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Exhaled Carbon Monoxide Levels of Scavengers in Bantargebang Landfill, Bekasi

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ABSTRACT

Background: The scavengres in the landfill have high risk pollution exposure. Carbonmonoxide (CO) is one of important pollutant produced by burning process. Exhaled CO level in scavenger predicted increase cause by exposure pollution in workplace area. There has been no data on exhale CO in scavengers, especially in Bantar Gebang, Bekasi. **Methods:** This study used a cross-sectional design to the scavengers who work and live in Ciketing Udik, Bantargebang, Bekasi. Conducted in January-March 2015, doing interview with questionnaires, and exhaled carbonmonoxide (CO) test. **Results:** Total sample was 108 subjects. Exhaled CO test result was 46 subjects (42.6%) had exhaled CO 5-10 ppm, 36 subjects (33.3%) > 10 ppm and 26 subjects (24.1%) ≤ 4 ppm. Multivariate analysis between exhaled CO levels with subject characteristic found smoking habits was significantly correlated with exhaled CO levels (p=0,000). **Conclusion:** There was 33.3% scavengers had exhaled CO > 10 ppm. Smoking habits is the only factor that significantly correlated with exhaled CO in scavenger

Keywords: *scavengers, carbon monoxide exhalation, pollution exposure*

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INTRODUCTION

Waste disposal at the final landfill location is increasingly causing concern for the health of the population living nearby, especially with hazardous waste being disposed of. Studies on health as a result of the disposal site have been carried out, especially in North America.[1] Sanitation workers, especially garbage collectors in urban areas, are one of the occupations that posed high risk to health and safety. Increased volume, influx of hazardous waste streams, manual handling of waste, inadequate personal protective equipment (PPE), lack of awareness about health, poor sanitation, and poor environmental management at landfill sites expose workers to environment and hazardous work. Eventhough the incidence and prevalence of hazards at waste sector workers are increasing, very little research has been done in developing countries. Much research was carried out in developed countries, but the data cannot be directly extrapolated for developing countries[2,3]

There have been reported occupational health hazards associated with handling waste including skin, eyes, and respiratory system infections, accidents such as bone and muscle disorders resulting from handling heavy containers, wound infections due to contact with sharp objects, poisoning and chemical burns due to contact with a small amount of hazardous chemical waste mixed with general waste, and other injuries due to workplace accidents at landfills or due to methane gas explosions at landfill sites.[4] Based on research conducted by Abdou, there were four major health problems due to working at landfill, including respiratory infections and/ or allergies (65.5%), eye infections (48.3%), gastrointestinal infections (20.7%), and musculoskeletal injuries (17.2%).[9] A study in Karachi, Pakistan, showed that diseases that arises including tuberculosis (TB), gastric problems, respiratory problems, skin infections, and ulcers.[5]

Workers in a landfill have a significantly higher prevalence to upper and lower airway disorders and they were more often suffer from diarrhea, fungal infections, skin ulceration, burning sensation in the extremities, tingling or numbness, temporary memory loss, and depression.[6] Another study in Delhi, India in 1995, reported that workers in landfills and plant incineration have an increased risk of lung and digestive disorders.[7] The gas in the landfill consists of a mixture of different gases, including methane (45%-60%) and carbon dioxide (40%-60%). Gas in the landfill also includes small amounts of nitrogen, oxygen, ammonia, sulfide,

hydrogen, carbon monoxide (CO), and nonmethane organic compounds (NMOCs) such as trichlor-ethylene, benzene and vinyl chloride.8 These gases also have an impact on the health of workers at the landfill especially pulmonary health problems.

The aim of this study was to obtain data on levels of exhaled air CO in scavengers in Bantar Gebang Landfill and the factors that influence it.

METHODS

This study used a cross sectional study design. This research was part of a research on respiratory disorders and pulmonary function in the scavengers in Bantar Gebang Landfill, Bekasi. The place of research was rukun tetangga (RT) 01/05, Ciketing Udik sub-district, Bantar Gebang, Bekasi. The study was conducted in January - March 2015. The sample of the study was all the scavengers living in the Ciketing Udik sub-district, Bantar Gebang, Bekasi and fulfilling the research criteria. The minimum total sample needed was 97 subjects, rounded to 100 subjects.

The sampling technique was done by consecutive sampling in which every affordable population that meets the research criteria was included as a sample to meet the required sample size. The inclusion criteria were male and female, >14 years old, were able to perform the lung function test and exhaled air CO examination properly, signed the consent form and were willing to complete the research procedures. The samples were excluded if the spirometry examination was not acceptable and was not reproducible. Subjects were given a basic questionnaire and underwent spirometry examination and exhaled air CO examination. The basic questionnaire including respondent's identity data and sociodemographic data. Exhaled air CO levels were measured using the Bedfont piCO+™ Smokerlyzer® device. Data on the content of air pollutant gases including CO levels in the air were obtained from the examination results of the Jakarta City Provincial Regional Environmental Management Department (Badan Pengelolaan Lingkungan Hidup Daerah). This research was approved by Ethics Committee of the Faculty of Medicine, Universitas Indonesia.

RESULTS

This research was conducted on scavengers who live and work in the Bantar Gebang Landfill (Integrated Waste Disposal) environment, Bekasi. Samples collected were 120 samples. Of the 120 samples, only 108 samples met the study criteria.

Table 1. Exhaled Air CO Levels

Exhaled air CO levels	n (subjects)	Percentage (%)
≤ 4 ppm	26	24.1
5-10 ppm	46	42.6
> 10 ppm	36	33.3

Characteristics of the Subjects

Characteristics of the subjects consisted of gender, age group, nutritional status, education level, smoking habits, distance of the house, exposure duration and work duration. In this study, most subjects were female which were 80 subjects (74.1%) while male subjects were only 28 subjects (25.9%). The age of research subjects consisted of 15-35 years as many as 51 subjects (47.2%) and >35 years as many as 57 subjects (52.8%). Body mass index (BMI) of the subjects were normal category in 60 subjects (55.6%), less in 10 subjects, overweight in 31 subjects, and obesity in 7 subjects. The education level of subjects were 21 subjects (19.4%) never attend formal education, 78 subjects (72.2%) graduated from Elementary Schools, 7 subjects (6.5%) graduated from Junior High Schools, and 2 subjects (1.9%) graduated from Senior High Schools. Based on smoking habits, subjects were found to be nonsmokers in 75 subjects (69.4%) and smokers in 33 subjects (30.6%). The distance between the house and landfill was 81 subjects (75%) ≤200 meters and 27 subjects (25%) >200 meters. Based on the work duration, subjects were divided into ≤10 years in 49 subjects (45.4%) and >10 years in 59 subjects (54.6%). The exposure duration/day is divided into 1-6 hours/day in 48 subjects (44.4%) and >6 hours/day in 60 subjects (55.6%). All 108 subjects (100%) did not use PPE.

Exhaled air CO levels

Exhaled air CO examination results have an abnormal distribution with a median value was 7 ppm, the lowest value was 2 ppm and the highest value was 23 ppm. While the COHb results obtained a median value of 1.8% with the lowest value was 1% and the highest value was 4.4%. Exhaled air CO of ≤4 ppm was found in 26 subjects (24.1%), 5-10 ppm was found in 46 subjects (42.6%) and >10 ppm was found in 36 subjects (33.3%). The distribution of subjects based on exhaled air CO examination can be seen in Table 1.

Pollutant levels from samples of airborne particles

Data on air analysis was obtained through inspection by Jakarta City Provincial Regional Environmental Management Department. The examination was carried out for 4 times on different days (Test results 1,2,3 and 4, as can be seen in Table 2). Based on data from Jakarta City Provincial Regional Environmental Management Department, the air quality at Bantar Gebang Landfill was still below the quality standard threshold.

Table 2. Samples of Air Particles

Parameters	Denomination	Test results				Quality Standard Threshold
		1	2	3	4	
NO_2	ug/Nm^3	<10	14.3	15.1	19	400
SO_2	ug/Nm^3	<27	34.1	31.6	<27	900
H_2S	ug/Nm^3	<8	<8	<8	<8	35
NH_3	ug/Nm^3	45.5	95.5	86.3	93.6	100
CO	ug/Nm^3	342	342	1026	570	30000
TSP	ug/Nm^3	134	271	71	125	230
Pb	ug/Nm^3	0.03	0.14	0.03	0.02	1

Table 3. Relationship Between Subject Characteristics and Carbon Monoxide (CO) Levels of Exhaled Air

Variable	Carbon monoxide exhalation levels Median (Min-Max)	p-value
Gender		
Male	15 (4-23)	0.000
Female	6 (2-14)	
Age		
15-35 years old	6 (2-21)	0.058
>35 years old	7 (2-23)	
Education Level		
Uneducated	6 (2-23)	0.409
Formal education	7 (2-22)	
Nutritional status		
Normal	7 (2-23)	0.074
Abnormal	7 (2-21)	
Smoking habits		
Nonsmokers	6 (2-14)	0.000
Smokers	15 (4-23)	
House distance		
≤200 meters	7 (2-23)	0.743
>200 meters	7 (2-21)	
Exposure duration		
1-6 hours	7 (2-19)	0.007
>6 hours	11 (2-23)	
Work duration		
≤10 years	7 (2-21)	0.294
>10 years	7 (2-23)	

*Fisher test

Relationship between subject characteristics and exhaled air CO levels

Analysis of exhaled air CO levels with independent variables, including age, gender, education level, nutritional status, smoking habits, exposure duration, house distance, and work duration was done with the Mann Whitney test. The results of the analysis of exhaled air CO levels on age categories (p=0.058), education (p=0.409), nutritional status (p=0.074), house distance (p=0.743) and work duration (p=0.294) have no statistically significant relationship (p>0.05). Only gender (p=0.000), smoking habits (p=0.000), and exposure duration (p=0.007) had a significant relationship with exhaled air CO levels (Table 3).

Further multivariate analysis of exhaled air CO levels were performed on independent variables with p<0.25, including age, nutritional status/BMI, gender, exposure duration and smoking habits (Table 4). The results of the linear regression analysis showed that the variables that were significantly related to the exhaled air CO levels were gender and smoking habit variables (p=0.015 and p=0.000, respectively). Correlation analysis result on gender and smoking habit variables were -0.302 and -0.504 thus an adjusted R2=0.636 was obtained. In other words, gender and smoking habit affected the exhaled air CO levels by 63.6% and the remaining were influenced by other variables.

Table 4. Linear Regression Analysis of Carbon Monoxide Exhalation Levels

Variable	R	p-value
Age	0.022	0.717
BMI	0.060	0.319
Exposure duration	-0.083	0.224
Gender	-0.302	0.015
Smoking habits	-0.504	0.000

DISCUSSION

This research was conducted with the aim of understanding the levels of exhaled air CO in scavengers working at Bantar Gebang Landfill. Exhaled air CO examination results in this study obtained a median value of 7 ppm with the lowest value was 2 ppm and the highest value was 23 ppm. The largest percentage of exhaled air CO was at 5-10 ppm as many as 46 subjects (42.6%), followed by >10 ppm as many as 36 subjects (33.3%) and ≤4 ppm as many as 26 subjects (24.1%).

Exhaled air CO levels have long been used extensively in assessing a person's smoking status indicator.[9] Exhaled air CO levels are also a potential biomarker associated with outdoor air pollution exposure.[10] Research conducted by Maga et al., who assessed the effect of air pollution and smoking habits on exhaled air CO levels, found that in nonsmokers, higher levels of exhaled air CO were found in subjects living in large-city areas compared to smaller cities.[11] In this study, analysis of exhaled air CO levels on gender, smoking habits, and exposure duration had a significant relationship. The relationship of exhaled air CO levels to gender cannot be concluded because the majority of subjects were women who mostly do not smoke thus it can cause bias. Based on multivariate analysis, it was found that the variables that correlated significantly with exhaled air CO levels were smoking habit variable (p=0.000). The results of the study were in accordance with research by Inayatillah et al., which found that exhaled air CO levels in smokers were higher than nonsmokers.[12] Research by Maga et al., assessed the effect of air pollution and smoking habits on exhaled air CO levels and also found that exhaled air CO levels in smokers were higher than nonsmokers.[11]

Based on air sample data, the CO levels of the Bantar Gebang Landfill environment were still below the quality standard threshold value. Therefore, the increase in exhaled air CO levels in subjects was more due to their smoking habit and did not because of exposure at work. This was also causing the distance between home and work duration did not have a significant relationship with exhaled air CO levels. This research data was in accordance with the literature which showed that the air CO gas levels in landfills area were very little.[8]

The habit of smoking in scavengers in this study was closely related to exhaled air CO levels. Smoking habits at work have a high risk of respiratory disorders in workers. According to Mustajbegovic et al., smoking has a close relationship with respiratory disorders in the workplace.[13] Research conducted by Eisner et al., also supported that smoking was a risk factor that can cause health problems in the workplace.[14]

CONCLUSION

A total of 36 scavengers subjects (33.3%) had high levels of exhaled air CO which were above 10 ppm. Exhaled air CO level in scavengers was not associated with exposure to pollutants at work but was significantly related to smoking habits

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