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THE INFLUENCE OF PERSONAL PROTECTIVE EQUIPMENT (PPE) USE AND PERIOD OF WORK ON THE INCIDENT OF PERSONAL PROTECTIVE EQUIPMENT (ARI) AMONG LANDFILL

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Abstract

Acute Respiratory Infection (ARI) is one of the most common health problems among informal workers, including waste pickers who are exposed to dust, bioaerosols, and hazardous gases at landfill sites. This study aimed to analyze the association between working duration and the use of personal protective equipment (PPE) with the incidence of ARI among waste pickers at Alak Landfill, Kupang City. This analytical quantitative study employed a cross-sectional design involving 90 respondents selected using a total sampling technique. Data were collected using a structured questionnaire and analyzed using the Chi-square test. The results showed that 87 respondents (96.7%) experienced ARI. There was a significant association between working duration and ARI incidence (p=0.003), in which all respondents with a working duration of more than five years experienced ARI (73.3%). In addition, PPE use was significantly associated with ARI incidence (p<0.001), all respondents who did not use PPE experienced ARI (84.4%). In conclusion, working duration and PPE use were significantly associated with ARI incidence among waste pickers at Alak Landfill, Kupang City.

Keywords: *Acute respiratory infection, Personal protective equipment, Waste pickers, Working duration*

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1. Introduction

Acute Respiratory Infection (ARI) is a public health issue that remains a leading cause of morbidity and mortality worldwide [1]. Globally, acute respiratory infections (ARI) specifically lower respiratory infections (LRI) remain a significant public health issue. According to the 2021 Global Burden of Disease Study, there were approximately 343.6 million cases of LRI, resulting in around 2.2 million deaths worldwide in 2021. Developing nations, particularly in Africa and South Asia, bear the largest share of this disease burden. Although mortality rates from LRI have declined compared to previous decades, the disease remains a leading cause of death from infectious diseases, especially in low and middle income countries [2][3]. This situation indicates a disparity in the determinants of health, including the environment and access to healthcare services.

In Indonesia, the prevalence of Acute Respiratory Infections (ARI) is high and constitutes a public health issue. Data from Riskesdas indicate significant incidence rates. Certain provinces show

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figures exceeding the national average such as East Nusa Tenggara, which reaches approximately 13% alongside other provinces with relatively high prevalence. This high prevalence is linked to environmental factors, community behaviors, and the diverse socioeconomic conditions found across different regions [4].

At the local level, cases of Acute Respiratory Infection (ARI) also show significant figures. Data from the Kupang City Health Office for 2022 recorded 14,178 ARI cases, with Alak District reporting the highest number 7,879 cases. Furthermore, ARI remained one of the most common conditions treated in outpatient services at several community health centers (Puskesmas) in Kupang City in 2023, indicating that the disease continues to be a significant public health issue in the area [5][6].

Waste pickers are a group of informal workers at high risk of health problems due to exposure to an unhealthy work environment. Landfill sites generate various air pollutants such as organic dust, fine particles, bioaerosols, ammonia, hydrogen sulfide, and pathogenic microorganisms that can cause acute and chronic respiratory disorders. A systematic review indicates that occupational respiratory diseases remain a significant health issue among sanitation workers, particularly those directly exposed to waste who do not optimally use personal protective equipment (PPE). Factors such as age, length of employment, duration of exposure, and the use of personal protective equipment (PPE) are associated with an increased risk of respiratory disorders [7].

Another study on informal waste pickers in Colombia found a high prevalence of respiratory symptoms such as cough, sputum production, and shortness of breath among the workers. The study identified age, job characteristics, and duration of exposure as factors influencing the onset of respiratory disorders. However, that study focused primarily on general respiratory symptoms and did not specifically examine the incidence of acute respiratory infections (ARI) in relation to the combined factors of length of employment and the use of personal protective equipment (PPE) [8].

Furthermore, a systematic review of epidemiological studies on waste pickers across various countries indicates that, despite the substantial volume of research on their health, there is a lack of studies evaluating multiple risk factors simultaneously, as well as limited research covering diverse working conditions and geographical regions. Research on waste picker health in developing countries particularly in Asia and Indonesia also remains relatively limited compared to other regions [9].

Research on the use of personal protective equipment (PPE) indicates that PPE particularly masks plays a crucial role in reducing the risk of respiratory disorders caused by exposure to dust and bioaerosols. However, compliance with PPE usage among waste pickers remains low. Studies on waste pickers in Indonesia show that PPE compliance continues to be an issue, thereby increasing the risk of exposure to various pollutants in landfill environments. Furthermore, inconsistent use of PPE is associated with a higher incidence of health problems among waste management workers [10].

Furthermore, other risk factors such as age, education level, smoking habits, and socioeconomic status have often not been simultaneously analyzed as confounding variables or controlled factors in research. Yet, various studies indicate that these factors play a significant role in determining an individual's susceptibility to acute respiratory infections (ARI), whether through mechanisms involving reduced immune function, health behaviors, or access to healthcare services [11].

Although various studies have reported that waste pickers face a high risk of respiratory disorders due to occupational exposure, most research has focused on environmental factors or

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individual characteristics in isolation. Studies specifically analyzing the impact of personal protective equipment (PPE) use and duration of employment on the incidence of Acute Respiratory Infections (ARI) among waste pickers remain limited particularly regarding landfill sites in Eastern Indonesia necessitating further research to obtain empirical evidence tailored to the specific characteristics of waste pickers at the Alak Landfill in Kupang City.

2. Methods

This study employed an analytical quantitative approach with a cross-sectional design. The study population consisted of all 90 waste pickers at the Alak Landfill in Kupang City; a total sampling technique was used, meaning the entire population served as the study sample. Respondents included waste pickers who were actively working at the Alak Landfill, willing to participate, and possessed good communication skills, whereas those who were inactive, unwilling, or unable to communicate effectively were excluded from the study.

Data collection utilized a questionnaire adapted from the study by Evelin Irsyandi Pratama (2019), which had previously been tested at the Caruban Landfill in Madiun Regency involving 20 respondents. The questionnaire comprised 11 items covering the variables of length of employment (1 item), use of Personal Protective Equipment (PPE) (2 items), and incidence of Acute Respiratory Infections (ARI) (8 items). All items were determined to be valid (calculated r > 0.4444) and reliable (Cronbach's Alpha = 0.661). Data analysis was conducted using univariate analysis to describe the frequency distribution of each variable and bivariate analysis—employing the Chi-Square test—to examine the relationship between length of employment and PPE usage with the incidence of ARI among waste pickers, at a 95% confidence level and a significance value of $p < 0.05$.

3. Results and Discussion

Table 1. The Effect of Length of Service on the Incidence of Acute Respiratory Infections (ARI)

Length of service	Incidence of Acute Respiratory Infections (ARI)				Total		*P-Value*
	Experienced ARI		Did not experience ARI				
	N	%	N	%	N	%	
Long	66	73,4	0	0	66	73,3	0.003
Short	21	23,3	3	3,3	24	26,7	
Total	87	96,7	3	3,3	90	100	

Based on Table 1, out of 90 respondents, 87 (96.7%) suffered from Acute Respiratory Infection (ARI), while 3 (3.3%) did not. In the group with lenght of service >5 years, all 66 respondents (73.3%) suffered from ARI; meanwhile, in the group with a tenure of ≤5 years, 21 respondents (23.3%) suffered from ARI and 3 (3.3%) did not. The Chi-Square test results showed a p-value of 0.003 ($p < 0.05$), leading to the conclusion that there is a significant relationship between tenure and the incidence of ARI among waste pickers at the Alak Landfill in Kupang City. This indicates that the longer an individual works as a waste picker, the higher the risk of developing ARI due to continuous exposure to the working environment.

Table 2. The Effect of PPE Use on the Incidence of Acute Respiratory Infections (ARI)

Use of PPE	Incidence of Acute Respiratory Infections (ARI)				Total		*P-Value*
	Experienced ARI		Did not experience ARI				
	n	%	n	%	N	%	0.000

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Not using PPE	76	84,4	0	0	76	84,4
Using PPE	11	12,3	3	3,3	14	15,6
Total	87	96,7	3	3,3	90	100

Based on Table 2, out of 90 respondents, 87 (96.7%) suffered from acute respiratory infections (ARI), while 3 (3.3%) did not. In the group of scavengers who did not use personal protective equipment (PPE), all 76 respondents (84.4%) suffered from ARI. Meanwhile, in the group that used PPE, 11 respondents (12.3%) suffered from ARI, and 3 (3.3%) did not.

The results of the Chi-square test analysis yielded a p-value of < 0.001 ($p < 0.05$); thus, the null hypothesis (H0) was rejected and the alternative hypothesis (Ha) was accepted. Consequently, there is a significant association between the use of personal protective equipment (PPE) and the incidence of acute respiratory infections (ARI) among waste pickers at the Alak Landfill in Kupang City. Waste pickers who do not use PPE are at a higher risk of developing ARI compared to those who use PPE while working.

The Effect of Personal Protective Equipment (PPE) Use on the Incidence of Acute Respiratory Infections Among Waste Pickers

Research findings indicate that the use of Personal Protective Equipment (PPE) has a significant influence on the incidence of Acute Respiratory Infections (ARI) among scavengers at the Alak Landfill in Kupang City. This finding is supported by statistical test results showing a significance value below the α threshold ($p < 0.05$). A Prevalence Ratio (PR) greater than one indicates that individuals who do not use PPE are more likely to develop ARI compared to those who do.

In theory, the use of PPE serves as a barrier that prevents harmful particles from entering the respiratory tract. Masks, a form of PPE, have proven effective in reducing the risk of respiratory infections by filtering airborne particles and droplets containing disease-causing microorganisms. Studies indicate that mask-wearing can reduce the transmission of respiratory infections, particularly in high-exposure environments [12].

The results of this study align with previous research indicating a significant association between the use of personal protective equipment (PPE)—specifically masks—and the incidence of Acute Respiratory Infections (ARI) among workers. Masks serve as a physical barrier that reduces exposure to dust, aerosols, and microorganisms that cause respiratory infections. Workers who do not use PPE face a higher risk of developing ARI symptoms, such as coughing, shortness of breath, and respiratory tract irritation, due to exposure to particles in the work environment. Consistent mask usage can lower the risk of respiratory infections, particularly in high-exposure settings such as the informal industrial sector and waste disposal areas [13]. Furthermore, research by Sampouw (2021) indicates that the use of masks as personal protective equipment (PPE) influences the incidence of acute respiratory infections (ARI) among furniture industry workers; specifically, the use of PPE—such as masks—can reduce the risk of contracting acute respiratory infections [14].

In addition to the actual use of PPE, compliance with PPE usage is a crucial factor. Many informal sector workers consider PPE unnecessary or a hindrance to their work, resulting in low compliance rates. Yet, failure to comply with PPE requirements can increase exposure to dust and pollutants that are hazardous to respiratory health. Other studies have found that low PPE compliance is closely linked to workers' knowledge and attitudes regarding the importance of personal protection in the workplace [15].

These results must be interpreted by taking several confounding factors into account. Smoking habits prevalent among long-term waste pickers cumulatively exacerbate damage to the respiratory tract

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mucosa. The age-related decline in lung vital capacity renders waste pickers increasingly susceptible to infections, despite their acclimatization to their working environment. Poor nutritional status resulting from low socioeconomic conditions further compromises the immune system, while prolonged daily exposure leads to a significant accumulation of infectious agents. Furthermore, overcrowded living conditions with poor ventilation near the landfill facilitate the transmission of infections among residents, thereby compounding the already high risk associated with the work environment.

It can be concluded that the use of personal protective equipment (PPE) is a crucial protective factor in preventing acute respiratory infections (ARI) among waste pickers. Inconsistent use of PPE increases the risk of exposure to pollutants and disease-causing microorganisms; therefore, efforts are needed to enhance awareness and compliance regarding PPE usage through health education and workplace supervision to reduce the incidence of ARI.

The Influence of Length of Employment on the Incidence of Acute Respiratory Infections Among Waste Pickers

Research findings indicate a significant relationship between length of employment and the incidence of Acute Respiratory Infections (ARI) among waste pickers. This is evidenced by a p-value of less than 0.05, signifying that the duration of work is linked to an increased risk of respiratory disorders. Furthermore, an Odds Ratio (OR) of 1.143 reveals that respondents with more than five years of work experience tend to exhibit a higher prevalence of ARI compared to those with shorter tenures. These findings suggest that the duration of exposure to a polluted work environment is a critical factor in increasing the risk of respiratory disease.

These findings align with the theory that the longer an individual is exposed to air pollution, the higher the risk of developing respiratory system disorders. Long-term exposure to dust, smoke, and hazardous gases in the workplace can cause respiratory tract irritation and a gradual decline in lung function. This condition increases the likelihood of acute respiratory infections (ARI), particularly among workers who do not use masks optimally.

The results of this study align with various recent studies demonstrating a link between length of employment and the incidence of Acute Respiratory Infections (ARI) among workers exposed to dust in the workplace. Research by Damayanti et al. (2023) indicates that length of employment is a factor associated with respiratory complaints resulting from workplace dust exposure. Long-term exposure to industrial dust leads to the accumulation of particles in the respiratory tract, thereby increasing the risk of ARI among workers [16].

Physiologically, long-term exposure to air pollutants can impair the respiratory tract's defense mechanisms, particularly the mucociliary system, which consists of cilia and mucus. Recent studies indicate that exposure to particulate pollutants such as PM2.5 and diesel exhaust can cause ciliary dysfunction, ciliary shortening, and excessive mucus production, thereby disrupting the process of mucociliary clearance. This condition reduces the lungs' ability to filter out foreign particles and pathogenic microorganisms. Furthermore, pollutant exposure can compromise the integrity of the airway epithelium and diminish local immune responses, making it easier for pathogens to invade the respiratory tract and increasing the risk of acute respiratory infections (ARI) [17].

However, other research presents differing results, indicating that length of employment does not always have a significant association with the incidence of Acute Respiratory Infections (ARI). Recent studies suggest that factors such as the use of personal protective equipment (PPE) and smoking habits may play a more dominant role in influencing ARI

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incidence among workers. Research by Zairinayati (2024) found no significant relationship between length of employment and ARI incidence ($p > 0.05$); however, smoking habits were significantly associated with respiratory disorders. Although length of employment can increase cumulative exposure, the risk of ARI is more strongly influenced by smoking behavior and adherence to PPE usage, which serves to reduce exposure to dust and pollutants in the work environment [18]. This indicates that the occurrence of acute respiratory infections (ARI) is multifactorial and not influenced by a single factor alone.

Several confounding factors exacerbate this relationship. Smoking even while working without personal protective equipment (PPE) compounds respiratory tract damage through the combined effects of environmental pollutants and harmful substances found in cigarettes. Older waste pickers, who often have reduced lung capacity, are particularly vulnerable when working without PPE. Poor nutritional status further compromises immune defenses against infectious agents that enter the body directly, unimpeded by any protective barriers. Daily exposure exceeding eight hours without PPE drives infection risk well beyond safe limits, while overcrowded living conditions near the landfill compound the risk of transmission from both the workplace and the home environment.

Overall, the findings of this study confirm that length of employment is a risk factor contributing to the incidence of acute respiratory infections (ARI), particularly when accompanied by poor workplace environmental conditions and a lack of personal protective equipment (PPE) usage. Therefore, preventive measures such as the use of PPE, control of environmental exposures, and worker health education are necessary to reduce the risk of ARI.

4. Conclusion

Based on an analysis of 90 waste pickers at the Alak Landfill in Kupang City, there is a significant association between the duration of employment and the use of personal protective equipment (PPE) and the incidence of Acute Respiratory Infection (ARI). Waste pickers with longer employment durations and those who did not use PPE exhibited a higher proportion of ARI cases compared to other groups. Thus, the duration of employment and the use of PPE are factors associated with the incidence of ARI among waste pickers at the Alak Landfill in Kupang City.

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