Health Risks of People Living Close Cipayung Depok Landfill Due to Hydrogen Sulfide Exposure: Respiratory Problems and Malodor Peceptions

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Abstract

Background: Cipayung Landfill operating with open dumping system which exceeded its capacity. The waste which enters the landfill is 800 tons/day and the height of the waste heap reaches 30 meters.

Objectives: This study aims to analyze the risk level of H_2S and to identify respiratory problems and malodor peceptions in people living around the landfill.

Method: This study uses the method of descriptive quantitative with analysis health risk approach. H_2S sampling was carried out at 2 points around the Cipayung landfill closest to resident areas. The number of samples in the study is 100 people who are in Hamlet 07, Cipayung Urban Village. Data collected uses three parts questionnaire consist; general characteristic of respondents, respiratory problems, and malodor perceptions.

Results: The highest measurement result of H_2S is 0.021mg/m^3 with RQ value calculation is 2.98 . Out of 100 respondents, 81% had suffered respiratory problems during living near the landfill the most frequent symptom of respiratory problems in the last 2 weeks was coughing (25%).All respondents (100%) smell foul of the landfill, with the majority saying that the smell disturbs daily activities (70%) and causes unhealthy effects (75%).

Conclusion: The RQ value >1 which means people living close to the landfill are at risk of non-carcinogenic effects in the next 30 years. Respiratory problems and malodor perceptions in people living close the landfill indicate that health effects have arisen from the potential hazards of H_2S. Recommendation: It needs amelioration of processing system and other efforts by the stakeholders to decrease the risk of health and environment problems caused by H_2S from Cipayung Landfill.

Keywords: *Environmental Risk, Landfill, Hydrogen Sulfide, Respiratory Problems, Malodor Perceptions.*

Introduction

Landfill is the way to manage domestic and industrial wastes in many developed and developing countries. If landfill not managed properly it can lead to environmental degradation by releasing various contaminants such as groundwater contaminations and odor emissions[1]. There are some bad things that are caused by landfils: Toxins, leachete, and greemhouse gasses. Toxic subtances are derived from waste like televisions, and other electronic appliances which contain hazardous substances (mercury, arsenic, PVC), lama kelamaan dapat menyerap ke soil and groundwater, and become environmental hazards. Leachate is highly

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toxic that can pollute the land and ground water. And greenhouse gasses removes the oxygen and causes it to break down in an anaerobic process[2].

Landfills in the decomposition process can produce harmful gases that can caused health problems. One of the gases produced at the landfill is H_2S[3]. The respiratory tract and nervous system are the most sensitive organs when exposed to H_2S exposure. H_2S at high concentrations can cause someone to lose their ability to smell, so it is wrong to think that H_2S is no longer available even though it still exists. This can increase the risk of exposure to air levels which can cause serious health effects[4]. Most health effects are respiratory disorders. Complaints of breathing can be coughing, coughing up phlegm, breathing sounds/wheezing, shortness of breath, breathing sound/wheezing accompanied by shortness of breath, chest pain, flu and coughing with flu[5]. Peoples living near the landfill are directly exposing to volatile H2S compounds. Long-term exposure to this compound is associated with potential health risks, such as respiratory irritation, cacer and even damage to the central nervous system[6].

Cipayung Landfill which began operating in 1984, is located in Cipayung Village, Depok City. Cipayung Landfill is a waste collection place originating from 11 subdistricts in Depok City with an area of 10.8 hectares. The area of the Cipayung landfill is categorized as overload with the amount of garbage entering 800 tons per day and will continue to increase with the height of 30 meters of waste generated[7]. The air quality around Cipayung Landfill for H_2S parameters is 0.14 mg/m^3 (converted to 0.1 ppm) which means it passes the odor threshold value based on the Decree of the Minister of Environment of the Republic of Indonesia Number 50 of 1996 which is 0.02 ppm[8]. Preliminary studies have been carried out by conducting observations and direct interviews with people who live close the Cipayung landfill. It is found that 15 people who have lived more than 15 years mentioned having experienced respiratory complaints such as coughing, chest pain, and most often is a sore throat due to the stench. from landfill. Based on observations obtained smells like rotten eggs smelled quite strong even from a distance of 1 km and smelled stronger when the wind blew.

Despite of the harmful effects caused by landfill there are not previous research on health and environmental impacts on the residents living closer to Cipayung landfil. Therefore this research was conducted to be able to find out the health risks, respiratory problems and odor problems in people who live close the Cipayung landfill.

Materials and Method

Data sources and Study Population: This study uses primary data derived from data collected using questionnaire and measurement of ambient H_2S around Cipayung landfill. The population in this study were all residents of hamlet 07, Cipayung Urban Village, which is the closest settlement to the landfill. Based on the sample size, 100 people became the study samples. The inclusion criteria determined are people aged $\geq$ 18 years based on anthropometric uniformity.

Measurements: Measurements were made using a questionnaire divided into 3 parts, consisting of the characteristics of respondents (age, sex, length of stay, and distance of the house from the landfill as measured by researchers using the Google Maps), malodor perceptions, and respiratory problems. And measurement for level ambient of H_2S using a spectrophotometer with the methylene blue method.

Data Analysis: Descriptive statistics generated for the questionnaire using SPSS Software Version 20.0. Risk level of H_2S exposured obtained by calculations using the Louvard formula from the measurement results of ambient H_2S concentration.

Results and Discussions

General Characteristic of People Living Close Landfill: Table 1 shows that there were more female than male respondents in this study. In terms of age group the 18-45 years old range was the highest represented with 68%. Majority of duration of time living close the landfill was >20 years (61%). Most of the respondents live with a distance of <300 meters from the landfill which is 76%.

The existence of a landfill in an area can have an impact on the peoples who live around it[9]. Therefore the distance between the landfill site and the nearest residential area is a crucial thing. The majority of respondents in the study were respondents whose home distance from the landfill was less than 300 meters with the nearest distance of only 120 meters. This distance is not by the recommended distance between the landfill site and the residential area. Some recommendation about the distances; 1) Regulation of the Minister of Public

Works of the Republic of Indonesia the recommended distance is at least 1 kilometer[10], 2) International Solid Waste Association the recommended minimum distance is 500 meters[11], 3) Standards and Regulations of British Columbia in Canada recommend a distance of at least 300 meters[12]. The recommended distance is a consideration for the exposure of the community to pollution caused by the landfill (leachate pollution, air pollution, odor, disease vector spread). Previous research found that residential houses with short distances (<124.94 meters) with landfill have higher air pollutant yields compared to those far away[13]. In line with the results from the study by Njoku showed that seventy eight percent of participants lived closer to the landfill site (100-500 meters) indicated serious contamination of air quality evident from bad odors linked to the landfill site[14]. Furthermore the results of a study conducted by Singga on scavengers at the Kupang Alak landfill found an association between the distance of the residence of the scavengers and health problems experienced by scavengers[15].

Table 1. General Characteristic of Respondents

	Number	Percentage (%)	Min-Max	Mean
Gender				
Male	23	23	-	-
Female	77	77		
Total	**100**	**100**		
Age				
18-45 years	68	68	19-74 years	41.26 years
> 45 years	32	32		
Total	**100**	**100**		
Duration of time living close the landfill				
9-20 years	39	39	9-74 years	28.62 years
> 20 years	61	61		
Total	**100**	**100**		
Distances from landfill				
< 300 meters	76	76	120-600 meters	275.0 meters
≥ 300 meters	24	24		
Total	**100**	**100**		

Level and Risk Quotient of H2S Ambient in Around Cipayung Landfill: H_2S concentrations based on the results of measurements made at 2 points around the Cipayung landfill are 0.015 ppm (0.021 mg/m^3) and 0.012 ppm (0.017 mg/m^3). The H2S concentration exceeds the normal H_2S concentration that comes from natural sources that is 0.00011-0.00033 ppm[4]. The Risk Quetiont (RQ) lifetime value calculated from the highest H_2S concentration was 2.98. The RQ value >1 which means people living close to the Cipayung landfill are at risk of noncarcinogenic effects in the next 30 years.

Table 2. Perception of malodor (smells like rotten eggs) coming from the landfill

	Yes		No		Total	
	N	%	N	%	n	%
The smell disturbs daily activities	70	70	30	30	100	100
The smell has an unhealthy effect	75	75	25	25	100	100

Previous research by Faisya et al. regarding health risks due to H2S exposure to communities around the Sukawinatan Landfill Palembang showed that in the next 30 years duration of exposure respondents would have noncarsinogenic risk (RQ> 1) of 1.48[16]. The risk of health problems appears more quickly in the results of a study by Rifai et al. The noncarsinogenic RQ value for the next 5 years is 1.13 (RQ> 1)[17].

Malodor Perceptions of People Living Close Cipayung Landfill: In this research, shows that most respondents perceived that the smell like rotten eggs disrupts daily activities which are about 70%. And then complained that the smell like rotten eggs caused an unhealthy effect that is equal to 75% (Table 2).

Cipayung landfill which has established for more than 35 years still operates with an open dumping system. Open dumping systems that are used can have bad impacts on both the environment and human health, including causing air contamination and odor pollutions[18]. This is worsened by the situation where the landfill waste heap passed the maximum capacity, which reached 30 meters from the ground.

Based on the results of this study it was found that all respondents (100%) claimed to have smelled like rotten eggs originating from landfill, consider the odor to disturb with their daily activities are 70% and consider the odor to have an unhealthy effect on them by 75% . This is in line with the survey found that 75% strongly agree living close to a landfill raises concern for them, with the majority of reasons worrying, is due to health[19]. And then, previous research conducted by Sakawi et al. showed that 83.7% of respondents living close to landfill felt the bad odor had affected the tranquility and quality of life, and 80.5% of respondents agreed that the foul smell was associated with their health effects[20].

The smell like rotten eggs (malodor) is most often smelled by people living close landfills during afternoon which is 56%, followed at evening which is 19%, almost all day is 15%, and morning is 10% (Figure 1).

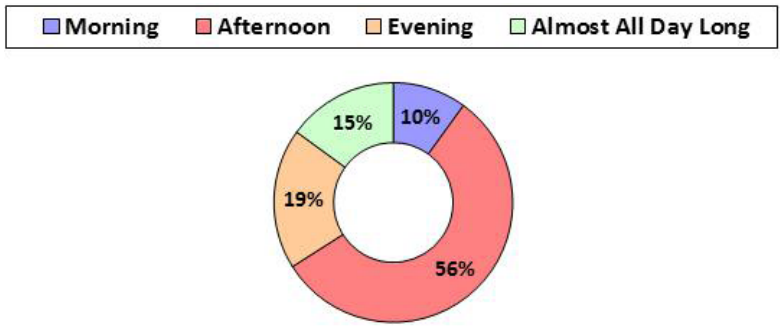

Figure 1. When it smells like rotten eggs (H_2S)

Respiratory Problems in People Living Close Cipayung Landfill: Result of this study shows that majority stated that they had experienced respiratory problems during living near Cipayung Landfill (81%) (Figure 2). Symptoms of respiratory problems that are often complained of in the last 2 weeks are cough by 25% (figure 3).

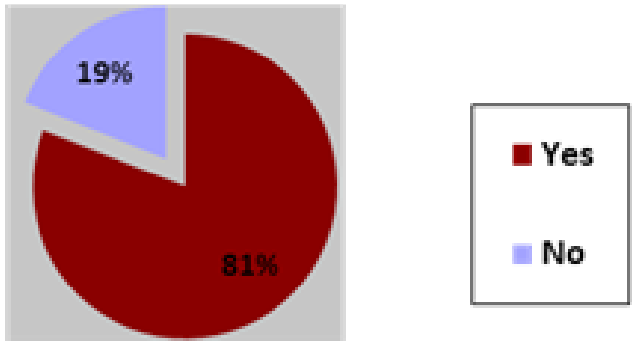

Figure 2. Have experienced respiratory problems (shortness of breath, chest pain, coughing, coughing with phlegm) during living close the Cipayung Landfill

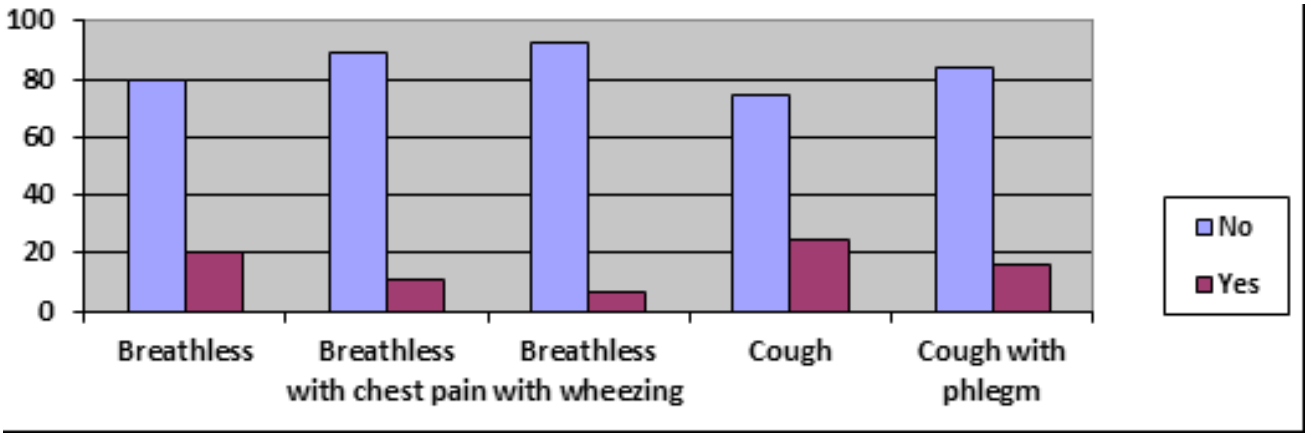

Figure 3. Respiratory problems that have been experienced in the last 2 weeks by peoples who live close the Cipayung landfill

H_2S can be smelled by humans at low concentrations in the air, ranging from 0,0005 to 0.3 ppm. Humans can be exposed to H_2S mainly through inhalation and can be quickly absorbed by the lungs. If H2S is repeatedly or prolonged exposure can cause some symptoms of health problems such as irritation of the nose, throat and eyes, headaches, difficulty breathing in asthma patients, fatigue and loss of body balance[4]. The most common health effect caused by H_2S exposure is respiratory disorders. Problems of breathing can be coughing, coughing up phlegm, breathing sounds or wheezing, shortness of breath, breathing sounds or wheezing accompanied by shortness of breath, chest pain, flu and cough accompanied by flu[3,5].

Based on the results of this study, it was found that the majority of respondents (81%) stated that they had experienced breathing problems while living near the Cipayung landfill with symptoms including shortness of breath, coughing, coughing with phlegm, shortness of breath accompanied by chest pain, and breathing sounds. This result of study in line with the research conducted by Njoku the results showed that residents who live close to the landfill experience breathing disorder while living near the landfill[14]. Then the results of a cohort study also showed an association between living close to a landfill and damage to the respiratory system, and symptoms of respiratory disorders among residents living near landfills[21]. And then, a previous study by Putri conducted on workers at the Super Depo Sutorejo landfill showed that 76.2% of workers had experienced respiratory complaints while working at the landfill[22].

Conclusion

This study evaluates the health risks, respiratory problems and odor problems in people who live close the Cipayung Landfill. This study concludes that people who live close the Cipayung landfill have risk of noncarsinogenic health disorder within the next 30 years (RQ = 2.98). This study is an important and early effort to understand the issues related to respiratory problems and malodor that emanate from Cipayung landfill. With this research, it is expected that the responsible stakeholders can make a comprehensive effort, including repairs, supervision and monitoring to reduce the health and environmental impacts caused by H2S originating from the landfill.

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