

Factors Associated with Vital Lung Capacity on Road Sweeper Workers

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Abstract

The decrease level of vital capacity can be restriction, obstruction or both of them. Some factors, like non jobs and environment can lead the decrease level of vital capacity. The goals of this research is knowing all factors that have associated with vital capacity of street sweeper in Kecamatan Medan Denai. The research was conducted on September 2018. The factors of this research are work period, exposure period, mask utilization, employment history, disease history, smoking and sports habits. The total sample of this research are 67 workers. The method of this research was cross sectional. Data was collected by using research instruments such as peak flow meter and questionnaires. The results showed that workers with more than 5 years of service experienced a decrease in KVP as many as 62 people (92.5%) and workers who did not use masks decreased by 53 people (79.1%). Based on the results of statistical tests, it is known that the variables of working period and the use of masks are associated with a decrease in KVP. To reduce the decrease level of street sweeper's vital capacity, it is recommended that workers are leave the workplace right after the job is done and use mask at work site all the time.

Keywords: Street Sweeper, Vital Capacity, Work Environment

Introduction

The vital lung capacity (KVP) is the total maximum amount of air that can be forcefully exhaled after a maximum inspiration. Inspiratory reserve volume and expiratory reserve volume (Tarwoto, 2000). Measurement of KVP can provide information about the amount of deviation or decrease in value that can determine a person's lungs are in a normal state or not (PDPI, 2013).

According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number 25 of 2008, a decrease in KVP can be in the form of restriction, namely the occurrence of lung limitations (West, 2003). Lung capacity will be reduced in lung disease, heart disease (which causes pulmonary congestion) and respiratory muscle weakness (Pearce, 2008). According to Gill (2003), lung function can be affected by a number of non-occupational factors including age, gender, lung size, race, height, and smoking habits. Several research results also prove that there are several factors associated with VVC.

Another factor is the length of exposure. Based on research conducted by Asna et al (2013), it was found that there was a relationship between duration of exposure and a decrease in vital lung capacity. This proves that the length of exposure has a negative effect on someone who works because the longer the exposure, the hazards posed by the workplace can affect health, especially the respiratory tract. Dust is a substance that is toxic (poison). According to WHO (1993), dust causes cough reflex or laryngeal spasm (stopping breathing). If dust penetrates into the lungs, it can cause toxic bronchitis, pulmonary edema or pneumonitis. The results of medical research show that dust particles measuring 0.1-5 μ m can remain in the alveoli as respiratory dust, while larger particles will persist in the mucous membranes of the nose, throat, trachea, and bronchi which will then be expelled through the mechanism. heart work (Riyadina, 1996).

The impact of continuous dust exposure results in a high accumulation of dust in the lungs which causes abnormalities and damage such as decreased lung capacity called obstruction and pneumoconiosis (Paudyal & Shakya, 2016). Dust particles can cause a decrease in the vital capacity of the lungs, so that it will reduce the optimal use of breathing apparatus to take oxygen in the respiration process (Sukarman, 1978). In Indonesia, the sick rate reaches 70% of workers who are often exposed to dust. Most work-related lung diseases have serious consequences, namely a decrease in lung capacity, with the main symptom being shortness of breath (Hesti, 2012). Based on the description above, the researcher is interested in examining the factors related to the vital lung capacity of street sweeper workers in Medan Denai District.

The lungs have the function of exchanging oxygen and carbon dioxide. Oxygen, which combines with carbon and hydrogen from tissues, allows each cell to carry out metabolic processes and the results of the process in the form of carbon dioxide can be removed from the body (Pearce, 2008). The vital capacity of the lungs is the total maximum amount of air that can be forcefully exhaled after a maximum inspiration. Lung vital capacity was obtained from the addition of tidal volume (TV), inspiratory reserve volume (VCI) and expiratory reserve volume (Shah et al., 2011). The maximum amount of air that a person can exhale after filling the lungs to the maximum and expelling as much as possible is 4,600 ml (Tarwoto, 2009).

Measurement of KVP can provide useful information about the strength of the respiratory muscles and other aspects of lung function. According to the Regulation of the Minister of Manpower and Transmigration of the Republic of Indonesia Number PER.25/MEN/XII/2008 concerning Guidelines for Diagnosis and Assessment of Disabilities Due to Accidents and Occupational Diseases, a decrease in vital lung capacity results in:

Restriction is a disorder of lung expansion due to any cause. The lungs become stiff, the inward pull is stronger so that the chest wall shrinks, namely KV (Vital Capacity), KPT (Total Lung Capacity), VR (Residue Volume), VCE (Expiratory Reserve Volume) and KRF (Functional Residual Capacity). (PDPI, 2013).

Obstruction is a lung disorder characterized by airflow obstruction in the airways that is progressive, non-reversible or partially reversible. Obstruction consists of chronic bronchitis and emphysema or a combination of both. Airway obstruction is irreversible and occurs due to structural changes in the small airways, namely inflammation, fibrosis, goblet cell metaplasia and smooth muscle hypertrophy which are the main causes of airway obstruction (PDPI, 2013).

Measurement of lung capacity consists of various methods. The following measurement methods are often used to measure lung capacity:

Spirometry is a lung function test that is commonly used and is useful for determining lung volume, lung capacity and air flow velocity (Giuliodori & DiCarlo, 2004).

Spirometry is used to determine lung function, detect lung disease, evaluate respiratory disorders, and monitor work-related lung diseases (McCarthy, 2015).

The way to use spirometry is that the patient is asked to do maximum inspiration then do maximum expiration into a pipe connected to spirometry. Measurements are repeated several times until the appropriate results are obtained (National Jewish Health, 2013).

A pulmonary plethysmograph is a test used to measure the amount of air that can be stored in the lungs. Pulmonary plethysmography helps health care providers to assess patients with lung disease that is often associated with total lung capacity. Plethysmography measurements are based on the principle of Boyle's Law which describes the relationship between pressure and volume of a gas.

The method of using pulmonary plethysmography is that the patient is placed in an airtight room in a standing or sitting position. The clip will be attached to the patient's nose to prevent air from entering the nostril. The patient is asked to breathe through the mouthpiece while the mouthpiece is open and closed. The occurrence of chest movement during breathing will change the pressure and amount of air in the chamber and funnel. From these changes, accurate results are obtained about the amount of air in the lungs or total lung capacity (Stang, 2017).

The Peak Flow Meter is a small, easy-to-use instrument that measures how well a worker's lungs are doing. This is done by measuring peak expiratory flow to determine how quickly the patient exhales after maximal inspiration. Peak Flow Meters are used to help identify lung work patterns and provide information for preventive measures against asthma.

Peak Flow Meter measurement is done by asking the patient to do maximum inspiration while standing or sitting upright, then the air is expelled with maximum expiration into the tube. Repeat the process up to 2-3 times then select the highest value from the measurement results and record it on the measurement sheet. This measurement should be done routinely to determine the changes that occur in the patient's lungs (National Jewish Health, 2012).

The working period is all calculations of the number of years of service in the work period, the longer a person's working period, the more likely that person has a greater risk of experiencing a decrease in vital lung capacity (Tamuntuan, 2013).

The length of exposure is the time a person spends in the work environment in a day (Mengkidi, 2006). The length of time a person works is generally around 6-8 hours a day, if the working time is extended it will cause high inefficiency and even cause disease due to the length of time a person is exposed to pollutants such as dust in the work environment. If workers are exposed to dust for a long time above the NAV, it is likely that respiratory tract disorders will arise (Suma'mur, 1996).

Guyton & Hall in Anugrah (2014) stated that conditions such as tuberculosis, emphysema, asthma, lung cancer and fibrous pleurisy can all reduce vital lung capacity. The history of the disease includes, among others, the onset of symptoms, symptoms during early disease, subsequent disease development, work-related relationships, etc. (Suma'mur, 1996).

Work history can be used to determine the possibility that one of the factors at work or at work can cause diseases such as the presence of dust generated by handling, crushing, grinding, rapid impact and blasting (Suma'mur, 1996).

Work history can describe whether the worker has been exposed to dusty work, hobbies, first job, work in certain seasons, etc. (Ikhsan, 2002).

The protection of workers through technical efforts to secure the place, equipment and work environment really needs to be prioritized (Suma'mur, 1996). Personal protective equipment (PPE) is a tool that has the ability to protect someone in work whose function is to isolate the workforce and provide effective protection against hazards (Nedved, 1991).

Workers whose work activities are heavily exposed to dust particles require personal protective equipment in the form of masks to reduce the number of particles that may be inhaled. Workers who obey using masks when working will minimize the amount of exposure to particles that can be inhaled (Budiono, 2007).

Smoking is one of the factors that affect lung function, one of which is the vital capacity of the lungs. Smoking can cause changes in the structure and function of the respiratory tract and lung tissue. In the large airways, the mucous cells enlarge and the mucus glands multiply. In the small respiratory tract, there is mild inflammation to narrowing due to increased mucus accumulation cells. In lung tissue there is an increase in the number of inflammatory cells and damage to the alveoli. As a result of changes in the anatomy of the airways, in smokers there will be changes in lung function and all kinds of clinical changes (Depkes RI, 2003).

There is a reciprocal relationship between lung capacity and exercise. Disorders of the lungs can affect the ability to exercise otherwise regular exercise can increase lung capacity (Sahab, 1997). Exercise can increase blood flow through the lungs, causing oxygen to diffuse into the pulmonary capillaries with a larger or maximum volume (Prasetyo, 2010).

Methods

This type of research is analytical using a cross sectional study design, which is a study to study the dynamics of the correlation between risk factors and effects through approaches, observations or data collection all at once (point time approach) (Notoatmodjo, 2010). That is, data concerning the independent variable and the dependent variable will be collected at the same time. The independent variables studied were years of work, length of exposure, smoking habits, use of masks, smoking, medical history, work and exercise history, while the dependent variable studied was the vital lung capacity of street sweeper workers in Medan Denai District.

The population in this study were street sweeper workers in Medan Denai District as many as 67 workers. Sampling in this research uses total sampling where the sampling is the same as the existing population.

The research instruments used in this study were peak flow meters and questionnaires. The data collected is sourced from primary data obtained from the measurement results of the variables to be studied directly. Primary data collected were vital lung capacity, years of work, length of exposure, use of masks, smoking, medical history, work and exercise history.

The data collected is primary data obtained directly through; (1) Measurement of vital lung capacity, Measurement of vital lung capacity in workers is done using a peak flow meter; (2) Questionnaire, the questionnaire includes a list of questions to obtain supporting data from workers.

Results and Discussion

Table 1. Frequency Distribution Based on Lung Vital Capacity

		Frequency	Percent
Valid	Not Normal	40	59,7
	Normal	27	40,3
	Total	67	100,0

Based on Table 1, it can be concluded that of the 67 respondents based on the vital lung capacity, 40 (59.7%) were abnormal and 27 (40.3%) were normal.

Table 2. Distribution of Frequency Based on the Length of Service

		Frequency	Percent
Valid	Less than 5 years old	5	7,5
	More than 5 years	62	92,5
	Total	67	100,0

Based on Table 2, it can be concluded that of the 67 respondents based on tenure, namely less than 5 years, there were 5 (7.5%) people and more than 5 years 62 (92.5%) people.

Table 3. Frequency Distribution by Length of Exposure

		Frequency	Percent
Valid	less than 8 hours	59	88,1
	more than 8 hours	8	11,9
	Total	67	100,0

Based on Table 3, it can be concluded that of the 67 respondents based on the duration of exposure, which is less than 8 hours, there are 59 (88.1%) people and more than 8 hours, there are 8 (11.9%) people.

Table 4. Distribution of Frequency Based on the Use of Masks

		Frequency	Percent
Valid	Not using	53	79,1
	Use	14	20,9
	Total	67	100,0

Based on Table 4 it can be concluded that of the 67 respondents based on the Use of Masks, namely not using 53 (79.1%) people and Using 14 (20.9%) people.

Table 5. Frequency Distribution by Smoking

		Frequency	Percent
Valid	No Smoking	40	59,7
	Smoke	27	40,3
	Total	67	100,0

Based on Table 5 it can be concluded that of the 67 respondents based on the History of Smoking, namely not Smoking, there were 40 (59.7%) people and Smoking 27 (40.3%) people.

Table 6. Distribution by Disease History

		Frequency	Percent
Valid	No History of Illness	63	94,0
	There is a History of Disease	4	6,0
	Total	67	100,0

Based on Table 6 it can be concluded that of the 67 respondents based on Disease History i.e. no History of 63 (94.0%) people and There is a History of 4 (6.0%) people.

Table 7. Frequency Distribution by Sports History

		Frequency	Percent
Valid	No Sports	55	82,1
	Sport	12	17,9
	Total	67	100,0

Based on Table.7 it can be concluded that of the 67 respondents based on Sports i.e. not Sports numbered 55 (82.1%) people and Sports 12 (17.9%) people.

Univariate Analysis

Distribution by Vital Capacity of the Lungs

Based on Table 1, it can be concluded that of the 67 respondents based on the vital lung capacity, 40 (59.7%) were abnormal and 27 (40.3%) were normal.

Based on Tarwoto's (2009) study, vital lung capacity is the total maximum amount of air that can be expelled strongly after inspiration. Maximum lung vital capacity is obtained from the addition of tidal volume (TV), inspiratory reserve volume (VCI) and expiratory reserve volume.

Distribution Based on Length of Service

Based on Table 2, it can be concluded that of the 67 respondents based on the tenure of less than 5 years, 5 (7.5%) people and more than 5 years 62 (92.5%) people.

Based on Anugrah's 2014 research, it was concluded that length of service could affect the capacity of the pulmonary vial in workers. If the lung condition is exposed to various pollutant components, the physiological function of the lung as the main organ of respiration will experience a number of pollutant components. The longer a person works, the more exposed to the dangers posed by the work environment

Distribution by Length of Exposure

Based on Table 3, it can be concluded that of the 67 respondents based on the duration of exposure, which is less than 8 hours, there are 59 (88.1%) people and more than 8 hours, there are 8 (11.9%) people.

Based on Asna et al (2013) it is concluded that there is a relationship between the length of exposure and a decrease in the vital capacity of the lungs. This proves that the length of exposure has a negative effect on someone who works because the longer the exposure, the hazards posed by the workplace can affect health, especially the respiratory tract.

Distribution Based on Mask Use

Based on Table 4, it can be concluded that of the 67 respondents based on the use of masks, 53 (79.1%) people do not use masks and 14 (20.9%) people use them.

Based on Suma'mu's 1996 research explaining the use of personal protective equipment, masks are related to the number of particulates that accumulate in the lungs due to pollution which can reduce the ability of lung function lungs.

Distribution By Smoking

Based on Table 5, it can be concluded that from 67 respondents based on smoking history, there are 40 (59.7%) people and smoking 27 (40.3%) people.

Based on the Indonesian Ministry of Health, 2003 smoking is one of the factors that affect lung function, one of which is the vital capacity of the lungs. Smoking can cause changes in the structure of the respiratory tract and lung tissue.

In the small respiratory tract, there is mild inflammation to narrowing due to increased mucus accumulation cells. In lung tissue there is an increase in the number of inflammatory cells and damage to the alveoli.

Distribution By Disease History

Based on Table 6, it can be concluded that from 67 respondents based on a history of disease, namely no history, there were 63 (94.0%) people and 4 (6.0%) people.

Based on the 2010 fatma research, the main cause of death is no longer infective diseases but has shifted to degenerative diseases. Old age is the age when the risk of developing degenerative diseases is greatest during the life cycle. If an elderly person has a degenerative disease then his nutritional intake is very important to pay attention to.

Distribution by Sports History

Based on Table 7, it can be concluded that from 67 respondents based on sports, namely no sports, 55 (82.1%) people and sports 12 (17.9%) people.

Based on Russell's 1998 research, sport plays an important role in improving a person's quality of life. During exercise, the cardiorespiratory system works together.

Bivariate Analysis

Relationship between working period and vital lung capacity in street sweeper workers

That 62 workers who have worked for more than 5 years have an abnormal KVP. Based on the results of statistical tests, the p-value was 0.005, which is less than $=0.05$ so that there was a significant relationship between tenure and KVP. Therefore, it can be said that there is a significant relationship between tenure and KVP. From the results of the analysis, the value of OR = 1,227, it means that workers who have a longer working period are at risk of 1,227 times having abnormal KVP compared to workers who work 5 years. 95% CI obtained was 1.025 – 1.469. The results of this study are in line with research conducted by Asna et al (2013), concluding that there is a relationship between duration of exposure and vital lung capacity.

The Relationship between Mask Use and Vital Lung Capacity in Street Sweeper Workers

A total of 53 workers do not use masks and have abnormal KVP. Based on the results of statistical tests obtained p value of 0.008 which is less than $= 0.05$. Therefore, it can be said that there is a significant relationship between the use of masks and KVP.

From the results of the analysis, the OR value = 5.294, meaning that workers who do not use masks are at risk of 5.294 times having an abnormal KVP compared to workers who use masks. 95% CI obtained is 1.450 - 19.330. The wide 95% CI range occurs due to the small number of samples in the study.

The results of this study are in line with research conducted by Sari, 2013 which showed a relationship between the use of masks and vital lung capacity.

Conclusion

Based on the results of research and discussion of factors related to vital lung capacity of street sweeper workers in Medan Denai District, it can be concluded that the working period factor with P value = 0.005 is smaller than = 0.05 and the mask use factor with P value = 0.008 smaller than = 0.05, which means that these two factors have a significant relationship with vital lung capacity (KVP).

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