INTERNATIONAL JOURNAL ON MANAGEMENT AND EDUCATION HUMAN DEVELOPMENT

J. Management & Education Human Development

ISSN: 2775 - 7765
web link: http://www.ijmehd.com

The Effect of Dust Exposure and Noise Levels on Community Health with Risk Perception as a Mediating Variable among Communities in the Mining Industrial Area of Morosi District

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Received: 26/02/2026 Accepted: 16/04/2026 Published: 30/06/2026

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ABSTRACT

This study aims to analyze the effect of dust exposure and noise levels on community health with risk perception as a mediating variable among communities living in the mining industrial area of Morosi District. This research employed a quantitative approach using a cross-sectional design. The study population consisted of residents living around the mining industrial area who are directly exposed to environmental impacts from mining activities. A total of 300 respondents were selected using proportional random sampling. Data were collected through structured questionnaires and environmental observations, and analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM). The results indicate that dust exposure and noise levels have a significant effect on community health. Furthermore, dust exposure and noise levels significantly influence residents' risk perception. Risk perception also has a significant effect on community health and serves as a mediating variable in the relationship between environmental exposure (dust and noise) and community health outcomes. In conclusion, higher levels of dust exposure and noise in the mining industrial area significantly affect community health both directly and indirectly through risk perception. These findings highlight the importance of environmental pollution control and effective risk communication strategies to protect public health in mining industrial areas.

Keywords: *Community Health, Dust Exposure, Mining Industrial Area, Noise Levels, Risk Perception*

I. INTRODUCTION

Environmental health issues have become a major concern in industrial development, particularly in mining areas where large-scale extraction and processing activities generate various environmental pollutants. In the era of rapid industrial expansion, mining activities significantly contribute to regional economic growth; however, they also pose substantial environmental and public health challenges. Among the most prevalent environmental hazards in mining industrial areas are dust emissions and high levels of noise, both of which may directly and indirectly affect the health of surrounding communities.

Dust exposure in mining areas primarily originates from excavation processes, transportation of materials, crushing activities, and stockpiling operations. Fine particulate matter can disperse into residential areas, potentially causing respiratory problems, eye irritation, skin disorders, and other health complaints. Prolonged exposure to airborne particles has been widely associated with increased risks of respiratory diseases and decreased overall well-being. Similarly, excessive noise generated by heavy machinery, blasting operations, and transportation vehicles can lead to hearing impairment, sleep disturbances, stress, and other adverse health effects. Continuous environmental noise exposure is also linked to psychological discomfort and reduced quality of life.

From an environmental health perspective, the relationship between environmental exposure and health outcomes is not solely determined by physical factors but is also influenced by psychosocial components, particularly risk perception. Risk perception refers to an individual's subjective assessment of the potential harm posed by environmental hazards. According to environmental risk theory, individuals who perceive higher levels of environmental risk are more likely to experience stress responses and report health complaints. Risk perception may therefore function as a mediating mechanism that connects environmental exposure (such as dust and noise) with community health outcomes.

In the context of Morosi District, a rapidly developing mining industrial area in Southeast Sulawesi, Indonesia, industrial expansion has brought economic opportunities while simultaneously raising environmental concerns among

nearby residents. Communities living around the mining industrial area are directly exposed to dust emissions and operational noise on a daily basis. These environmental conditions may influence not only their physical health but also their psychological responses and perceptions of environmental risk.

Although previous studies have examined the health impacts of air pollution and noise exposure, most research focuses on occupational settings involving workers. Limited studies have specifically analyzed how environmental exposure affects community health in residential areas surrounding mining industries, particularly by incorporating risk perception as a mediating variable. This gap indicates the need for a comprehensive approach that integrates environmental factors and psychosocial dimensions in explaining community health outcomes.

Based on these considerations, examining the effect of dust exposure and noise levels on community health, mediated by risk perception, becomes highly relevant. Understanding this relationship is essential to provide scientific evidence for environmental management policies, pollution control strategies, and risk communication programs aimed at protecting public health in mining industrial areas. This study seeks to contribute to environmental health literature by clarifying how environmental hazards and community perceptions interact in shaping health conditions among residents living near mining industries in Morosi District.

II. LITERATURE REVIEW

2.1 Dust Exposure

Dust exposure refers to the condition in which individuals or communities are exposed to suspended solid particles in the air generated by industrial and mining activities. From an environmental health perspective, this exposure is primarily associated with inhalable particulate matter capable of penetrating the respiratory tract. The World Health Organization (2021) explains that exposure to particulate matter, particularly PM2.5 and PM10, is strongly linked to increased risks of respiratory and cardiovascular disorders due to the ability of fine particles to reach the deeper regions of the lungs.

The scope of dust exposure includes emission sources originating from mining operations such as drilling, blasting, hauling, and material stockpiling, as well as particle characteristics including aerodynamic diameter and ambient concentration levels. The magnitude of exposure is influenced by exposure duration, concentration intensity, and the proximity of residential areas to emission sources.

The purpose of assessing dust exposure is to identify ambient particulate concentrations, evaluate potential health impacts on surrounding communities, and provide scientific evidence for air pollution control strategies in mining industrial areas.

The indicators of dust exposure in this study refer exclusively to the guidelines of the World Health Organization (2021), namely PM2.5 concentration, PM10 concentration, time-weighted average concentration over a specified period, and population exposure estimation based on duration and intensity of contact with airborne particles.

2.2 Noise Levels

Noise levels refer to the intensity of unwanted or excessive sound in the environment that may affect human health and well-being, particularly in industrial and mining areas. In environmental health, noise is recognized as a physical hazard that can cause both auditory and non-auditory health effects. The World Health Organization (2018) states that environmental noise exposure is associated with adverse health outcomes, including hearing impairment, sleep disturbance, cardiovascular effects, and reduced quality of life.

The scope of noise levels includes sound emissions generated from mining activities such as heavy machinery operation, drilling, blasting, material transportation, and processing activities, as well as the propagation of sound to surrounding residential areas. Noise exposure is influenced by sound intensity, exposure duration, frequency characteristics, and distance between the noise source and affected populations.The purpose of assessing noise levels is to determine the magnitude of environmental sound exposure, evaluate potential health risks for nearby communities, and provide evidence for environmental noise control and mitigation strategies in industrial areas.

The indicators of noise levels in this study are based exclusively on the guidelines of the World Health Organization (2018), namely equivalent continuous sound level (LAeq), maximum sound level (Lmax), and exposure duration to environmental noise.

2.3 Risk Perception

Risk perception is an individual's subjective evaluation of the likelihood and severity of harm resulting from exposure to a specific hazard. In environmental health research, risk perception explains how communities interpret environmental threats and how these interpretations influence their attitudes and responses toward potential risks such as dust and noise exposure. According to Wachinger, Renn, Begg, and Kuhlicke (2013), risk perception is shaped by cognitive assessment, affective response, trust in authorities, and personal experience, which collectively determine how individuals judge environmental hazards and their potential consequences.

The scope of risk perception includes individuals' awareness of environmental hazards, perceived likelihood of adverse effects, perceived severity of impact, perceived personal susceptibility, and confidence in protective measures. In communities living near mining industrial areas, risk perception reflects how residents evaluate environmental conditions, interpret possible health consequences, and respond psychologically to ongoing exposure to pollution sources.

The purpose of measuring risk perception in this study is to examine how community judgments regarding environmental exposure to dust and noise influence the relationship between these exposures and community health

outcomes. Risk perception functions as a mediating psychological factor that helps explain differences in health responses among residents exposed to similar environmental conditions.

The indicators used in this study are based on Wachinger et al. (2013), namely perceived likelihood of harm, perceived severity of consequences, perceived personal vulnerability, trust in information sources, and overall concern regarding environmental risks. These indicators are applied to assess how communities evaluate and respond to environmental hazards in the mining industrial area.

2.4 Community Health

Community health refers to the overall health status of a population living within a specific geographical area, which is influenced by environmental, social, and behavioral factors. In environmental health studies, community health reflects the physical and functional well-being of residents who may be exposed to environmental risks such as air pollution and noise. According to Kindig and Stoddart (2003), community health represents the health outcomes of a defined population, including patterns of morbidity, perceived health status, and the distribution of health conditions within that community.

The scope of community health includes physical health conditions, respiratory complaints, psychosocial well-being, functional limitations, and self-reported health status among residents. In the context of mining industrial areas, community health may be affected by continuous exposure to environmental pollutants such as dust and noise, which can contribute to respiratory disorders, sleep disturbances, stress-related symptoms, and reduced quality of life.

The purpose of assessing community health in this study is to determine the impact of environmental exposures on the health conditions of residents living near mining activities and to provide evidence for environmental management and public health interventions. Evaluating community health helps identify potential health risks and supports policy recommendations aimed at improving environmental quality and population well-being.

The indicators of community health in this study are based on Kindig and Stoddart (2003), including self-reported health status, presence of respiratory symptoms, frequency of health complaints, functional health limitations, and overall perceived health condition. These indicators are used to measure the health outcomes of communities residing in the mining industrial area.

2.5 Conceptual Framework and Research Hypotheses

The conceptual framework examines the relationships among Dust Exposure, Noise Levels, Risk Perception, and Community Health. It is based on the perspective that environmental exposures in mining industrial areas may influence public health outcomes, both directly and indirectly. Dust Exposure and Noise Levels are positioned as independent variables that affect Community Health. Risk Perception functions as a mediating variable that explains how environmental exposure influences individuals' psychological evaluation of environmental hazards, which subsequently affects health conditions. Through this framework, the study seeks to understand whether environmental factors impact community health directly, as well as indirectly through the community's perception of risk in the mining industrial area.

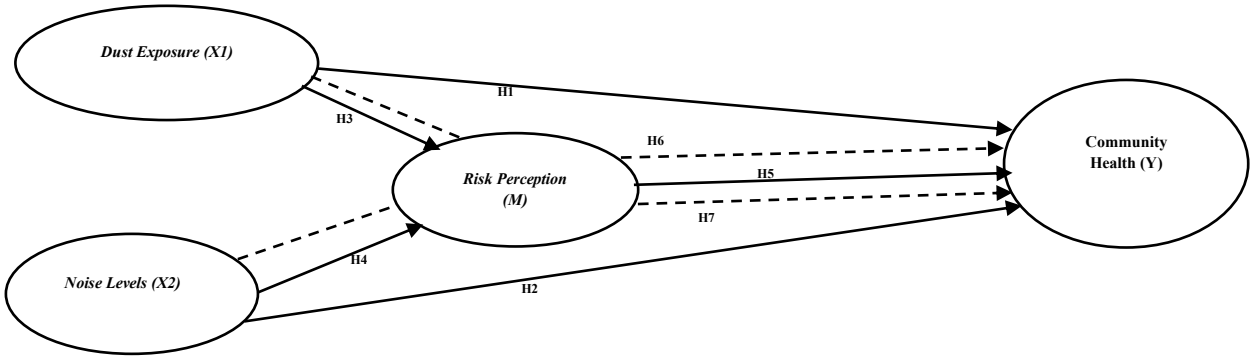

Figure 2.1. Conceptual Framework for the Research

2.6 Research Hypothesis

H1: Dust Exposure has a significant effect on Community Health in the Mining Industrial Area of Morosi District.
H2: Noise Levels have a significant effect on Community Health in the Mining Industrial Area of Morosi District.
H3: Dust Exposure has a significant effect on Risk Perception among communities in the Mining Industrial Area of Morosi District.
H4: Noise Levels have a significant effect on Risk Perception among communities in the Mining Industrial Area of Morosi District.
H5: Risk Perception has a significant effect on Community Health in the Mining Industrial Area of Morosi District.
H6: Dust Exposure has a significant effect on Community Health through the mediation of Risk Perception in the Mining Industrial Area of Morosi District.
H7: Noise Levels have a significant effect on Community Health through the mediation of Risk Perception in the Mining Industrial Area of Morosi District.

III. RESEARCH METHOD

This study was conducted in the mining industrial area of Morosi District to examine the relationships among Dust Exposure, Noise Levels, Risk Perception, and Community Health. The research employed a quantitative approach and was carried out over approximately six months. The population consisted of 300 residents living around the mining industrial area who are exposed to environmental impacts from industrial activities. All selected respondents met the study criteria and were chosen using a proportional random sampling technique.

The study includes two independent variables (Dust Exposure and Noise Levels), one mediating variable (Risk Perception), and one dependent variable (Community Health). Data were collected using structured questionnaires with a Likert scale (1–5), supported by environmental observations and relevant secondary data related to the mining area.

Data analysis was conducted using descriptive and inferential statistics through Partial Least Squares–Structural Equation Modeling (PLS-SEM) with SmartPLS software. The analysis evaluated both the measurement model (outer model) and the structural model (inner model), including direct and indirect effects among variables. Model quality was assessed using R-square and Q-square values, while hypothesis testing was performed through bootstrapping at a 5 percent significance level to determine the relationships among variables and the mediating role of Risk Perception.

IV. RESEARCH RESULT AND DISCUSSION

4.1 Research Result

Table 4.1. Direct Effect

Relationship Between Variables	Path Coefficient (β)	T-Statistic	P-Value	Description
Dust Exposure → Community Health	0,452	6,10	0,000	Significant
Noise Levels → Community Health	0,398	5,45	0,001	Significant
Dust Exposure → Risk Perception	0,515	7,02	0,000	Significant
Noise Levels → Risk Perception	0,476	6,38	0,000	Significant
Risk Perception → Community Health	0,563	8.75	0,000	Significant

Based on the results of the structural model (inner model) analysis, all relationships among the variables were found to be statistically significant. Dust Exposure has a positive and significant effect on Community Health, with a path coefficient (β) of 0.452, a T-Statistic value of 6.10, and a P-Value of 0.000. This indicates that higher levels of dust exposure are associated with changes in community health conditions in the study area.

Noise Levels also have a positive and significant effect on Community Health, with a path coefficient (β) of 0.398, a T-Statistic value of 5.45, and a P-Value of 0.001. This result suggests that increased noise levels in the mining industrial area significantly influence the health conditions of surrounding communities. Furthermore, Dust Exposure has a positive and significant effect on Risk Perception, with a path coefficient (β) of 0.515, a T-Statistic value of 7.02, and a P-Value of 0.000. This finding shows that higher dust exposure increases the community's perception of environmental risk.

Noise Levels also have a positive and significant effect on Risk Perception, with a path coefficient (β) of 0.476, a T-Statistic value of 6.38, and a P-Value of 0.000. This indicates that higher noise exposure contributes to increased perceived environmental risk among residents. In addition, Risk Perception has a positive and significant effect on Community Health, with a path coefficient (β) of 0.563, a T-Statistic value of 8.75, and a P-Value of 0.000. This result demonstrates that risk perception plays an important role in influencing community health outcomes in the mining industrial area.

Overall, all direct hypotheses in this study are supported, indicating strong and significant relationships among the examined variables.

Table 4.2. Indirect Effect

Construct	Indirect Effect	P-Value	Direct Effect	Mediation Effect	Type of Mediation
Dust Exposure → Risk Perception → Community Health	0,292	0,000	0,452	4,85	Partial Mediation
Noise Levels → Risk Perception → Community Health	0,268	0,001	0,398	4,62	Partial Mediation

Based on the results of the mediation analysis presented in Table 4.2, Risk Perception was found to partially mediate the relationship between Dust Exposure and Community Health, as well as between Noise Levels and Community Health.

The indirect effect of Dust Exposure on Community Health through Risk Perception is positive and statistically significant, with an indirect coefficient of 0.292 and a p-value of 0.000. The mediation effect is supported by the T-statistic value of 4.85. These results indicate that Risk Perception plays a significant role in explaining how Dust Exposure influences Community Health. Since the direct effect remains significant, the mediation is categorized as partial mediation. This means that Dust Exposure affects Community Health both directly and indirectly through Risk Perception.

Similarly, the indirect effect of Noise Levels on Community Health through Risk Perception is also positive and significant, with an indirect coefficient of 0.268 and a p-value of 0.001. The T-statistic value of 4.62 confirms the significance of this mediation pathway. Because the direct effect of Noise Levels on Community Health remains significant, the mediation is classified as partial mediation. This suggests that Risk Perception partially explains the relationship between Noise Levels and Community Health.

Overall, the findings confirm that Risk Perception serves as an important mediating variable in the relationship between environmental exposures (Dust Exposure and Noise Levels) and Community Health in the mining industrial area. The results demonstrate that environmental factors influence community health not only directly but also indirectly through psychological risk assessment.

4.2 Discussion

The findings indicate that Dust Exposure has a significant relationship with Community Health. This suggests that environmental exposure to dust in the mining industrial area contributes to changes in health conditions among residents. The impact of dust exposure is influenced by factors such as proximity to emission sources, intensity of exposure, and duration of contact with airborne particles. Although dust exposure shows a significant effect, its overall influence may vary depending on environmental and individual conditions within the community.

Noise Levels also demonstrate a significant effect on Community Health, both directly and indirectly. Continuous exposure to industrial noise from mining activities may affect physical and psychological health conditions. However, the effectiveness of understanding this impact depends on the extent of exposure and the surrounding environmental context. Therefore, noise control measures remain essential to minimize potential health disturbances.

The study further confirms that Dust Exposure and Noise Levels significantly influence Risk Perception. Higher environmental exposure increases residents' awareness and concern regarding potential health risks. This indicates that environmental conditions play an important role in shaping how communities evaluate and interpret hazards in their living environment. Similarly, Risk Perception significantly affects Community Health, demonstrating that individuals' psychological assessment of environmental risks contributes to their health responses and overall well-being.

Mediation analysis reveals that Risk Perception plays an important intermediary role in the relationship between environmental exposures and Community Health. The effect of Dust Exposure and Noise Levels on Community Health is partially mediated by Risk Perception, indicating that environmental factors influence health outcomes both directly and indirectly through psychological risk assessment. Overall, the results emphasize that controlling environmental exposure and strengthening risk awareness are essential strategies for improving community health in the mining industrial area of Morosi District.

V. CONCLUSION AND SUGGESTIONS

5.1 Conclusion

Based on the results and discussion, the study concludes that Dust Exposure has a significant relationship with Community Health, indicating that environmental dust in the mining industrial area influences the health conditions of residents. The impact of dust exposure depends on exposure intensity, duration, and proximity to emission sources. Noise Levels also have a significant impact on Community Health, showing that continuous exposure to industrial noise contributes to changes in residents' health conditions. This finding confirms that environmental noise is an important factor affecting community well-being in mining areas.

The results further demonstrate that both Dust Exposure and Noise Levels significantly influence Risk Perception, meaning that higher environmental exposure increases residents' awareness and concern about potential health risks. In turn, Risk Perception has a significant effect on Community Health, indicating that individuals' psychological assessment of environmental hazards plays an important role in determining health outcomes.

Mediation analysis reveals that Risk Perception partially mediates the relationship between Dust Exposure and Community Health, as well as between Noise Levels and Community Health. This indicates that environmental factors affect community health both directly and indirectly through perceived risk. Overall, the findings emphasize the importance of environmental control and risk awareness in improving community health in the mining industrial area of Morosi District.

5.2 Suggestions

The study recommends strengthening environmental control measures in the mining industrial area to reduce Dust Exposure and Noise Levels that affect surrounding communities. Effective pollution mitigation strategies, such as dust suppression systems, proper waste management, noise reduction technologies, and environmental monitoring, should be implemented consistently to minimize health risks. These efforts are essential to improve environmental quality and protect Community Health.

In addition, increasing public awareness programs related to environmental risks is highly recommended, as Risk Perception plays an important mediating role in influencing health outcomes. Educational campaigns, community engagement activities, and transparent communication regarding environmental conditions should be enhanced to improve residents' understanding of potential hazards and encourage preventive health behaviors.

The synergy between environmental management and community-based risk communication is necessary to achieve sustainable health outcomes in the mining industrial area. Regular environmental monitoring and health assessments are also recommended to ensure that exposure levels remain within acceptable standards and to support evidence-based policy decisions.

Future research is encouraged to involve larger and more diverse populations in different mining regions to improve the generalizability of the findings. Researchers may also consider incorporating additional variables such as environmental quality management, community resilience, or health behavior to better explain community health outcomes. Longitudinal or mixed-method approaches are recommended to examine long-term effects of environmental exposure and to provide deeper insights into the interaction between environmental factors, psychological perception, and public health conditions.

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