirical investigation (Istifa & Ali, 2025).

In practice, empirical findings on the relationship between educational attainment and individual understanding have yielded mixed results. Martini et al. (2024) found a significant relationship between education level and knowledge of maternal nutrition, supporting the view that education is often associated with levels of understanding. In contrast, Hafilda et al. (2024) reported no relationship between education level and employees' knowledge of indoor air quality during the COVID-19 pandemic. Thus, the relationship between education level and level of understanding may vary depending on the context and the variables measured. This may be attributed to the fact that individual understanding is influenced not only by formal education but also by other factors, including direct experience, exposure to information through various media, and local social and cultural contexts. Consequently, the association between education level and understanding is not always strong or statistically significant.

Previous research by Hasna et al. (2025) examined the level of public understanding of air pollution in Serang City, encompassing aspects of knowledge, perception, and community behaviour related to the issue. The findings indicated that the majority of residents possess a good understanding of the sources of air pollution and demonstrate a relatively high level of awareness regarding its impacts on health and environmental quality. However, the relationship between education level and public understanding has not been specifically examined. Therefore, this study focuses on analysing the relationship between education level and public understanding of air pollution in Serang City. This study aims to provide a more in-depth analysis of how education level relates to public understanding, thereby addressing a gap in the existing literature. The results are expected to complement previous findings and provide more comprehensive empirical evidence to support the development of environmental policies and public education strategies at the regional level.

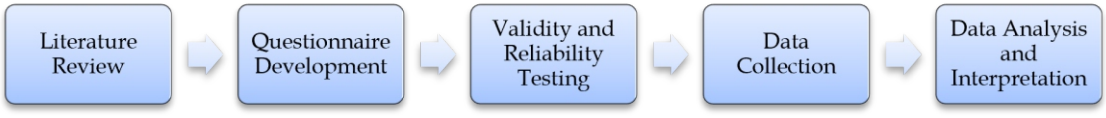
RESEARCH METHOD

This study used a quantitative approach to analyse the association between education level and public understanding of air pollution in Serang City. This approach was chosen because it provides an empirical pmeasurable statistical analysis. The general stages of the research are presented in the flowchart in Figure 1.

After conducting a literature review to strengthen the theoretical and conceptual basis of the research, the initial stage was the development of a research instrument, a questionnaire. The questionnaire was systematically developed to assess public understanding of air pollution using several indicators aligned with the research objectives. Next, the sample size is determined using the Slovin formula based on the available population size, taking into account the established error rate, to obtain a representative sample size to describe the population's condition. The Slovin formula and its explanation are shown below:

$$n = \frac{N}{1 + e^2 N} \quad (1)$$

where n is the sample size, N is the population size, and e is the margin of error (Majdina et al., 2024). Based on calculations using equation (1) with a margin of error of 0,05 or 5%, from a population of 526.242 residents of Serang City who met the respondent criteria at the end of 2024, based on data from Dinas Kependudukan dan Pencatatan Sipil Kota Serang (2025), a sample size of 400 people was obtained. Subsequently, respondents were selected using convenience sampling, a technique based on ease of access and individual willingness to participate, while adhering to specific respondent criteria (Etikan et al., 2016). The criteria for respondents in this study included being a resident of Serang City, being at least 17 years of age, being able to comprehend the questionnaire statements, and being willing to participate in the study. Respondents who did not meet these criteria or provided incomplete responses were excluded from the analysis. Data collection continued until 400 respondents meeting the study criteria were obtained.



Source: Primary Processed Data, (2026)

Figure 1
Flowchart of the Research Methodology

Furthermore, the validity and reliability test of the instrument was carried out through a pre-test stage on 40 respondents selected from the research population, but not included in the main sample. This stage aims to ensure that each item in the questionnaire accurately and consistently measures the intended construct. Validity testing was conducted using Pearson correlation, while instrument reliability testing was performed using Cronbach's alpha. The entire testing process was conducted using the R statistical software to improve the accuracy and efficiency of the analysis. The number of respondents in the pre-test stage exceeded the minimum sample size recommended by Perneger et al. (2015), who suggested that approximately 30 respondents are sufficient for identifying potential issues with a questionnaire prior to the main data collection. The questionnaire instrument that met the validity and reliability criteria consisted of nine positive items measured using a five-point Likert scale, where a score of 1 indicates strongly disagree, and a score of 5 indicates strongly agree. The validated instrument was then used for the main data collection through questionnaire distribution, yielding a total of 400 respondents as the study sample.

The collected data were subsequently analysed to derive a score representing the public's level of understanding, based on nine statements included in the final instrument. Each item was scored using a 1–5 Likert scale, and each respondent's understanding level was calculated as the average score across the nine statements. Consequently, the understanding score ranged from 1 to 5, with higher values indicating a greater level of understanding regarding the measured indicators of perception and behaviour. The average score was subsequently used to examine the relationship between educational attainment and public understanding of air pollution in Serang City using Spearman's rank correlation test. This non-parametric test is appropriate for assessing associations between ordinal variables and does not require the data to meet the assumption of normality (Guglielmetti et al., 2022). The null hypothesis (H0) in this study states that there is no significant association between education level and public understanding of air pollution in Serang City. In contrast, the alternative hypothesis (H1) states that there is a significant association between the two variables.

In hypothesis testing, a significance level (α) of 0,05 (5%) was set as the threshold for statistical decision-making. The null hypothesis is rejected when the ρ-value is less than 5%, indicating a statistically significant association between the variables. Conversely, the null hypothesis is not rejected when the ρ-value is greater than or equal to 5%, indicating no statistically significant association (Fitriani et al., 2025). The ρ-value obtained from the test reflects only statistical significance and does not provide information about the strength or direction of the relationship between the variables (Schober et al., 2018). The ρ-value was calculated using R to enhance accuracy and facilitate data analysis and interpretation.

RESULT AND DISCUSSION

The demographic profile of respondents, stratified by educational attainment, provides an overview of their educational background, which may be associated with differences in knowledge, comprehension, and awareness of air pollution issues in Serang City. The distribution of respondents across educational levels is detailed in Table 1.

Based on the Table 1, the majority of respondents have attained a high school education or equivalent, totalling 248 individuals. This finding indicates that the majority of the study population originates from a demographic with a secondary education background. This profile indicates that most respondents generally have the basic capacity to receive, understand, and process information, including environmental and health-related data, especially the impact

Table 1
Demographic Profile of Respondents

No.	Education Level	Frequency	Persentase (%)
1	Postgraduate	15	3,75
2	Undergraduate (Bachelor's)	126	31,50
3	Senior High School	248	62,00
4	Junior High School	7	1,75
5	Elementary School	3	0,75
6	No Formal Education	1	0,25

Source: Processed Primary Data, 2026

of air pollution on quality of life. Secondary education typically provides an adequate knowledge base for individuals to recognise various environmental problems and understand their consequences. This aligns with research indicating that individuals with secondary education backgrounds tend to demonstrate an adequate level of understanding and awareness regarding environmental pollution and surrounding ecological issues (Sholikhah & Shofiyah, 2024). Consequently, the dominance of respondents with a high school education or equivalent suggests that basic comprehension regarding air pollution is present among the majority of the population, although the depth of this understanding may vary among individuals.

Furthermore, respondents with undergraduate degrees constituted the second-largest educational group, with 126 individuals. The representation of respondents with tertiary education provides insight into the educational diversity of the study population, which may influence their understanding of environmental issues, including the causes and impacts of air pollution. Meanwhile, 15 respondents had postgraduate qualifications. Although this group was relatively small, its inclusion contributed to the diversity of educational backgrounds represented in the study. Higher educational attainment may provide greater opportunities to access scientific literature, environmental policy information, and academic discussions on air pollution and environmental sustainability (Ying & Wang, 2024). However, educational attainment alone does not necessarily indicate a higher level of environmental knowledge or awareness, as these may also be influenced by individual experiences, information sources, and exposure to environmental issues.

Meanwhile, respondents with junior high school education totalled 7, those with elementary school education totalled 3, and only 1 respondent reported having no formal schooling. The relatively small number of respondents in the primary education category indicates that the vast majority of the study population has secondary or higher education. In general, these results show that the respondent composition is dominated by individuals with high school and undergraduate education. This suggests that the majority of respondents possess a sufficient level of literacy to understand the questionnaire items and the issues related to air pollution. Thus, the collected data is expected to effectively represent the perceptions of Serang City residents regarding local air quality.

The results of the Spearman Rank correlation analysis regarding the association between educational attainment and the level of public understanding of air pollution in Serang City yielded a Spearman correlation coefficient (r_s) of −0,011, with a ρ-value of 0,821406. A correlation coefficient value very close to zero indicates that the relationship between education level and the community's level of understanding is very weak. Furthermore, the ρ-value of 0,821406 exceeds the established significance level *(a)* of 0,05. Therefore, the

null hypothesis (H_0) is not rejected, indicating no statistically significant relationship between educational attainment and public understanding of air pollution in Serang City at the 0,05 significance level. This result is consistent with the study by Dhirisma & Moerdhanti (2022), which examined the relationship between education level and public knowledge regarding hypertension in Bantul, Yogyakarta. This demonstrates that although in theory higher education is expected to be associated with greater knowledge, under certain empirical conditions, this association is not always statistically significant.

The absence of a statistically significant relationship between educational attainment and understanding of air pollution suggests that formal education alone may not adequately explain variations in public understanding of environmental issues. Although formal education provides a foundation for literacy and critical thinking, understanding specific environmental problems, such as air pollution, may require more specialized knowledge and targeted learning experiences. This interpretation is consistent with the meta-analysis by van de Wetering et al. (2022), which examined 169 studies across 43 countries and found that environmental education programs significantly improved environmental knowledge, although the magnitude of these effects varied across studies. These findings highlight the importance of considering not only educational attainment but also the content, delivery, and effectiveness of environmental education in shaping environmental knowledge. In the context of Serang City, the findings suggest that respondents with different levels of educational attainment may demonstrate comparable levels of understanding of air pollution, particularly if their formal education has provided limited exposure to air quality-related topics. Nevertheless, this interpretation should be treated cautiously, as the absence of a statistically significant association does not necessarily indicate that educational attainment has no influence on environmental understanding.

Furthermore, knowledge of air pollution should be regarded as specific knowledge concerning air quality rather than as an automatic consequence of an individual's educational attainment. Del Ponte et al. (2022) developed and validated the Air Quality Information and Knowledge (AQIQ) instrument as a specialized tool for assessing public knowledge of air quality among respondents from the United States, India, and China. The development of such a specialized instrument indicates that knowledge of air quality encompasses dimensions that may differ from general educational attainment. In addition, research on air pollution risk has shown that perceptions and socio-environmental factors may be associated with public awareness and preparedness, but do not necessarily have the same influence on overall knowledge (Ho et al., 2021). Therefore, the nonsignificant association between educational attainment and understanding of air pollution observed in the present study may indicate that formal education alone is insufficient to explain variations in public understanding of air quality issues.

The findings of this study have important implications for strategies to improve public understanding of air pollution. Rather than relying solely on formal education, public awareness initiatives should incorporate targeted environmental education that explains the sources, health effects, and environmental consequences of air pollution. Evidence from previous studies supports the potential of such interventions to improve environmental knowledge and promote informed decision-making. For example, an experimental study conducted in Japan found that environmental learning improved students' basic knowledge of environmental problems (Kurokawa et al., 2023). Similarly, Kim et al. (2024) reported that interventions based on

environmental health literacy have also been associated with improvements in indoor air quality and reductions in pollutant exposure (Kim et al., 2024). These findings highlight the potential value of targeted environmental education in addressing air pollution-related issues. In Serang City, educational initiatives could be implemented through schools, community-based activities, and public information campaigns focusing on local sources of air pollution and their potential impacts on human health and the environment. Therefore, in Serang City, these findings highlight the importance of developing targeted communication strategies and environmental education programs that are accessible to people across different educational backgrounds. Such initiatives should focus on improving public understanding of the sources, impacts, and prevention of air pollution rather than assuming that higher educational attainment necessarily corresponds to a greater understanding of the issue.

CONCLUSION

This study found no statistically significant association between educational attainment and public understanding of air pollution in Serang City. This finding indicates that differences in formal education levels were not significantly associated with variations in respondents' understanding of air pollution. Therefore, improving public understanding of air pollution requires complementary efforts beyond formal education, such as accessible environmental information, public awareness campaigns, digital media, and community-based educational programs. These initiatives should be tailored to diverse educational backgrounds to ensure that information about air pollution, its sources, and its potential impacts on human health and the environment is widely understood. Such efforts may strengthen public awareness and encourage more environmentally responsible behaviour.

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