Respiratory Symptoms and Lung Functions among Domestic Waste Collectors: An Experience in a Developing Country like Malaysia

Junaidi Djoharnis, Mohd Nazri Shafei, Kamarul Imran Musa, Mohammed Rusli Abdullah, Mohd Ismail Ibrahim *

Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kota Bharu, Kelantan, Malaysia

Corresponding Author: Dr. Mohd Ismail Ibrahim
Postal address: Department of Community Medicine, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kota Bharu, Kelantan, Malaysia
Email: ismaildr@kb.usm.my | Fax number: 609-7676654

Abstract

Introduction: Domestic waste collectors are potentially exposed to many occupational hazards which might result in health problems including respiratory illnesses. The degree of the problem might differ between develop and developing countries.

Objective: To determine the prevalence of respiratory symptoms and status of lung functions among domestic waste collectors working in the Kota Bharu Municipal Council, Kelantan, Malaysia

Methods: A cross sectional study was carried out for two months period starting from September 2008 at Kota Bharu Municipal Council. Those ages between 18 to 56 years old and have at least one year working experience were included in the study. Data on respiratory symptoms were obtained using interview-guided questionnaire and a spirometer was used to determine lung function test.

Results: Hundred and ninety one male respondents were involved in the study. There were significant difference in the proportion of those who had respiratory symptoms between domestic waste collectors and office worker: morning cough (20%, 3%), morning phlegm (32.6%, 16.7%), and shortness of breath (42.1%, 27.1%). However, the recorded patterns of mean lung function parameters were almost similar in both study groups.

Conclusion: The domestic waste collectors showed higher prevalence of respiratory symptoms as compared to the control group. There was no significant difference of lung function measurements between the study groups.

Keywords: Domestic waste collectors, respiratory symptoms, lung functions, developing country, Malaysia

Background

The growth of the world's population, increasing urbanization, rising standards of living, and rapid developments in technology have contributed to an increase in both amount and variety of solid wastes generated by industrial, domestic and other activities.[1] Dealing with greater volumes production and present of dangerous waste materials are relatively acute in management of waste in developing countries whereby the proportion of waste been produced have not been met by improvements in waste management technologies.[2] Domestic solid waste has even became one of the sources of health hazard in many developing countries. It was due to careless in handling the waste and failure to organize appropriate solid waste collection schemes and management.[3]

In Malaysia, waste management services fall under the local authority administration. It includes the process of collection and waste disposal. Agencies that are involved directly in solid waste management are the Federal and State Government as well as local authorities. In 1995, it was estimated that 5.5 million tons of domestic waste and commercial waste were generated in Malaysia. This amount has increased to 6 million tons per year in 1998 and 8 million tons in 2000. Over the period of 1991 to 2020, waste generation is estimated to increase by an average of 3.24% per annum. Domestic waste composition in urban setting of Malaysia consists of 51.8% vegetables and putrescible, 28.3% paper, 7.7% plastics, 4.9% metal, 2.3% glass as well as 2.0% textile.[4]

All activities in solid waste management involve risk. The risk could appear at any step starting from collection till disposal process at landfill. The relative risk for disease and injury for domestic waste collectors are noted to be six times more compared with the control population.[1]

Domestic waste collectors have an increased risk of respiratory and influenza-like symptoms as they are exposed to various materials found in the waste itself, irrespective of the type of waste they collect. Despite the low levels of exposure, several studies have demonstrated that it has an effect to the respiratory system and that the exposure levels are measurable.[5]

Based on several studies conducted before, environment in waste collection site is a potential place to cause health hazard because of the dusts, gases, bio-aerosols, chemicals as well as biological materials released or contacted during waste handling.[6,7,8] The effect of these substances towards the increased prevalence of respiratory diseases has been reported in Netherland, USA and Norway. Once a disease stage has occurred, a long life treatment is usually required.

Therefore, it is important to detect the disease as early as possible. Respiratory function test is one of the assessment tools that are able to detect the respiratory impairment, which occur at an early stage and the probability of developing respiratory illnesses. Respiratory impairment is a reversible condition whereas respiratory illnesses usually irreversible.[9, 10] Thus, it is important to detect respiratory impairment as early as possible in order to prevent the development of respiratory illnesses.

Although there were many worldwide epidemiological studies had shown relationship between work exposure and adverse health effects including respiratory problems. To date there was no similar study conducted in Malaysia that relates the effect of these exposures to respiratory

health of domestic waste collectors. Therefore, the present study was conducted to explore the exposure status of working environment and gather information on the respiratory health status among domestic waste collectors in northeastern Malaysia.

Methods

Study design, study population and setting

This comparative cross sectional study was conducted among Kota Bharu Municipal Council (KBMC) workers. The local authority houses all domestic waste collectors, equipments such as trucks for garbage collection and others. In this study, domestic waste collectors from the Town Service Department of KBMC were treated as the exposed group while office workers of main administrative building of the same working environment were grouped as non-exposed. Those who aged between 18 and 56 years, and have working experience for at least one year were included in the study. However those who had any medical history of respiratory illness or currently been diagnosed to have respiratory problem were excluded from the study. Similar criteria were used for non exposed group.

Sampling method and data collection method

Sample size was calculated by using two proportion formula based on the prevalence of respiratory symptoms in a study of domestic waste collectors in Netherlands.[7] We required 128 respondents per group after considering 10 percent of non-response rate.

One hundred and three workers involved in domestic waste collection under town service department and 122 office workers from KBMC who fulfilled the study criteria were included in the study. All were included as study subjects to meet the required sample size but only 95 male domestic waste collectors and 96 male office workers were consented for the study. Only male respondents were recruited as majority of the workers in the council were male.

An interview-guided questionnaire based on variables of interest was used to gather information from respondents. An interview was conducted by a single researcher to avoid interviewer bias. All information and findings were recorded. For each respondent, about 20 to 30 minutes was taken to complete the task. Information on occupational and environmental history obtained was based on the past six months period. General physical examination was carried out individually to assess the overall fitness of the workers. Then, specific examination of the chest was done in terms of inspection, palpation, percussion and auscultation. The findings were recorded as normal or abnormal. This clinical examination was conducted by the researcher.

A portable lung function test machine (Microlab 3500, UK version 6 which meets standard specifications) was used for spirometry test. The test was performed following the American Thoracic Society (ATS) recommendations.[11] It was conducted in a room located at KBMC. Before embarking on the test, a detailed explanation and instruction on how to perform the test was given to every respondent. Each of them was asked to take the deepest breath they could,

and then exhale into the sensor as hard as possible, for as long as possible, preferably at least 6 seconds. The procedure was repeated for three times and the best results were chosen. Forced vital capacity (FVC), Forced expiratory volume in one second (FEV_1), FEV_1/FVC ratio, Peak expiratory flow at 25% ($PEF_{25\%}$) and Peak expiratory flow at 50% ($PEF_{50\%}$) were then, determined. The test was also conducted by the researcher alone to avoid measurement bias.

Statistical analysis

Data management and analysis were performed using SPSS version 12. The distribution and frequencies were examined. Chi square test was used to compare the categorical data while independent t test was used to compare the numerical variables.

Ethical Consideration

This study was approved by the Research and Ethics Committee, Universiti Sains Malaysia (USM), Health Campus; reference number PPK/ST – 376 dated 6 October 2008. All data were kept confidential throughout the study.

Results

Socio-demographic characteristics of respondents

A total of 103 domestic waste collectors and 122 office workers were eligible for the study after considering the inclusion and exclusion criteria. Although the initial sample size was 99 in both groups, to strengthen the power of the study, a decision had been made to include all eligible workers. However only 95 domestic waste collectors and 96 office workers were recruited as eight waste collectors and 26 office workers not consented giving a response rate of 96.5%. The age of the respondents ranged from 24 to 56 years old. Majority of the domestic waste collectors and office workers were smokers. Their smoking prevalence was 65.3% and 54.2%, respectively. The domestic waste collectors had significantly lower education level compared to office workers Table 1a and 1b shows the socio-demographic characteristic of the respondents.

Occupational characteristics

Occupational characteristics respondents were shown in Table 2. Generally, 93 (97.9%) domestic waste collectors practiced overtime job compared to office workers [51 (53.1%) ($p < 0.001$)]. There were no significant difference between the study groups pertaining to duration of working, number of absentee due to medical sick obtained in the last six months and doing shift work.

Prevalence of respiratory symptoms

Table 3 shows the distribution of respiratory symptoms such as morning cough, morning phlegm production, chest tightness and shortness of breath between both study groups. The respiratory symptoms such as morning cough, morning phlegm and shortness of breath were significantly higher among domestic waste collectors compared to office workers. However, there was no significant difference in chest tightness symptom between the study groups.

The most frequently reported respiratory symptoms among domestic waste collectors were shortness of breath 40 (42.1%), followed by chest tightness 35 (36.8%), morning phlegm 31 (32.6%) and morning cough 19 (20%). There was slightly different in its distribution among office worker where chest tightness 30 (31.3%) was the most common symptom and followed by shortness of breath 26 (27.1%), morning phlegm 16 (16.7%) and morning cough 3 (3.1%).

Status of lung functions

Table 4 shows the differences in mean respiratory function parameters between the domestic waste collectors and office workers. There were no significant differences in all the respiratory function parameters between domestic waste collectors and office workers. Table 5 shows the differences in the result of spirometry test between the study groups. There was no significant difference of spirometry test results recorded between the study groups.

Discussions

The present study reveals that those who work as domestic waste collector is easily exposed to respiratory problems as compared to office worker. This is consistent with many studies in the past.[6,7] The workers could simply inhaled organic dust, bio-aerosols or aerosolized bacteria and fungi while commenting the work. The exposure leads to infection and inflammation of the airways and results in development of respiratory symptoms. The symptoms might vary from one country to others and in the present study most of the workers complained of shortness of breath while study conducted in the Netherlands, majority of the exposed group complained of cough. While an epidemiological study conducted in Mumbai, India [12] reported that prevalence of cough was higher among sewage worker compared to other symptoms. The differences could be due to many factors like differences in climate, types of waste and personal attribute of the worker such as smoking as we noticed that a large portion of the workers in the present study were active smokers and came from low education background. The respiratory problems also occur in other type of occupations like quarry worker but the content of the irritant might be different.[13] Even though the causative agent are different, those workers need to be informed about the risk so that the condition will not get worse. Despite the presence of high prevalence of respiratory symptoms in this study, there was no abnormal physical finding on the respiratory system detected during examination. This was probably best explained by the appearance of physical signs later than the appearance of symptoms in most of the respiratory diseases such as in chronic obstructive pulmonary disease (COPD). In COPD, symptoms such as cough may

initially intermittent in nature and physical signs of airflow limitation are rarely present until significant impairment of lung function occurred.[14] As a result, during physical examination, the signs might not be detected by the researcher.

The spirometry results showed that domestic waste collectors had no significant differences in all respiratory function parameters compared to office workers. These findings were similar with other studies. For example, Sunyer *et al*., (2005) in his 9-year prospective study on general population aged 20 to 45 who were occupationally exposed to vapors, gas, dust, or fumes, reported that the exposed individuals did not show steeper decline in FEV_1 than office workers (non-exposed) nor an increase of prevalence or incidence of airway obstruction (defined as FEV_1/FVC ratio < 0.7) during the follow-up. [15]

Only 12.6% of domestic waste collectors and 13.5% of office workers had abnormal spirometry test results. Higher prevalence of smoking in both study groups might have contributed to the similarity of the findings. Another possible explanation of the overall lack of effect on lung function includes the age of the subject enrolled in the study. Majority of them were relatively young. The defect could not be easily seen because the decline of lung function and prevalence of airway obstruction with increasing age, were less pronounced during youth and early adulthood.[16] Furthermore, factors such as non-occupational outdoor pollution, indoor pollution as well as environmental tobacco smoke, poor and undetectable flaws in spirometry method, in both study groups possibly contributed to the insignificant different in the results.

The present findings in this study have several potential limitations. The presence of healthy worker effects might cause the relationship between lung function parameters and various occupational factors to be none of significance. Health assessment that was done might not reflect the true health status of the workers and the exposure status of the work environment due to limited study design. Non-occupational outdoor environment pollution such as automobile exhaust fume, dusty surrounding and environmental tobacco smoke create hazardous dust and fumes could affect the respiratory health to both study groups and might act as cofounders to the study.

Conclusion

In conclusion, there was a certain degree of effect on respiratory health from chronic exposure to hazardous materials found in domestic waste among domestic waste collectors. Nevertheless, the symptoms could become serious if no proper preventive measures are put in place. Further study with better design such as prospective cohort with a larger sample is required to identify associated factors contributing to development of respiratory problems. It is important to identify risk factors among domestic waste collectors so that an intervention packages could be developed to reduce the exposure and hence to prevent the occurrence of adverse health effects**.**

Grant registration number: 304/PPSP/6139012

Acknowledgement

We would like to acknowledge all the domestic waste workers and office workers of the Municipal Office Kota Bharu Kelantan who participated in this study and the USM for providing financial support to the study.

References

1. Cointreau S. Occupational and Environmental Health Issues of Solid Waste Management: Special Emphasis on Middle and Lower Income Countries. *The World Bank Group Washington, D.C*, 2006.
2. Wilson DC, Balkau F. Adapting hazardous waste management to the needs of developing countries – An overview and guide to action. *Waste Management & Research.* 1990;6(2):87-97.
3. UNEP. *Solid waste*. Available at http://www.unep.org. Accessed June 15, 2008.
4. Abdul Manaf L, Abu Samah MA, Mohd Zukki NI. Municipal solid waste management in Malaysia: Practices and challenges. *Waste Management.* 2009;29:2902-2906
5. Kuijer PPFM, Frings-Dresen MHW. World at work: Refuse collectors. *Occup Environ Med.* 2004;61:282-286.
6. Heldal KK, Halstensen AS, Thorn J. et al. Upper airway inflammation in waste handlers exposed to bioaerosols. *Occup Environ Med.* 2003;60:444–50.
7. Wouters IM, Hilhorst SKM, Kleppe P et al. Upper airway inflammation and respiratory symptoms in domestic waste collectors. *Occup Environ Med.* 2002;59:106–12.
8. Betsinger G, Brosseau LM, Golden J. Occupational health and safety in household hazardous waste management facilities. *Am Ind Hyg. Assoc Journal.* 2000;61:575-583.
9. Cotes JE, Steel J. *Work related lung disorder*, Oxford: Blackwell Scientific Publication. 1983.
10. Cotes JE. *Lung function: Assessment and application in medicine*, London: Blackwell Scientific Publication. 1993.
11. ATS. Standardization of Spirometry update. American Thoracic Society. *Am J Respir Crit Care Med*. 1994;152:1107-1136.
12. Giri PA, Kasbe AM, Aras RY. A study on morbidity profile of sewage workers in Mumbai city. *International Journal of Collaborative Research on Internal Medicine & Public Health.* 2010; 2(12):450-463.

13. Razlan M, Lin Naing, Zulkifli A, Rusli N. Respiratory symptoms and pulmonary function among male quarry workers in Kelantan, Malaysia. *Malaysian Journal of Public Health Medicine.* 2002;2:54-57.

14. Pauwels RA, Buist AS, Calverley PM, Jenkins CR, Hurd SS. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. *Am J Respir Crit Care Med.* 2001;163:1256-1276.

15. Sunyer J, Zock JP, Kromhout H, Garcia-Esteban R. et al. Lung function decline, chronic bronchitis and occupational exposures in young adults. *Am J Respir Crit Care Med.* 2005;172:1139-1145.

16. Robbins DR, Enright PL, Sherrill DL. Lung function development in young adults: is there a plateau phase? *Eur Respir Journal.* 1995;8:68-77.

Table 1a: Socio-demographic characteristic of respondents (numerical data)

Variables	Waste Collectors (n = 95)	Office workers (n = 96)	t statistic (df)	P value*
	Mean (SD)	Mean (SD)		
Age (year)	39.9 (9.14)	41.1(9.06)	1.18 (189)	0.240
Duration of smoking (year)	20.7 (9.46)	20.4 (9.86)	-0.196 (189)	0.845
Number of cigarette/day	11.0(6.44)	12.8 (9.30)	1.29 (189)	0.201

*Independent t-test

Table 1b: Socio-demographic characteristic of respondents (categorical data)

Variables	Waste Collectors (n = 95)	Office workers (n = 96)	χ^2 (df)	P value*
	No (%)	No (%)		
Smoking status				
Smoker	62(65.3)	52 (54.2)	2.44	0.188
Non Smoker	33 (34.7)	44 (45.8)	(1)	
Marital status				
Single	14 (14.7)	10 (10.4)	2.75	0.257
Married	81 (85.3)	84 (87.5)	(2)	
Divorce	0	2 (2.1)		
Education status				
Primary school	20 (21.0)	1 (0.01)	94.24	**<0.001**
Secondary school	75 (79.0)	64 (66.7)	(2)	
Tertiary education	0 (0)	31 (32.3)		

*Chi square test

Table 2: Occupational characteristics of the respondents

Variables	Waste collectors (*n*=95)		Office workers (*n*=96)		*t* statistic	χ^2 value	df	p value
	Mean (SD)	No. (%)	Mean (SD)	No. (%)				
Duration of working (yr)	11.2 (8.76)		10.3 (9.36)		-0.71		189	0.479*
MC last 6 months (day)	1.38 (3.3)		1.56 (4.75)		0.31		189	0.757*
Overtime								
Yes		93 (97.9)		51 (53.1)		-	-	<0.001 $^{\Psi}$
No		2 (2.1)		45 (46.9)				
Shift work								
Yes		8 (8.4)		8 (8.3)		-	-	0.983 $^{\Psi}$
No		87 (91.6)		88 (91.7)				

*Independent t test, $^{\Psi}$ Fisher Exact Test

Table 3: Differences in distribution of respiratory symptoms in the study groups

Symptoms	Waste collectors (*n*= 95)	Office workers (*n*= 96)	χ^2 value	df	(p value)*
	No. (%)	No. (%)			
Morning cough					
Yes	19 (20.0)	3 (3.1)	13.34	1	<0.001
No	76 (80.0)	93 (96.9)			
Morning phlegm					
Yes	31 (32.6)	16 (16.7)	6.56	1	0.01
No	64 (67.4)	80 (83.3)			
Shortness of breath					
Yes	40 (42.1)	26 (27.1)	4.765	1	0.029
No	55 (57.9)	70 (72.9)			
Chest tightness					
Yes	35 (36.8)	30 (31.3)	0.665	1	0.415
No	60 (63.2)	66 (68.8)			

*Chi square test

Table 4: Differences in mean respiratory function parameters in the study groups

Lung function parameters	Waste collectors (*n*= 95) Mean (SD)	Office workers (*n*= 96) Mean (SD)	*t* statistic	p value*
FEV1 (liter)	2.82 (0.56)	2.87 (0.57)	0.69	0.489
FVC (liter)	3.29 (0.64)	3.43 (0.71)	1.51	0.132
FEV1/FV	0.86 (0.09)	0.84 (0.09)	-1.13	0.258
PEF at 25% (liter)	1.46 (0.73)	1.49 (0.90)	0.20	0.843
PEF at 50% (liter)	3.87 (1.30)	3.91 (1.35)	0.23	0.817

*Independent t test

Table 5: Differences in the spirometry test in the study groups

Spirometry test result	Waste collectors (*n*= 95) No. (%)	Office workers (*n*= 96) No. (%)	χ^2 value	df	p value*
Normal	83 (87.4)	83 (86.5)	4.00	6	0.677
Abnormal	12 (12.6)	13 (13.5)			
The friction of abnormal findings:					
Borderline obstruction	1 (1.1)	3 (3.1)			
Mild obstruction	1 (1.1)	0 (0)			
Moderate obstruction	1 (1.1)	0 (0)			
Mild restriction	8 (8.4)	8 (8.3)			
Moderate restriction	1 (1.1)	1 (1.0)			
Severe restriction	0 (0)	1 (1.0)			

*Chi square test