

Original article:

Factors associated with pulmonary function disease in fire officer

¹Tiyar Junaedi, ²Tri Martiana, ³Arief Wibowo

^{1,2}Department of Occupational Health and Safety, Public Health Faculty, Airlangga University, Surabaya, Indonesia.

³Departement of Biostatistic and Demographic, Public Health Faculty, Airlangga University, Surabaya, Indonesia

Corresponding author : Tiyar Junaedi

Abstract:

The high number of fires in Surabaya was a problem for fire officers. The greatest impact of the fires on human health was the most deadly smoke. The smoke is the most dangerous killer that must be observed by everyone who was around him. One effect of the smoke was disturbing lung function. Pulmonary Function Disease (PFD) is one of the work-related diseases caused by many factors, which factors in the workplace have a role along with other risk factors and diseases. The purpose of this study was to analyze factors associated with pulmonary function in fire officers. This observational study was used a cross-sectional approach conducted at 55 fire officers. Fisher's exact test showed that individual factors (age, smoking habits, nutritional status, PPE usage habits, exercise habits), occupational factors (length of service) were associated with PFD in fire officers. Expected Fire Department of Surabaya to implement age restrictions for fire officers in the field, supervision of personnel on the use of PPE, provision of personal protective equipment for all fire officers, to regulate the ban on smoking, regular exercise three times a week, keeping Mass Index body (BMI) remained normal threshold through socialization and training on the dangers of the main fire hazards of smoke and gas.

Keyword: Work Related Disease, PFD, Fire officer.

Introduction:

The high number of fires in Surabaya was a problem for fire officers. Fire Department of Surabaya has mentioned an increasing in fires is high enough for 5 years, in 2010 the total number of fire as many as 197 times the incident, while the 2014 fire numbers as much as 596 times the incident. The demands of the community to work quickly and accurately make fire officers less attention to the health and safety of themselves during a blackout task. In the course of his blackouts, fire officers have high risk exposure to hazardous materials. Hazardous materials can enter through the nose and damage the respiratory tract, if hazardous substances are swallowed and enter through the mouth, gastrointestinal tract may be decreased function and if hazardous materials are exposed to the skin can damage the skin or be absorbed into the skin.

The greatest impact of the fire for fire officers is healthy which cause of death is the smoke. Smoke is one of the factors that cause the most deaths were caused by fires that deserves special attention. The high hazard and the risk of

death caused by smoke is generally caused by high gas temperatures and hazardous and toxic gases contained in the fumes. Among the hazardous and toxic gases contained in the gas is carbon monoxide (CO), carbon dioxide (CO₂) and other toxic gases. Given the impact of the officer recommended have the tools or personal safety to prevent respiratory problems such as PFD. Fire officers are susceptible to illnesses arising from the employment relationship. Diseases are caused by a working relationship with the term work-related disease is a disease caused by many factors which workplace factors play a role along with other risk factors and diseases caused have complex causes.

The fires in work environment is very dangerous and high risk to the health and safety of fire officers. Illness can be aggravated, accelerated or relapse by environmental exposure to fires and reduce working capacity. The individual nature of a fire officer, environmental and socio-cultural factors generally act as a risk factor and is more common than occupational disease. Research on lung function in fire officers mostly done abroad. Previous research found 332 fire

officers suffer from coughing, shortness of breath and upper and lower respiratory tract after the blackout in the WTC. Result of the Ju Hwan Choi research, said that there was a significant decrease in lung function at 333 fire officers. Similar research conducted in South Australia by Alan Crocket in December 1999 - July 2003 says there are 82 (16.4%) fire officers have a health record decline in lung function.

Fires in Surabaya was very varied include pampas grass fires, trash fires, fires densely populated, factory fires, fire vehicles and others. Techniques and strategies outages can be done to reduce the number of accidents at the scene of the fire primarily related to the lung function. Lack of Self Contained Breathing Apparatus (SCBA) provided by the Fire Department to force members to do other types of respiratory protective equipment, namely gas mask canister or regular fabric. Things must be done by fire officers, among others, (1) not entered the area that smoke was very thick due to gas canister and a cloth mask used to have restrictions faced smoke or gas, (2) put on nozzle combination which can emit a jet nozzle and spray. Attack jets spray can dispel smoke and heat effectively. Factors associated with decreased of lung function in fire officers are individual factors, occupational factors and work environment factors. Individual factors include age, smoking habits, nutritional status, the habit of using personal protective equipment (PPE), exercise habits.

Occupational factors include length of service by fire officers. Factors in the work environment, namely when the task at the scene extinguishing the fire. Fire coming from the house, building or vehicle fires produce smoke, where concentration and spread of smoke depends on the chemical composition and the burning products, such as interior, home furnishings, and others. Based on previous studies in the field known for some reaction fire officers are mostly complaining runny nose, shortness of breath and coughing at work. If this condition is ignored the possibility of occupational diseases to be increased. Understanding the magnitude of the health risks that occur in fire officers, will be an important thing to know the causes of pulmonary function impairment who often felt

by fire officers. Various protection should be given to minimize the risk of poor health.

Method:

This observational study using cross sectional design was studied the dynamics factors associated to the lung function in fire officers at Surabaya City. Observation or data collection at once at one time. This research was conducted at the Technical Implementation Unit of West Surabaya, Surabaya City Fire Department and implementation of the data collection was in July-August 2015. The sample 55 people taken at random. The independent variables that will be examined is the individual factors (age, nutritional status, smoking habits, PPE usage habits, exercise habits) and occupational factors (length of service), while the dependent variable is the PFD. Lung function of the respondents were analyzed for interference pulmonary ventilation function that restrictive ventilation disorder, obstructive and mixed. Data is collected using questionnaires, observation sheets, bath and body weight scale, microtoice, and spirometer. Data collected in the computational analysis using *fisher exact test*, using the value of α : 0.05.

Results:

1. Description of age, nutritional status, smoking habits, PPE usage habits, exercise habits, working life, and lung function.

Indian Journal of Basic and Applied Medical Research

**Is now with
IC Value 91.48**

Table 1. Distribution of respondents by age, nutritional status, smoking habits, PPE usage habits, exercise habits, length of service, and lung function.

Age(years)	Number	(%)
16 – 25	15	27,3
26 – 35	9	16,4
36 – 45	20	36,4
46 – 55	9	16,4
56 – 65	2	3,5
Total	55	100,0
Smoking habits	Number	(%)
Not a smoker	19	34,6
Light smokers	7	12,7
smokers Medium	11	20,0
Heavy smokers	18	32,7
Total	55	100,0
Nutrition Status	Number	(%)
Normal	18	32,7
Malnutrition	2	3,6
Obesity	35	63,6
Total	55	100,0

PPE Usage Habits	Number	(%)
Always	14	25,5
Rarely	32	58,2
Never	9	16,3
Total	55	100,0
Exercise Habits	Number	(%)
Routine	5	9,1
Rarely	40	72,7
Never	10	18,2
Total	55	100,0
Length of service (years)	Number	(%)
1 - 10	28	50,9

11 – 20	20	36,4
21 – 30	4	7,3
31 – 40	3	5,4
Total	55	100,0
Lung Function	Number	(%)
Disorders	6	10,9
No Disorders	49	89,1
Total	55	100,0

Table 1 shows the majority of respondents aged 36 to 45 years (36.4%), most respondents smokers (65.4), most have the nutritional status of obesity (63.6%), sometimes using PPE (58.2 %), most rarely exercise (72.7%). Most respondents have length of service under 10 years (50.9%), there are six (10.9%) of respondents.

2. Analysis of individual factors and length of service with PFD.

The results of the analysis of the influence of individual factors and length of service with PFD are summarized in Table 4.

Table 4. Analysis of individual factors and length of service with PFD

Variable	P-value	Explanation
Age	0,006	Significant
Smoking habits	0,019	Significant
Nutritional habits	0,028	Significant
PPE usage habits	0,015	Significant
Variable	P-value	Explanation
Exercise habits	0,016	Significant
Length of service	0,025	Significant

Table 4 shows that there is a relationship between the age with PFD. The results of calculations known that increasing age of the respondents will potential for greater PFD, there is a correlation between smoking and lung problems. This means that respondents who are heavy smokers are have greater potential of PFD exposed than light smokers or non-smokers. There is a correlation between nutritional status and PFD, the

nutritional status of respondents with overweight have a greater potential affected PFD than who are malnutrition or good. There is a correlation between respiratory protective equipment (PPE) usage habits with lung problems. This means that respondents who never wear respiratory protective equipment have a greater potential disorder lung function than those who occasionally or never wear respiratory protective equipment. There is a correlation between exercise habits with lung problems. This means that respondents who never exercise regularly exposed to large potentially PFD than those who rarely or regularly exercise. There is a correlation between working period with PFD, the respondents who have a long working life potential decline in lung function compared with short duration of working.

Discussion:

1. The relationship of individual factors (Age) with PFD.

Fisher exact statistical test showed there was significant relationship between age with PFD in fire officers with $p = 0.021$. There is a 3.63% attendant who was under 49 years of PFD, and there are 7.3% of the officers who was 49 to 58 years of PFD. The results showed the increasing age more potential decreased fire officers lung function. It is as disclosed Pallock ML (1971), pulmonary diffusing capacity, pulmonary ventilation, vital capacity and all other parameters of lung function decreases in accordance with increasing age, after reaching a maximum in adulthood. PFD in fire officers may caused by the older person will get degeneration respiratory muscle and elastic tissue, it will decrease respiratory muscle strength and can reduced causing decrease ability to breathe. The older age will be more and more lung alveoli damaged, causing no function of alveoli and a shift in the walls of the alveoli.

This study was supported by the Sunyono (2001) opinion, argue that age is associated with aging. The older person, the greater possibility of decline in lung function. Maximum muscle strength at the age of 20-40 years and would be reduced by 20% after the age of 40 years. Similarly, the need for energy substances continue to rise until finally declining after the age of 40 years,

reduced need of energy has caused the decrease of physical strength. This is evidenced in Mengkidi study (2006) found that more than 30 years of age is a risk factor for PFD, which means employees with over 30 years old got the potential PFD is 1.7 times greater than less than 30 years old. Thus, it can be concluded from these results that the older worker have more risk of get PFD.

2. The relationship of individual factors (smoking) with PFD

There is a significant relationship between the smoking habit with PFD in fire officers with $p = 0.019$. 90% of the PDF officers are heavy smokers and 10% were light smokers. The data show the more cigarettes smoked, the potential for PFD is greater. Officers who have the habit of smoking could potentially get PFD. The decline in forced expiratory volume per year was 28.7 mL for non-smokers, ex-smokers to 38.4 mL and 41.7 mL for active smokers. The effect of cigarette smoke can be greater than the effect of dust only about a third of the adverse effects of cigarettes (MOH, 2003). Raharjo et al (1994) revealed that smoking can cause lung ventilation disorder because it causes irritation and excessive bronchial secretions. The more often the frequency of smoking be a risk factors of PFD, because the number of cigarettes consumed per day was very influential, the more smoke then the officer can reduce lung function.

3. The relationship of individual factors (nutrition) with PFD

The nutritional status is also associated with PFD in fire officer. All of PFD fire officers have the obesity nutritional status, while the officer with the normal nutritional status get nothing less PFD. The data shows the abnormal nutritional status is potentially PFD. Poor nutritional status will cause a person's endurance will be decreased, so the immune deficiencies, a person will be easily infected by microbes. Respiratory tract infections related to the event repeatedly and with a productive cough, it can cause chronic bronchitis. One effects of malnutrition can lower immunity and

antibodies that a person prone to infections such as coughs, colds, diarrhea and reduced ability to detoxify the body against foreign substances that enter the body. Likewise, the nutritional status of obesity, will lead to increased metabolism of the body including lung organ. So that the workers who had normal nutritional status do not have the risk of pulmonary function impairment or decline in lung function was higher than normal nutritional status.

4. The relationship of individual factors (PPE usage habits) with PFD.

There is a relationship between habitual use of PPE with PFD in fire officers with $p = 0.015$. 80% fire officers with PFD, never wear respiratory protective equipment and 20% rarely wear respiratory protective equipment. The data indicate the officer who rarely or never wear respiratory protective equipment is potentially PFD. According Tarwaka (2008), protective devices are used to protect from the risk of exposure to respiratory gases, vapors, dust, or contaminated air or toxic, corrosive or nature stimuli. Selection of an appropriate respiratory protective equipment is to find out information about potential hazards or contaminants that exist in the workplace. Thus concluded that the officers were not wearing or rarely wear respiratory protective equipment has the potential risk of pulmonary function impairment caused by products of the fire entering through the respiratory tractus.

5. The relationship of individual factors (exercise habits) with PFD

There is a relationship between exercise habits with PFD in fire officers. 80% fire officer with PFD have rarely do sports and sports officials, who routinely perform no PFD. These results showed the clerk who never exercise potentially PFD than the exercise routine. According to Yunus (1997), regular exercise can improve blood flow through the lungs will cause pulmonary capillary perfusion maximum gain, so O₂ can diffuse into the pulmonary capillaries with larger volumes or maximum. Exercise should be done at least three times a week. The

result conclusion the more rare officer exercise, the more potentially impaired or decline in lung function due to exercise breathing ability to be much better.

6. The relationship of individual factors (length of service/work) with PFD.

Working period is a period of a person who has worked in an office, agencies, entities, and so forth. The longer a person is in the works, the more he had been exposed to the dangers posed by the work environment (Suma'mur, 1996). Workers who are in the work environment with high dust levels in a long time have a higher risk of pulmonary obstruction. Based on the studies show that the life of over 10 years has a risk of lung obstruction in a dusty industrial workers (Sugeng, 2003).

The results showed no relationship length of service with PFD, there are four officers who have a life of over 10 years of PFD, and two officers working period of 0-10 years of PFD. Observation, showed the clerk with length of service of more than 10 years receive exposure to higher gas and smoke. This can increase the risk of PFD or decline in lung function. So concluded the longer term officers working, the higher of disorder or decrease in lung function. World Health Organization said data on the number of working hours per week on the activities of employees exposed to chemicals can be used to estimate the cumulative exposure received by an employee. PFD in employee may depending on the length of exposure and the exposure dose received. Exposure to low levels for a long time may not immediately show their pulmonary function impairment. The relationship between exposure and effect is highly dependent on three things: the level of fumes or gases in the air, the cumulative exposure dose (summation level in the air and the duration of exposure) and the residence time or duration of the chemicals are in the lung. Exposure to low levels in the long term cause less severe disease than exposure to high levels in a short time.

Conclusions And Suggestions:

Conclusions

1. There is a relationship between individual factors such as age, smoking habits, nutritional status, PPE usage habits, exercise habits with PFD in fire officers.
2. There is a relationship between work factors (length of service) with PFD in fire officers.

Suggestion

Based on the research that can be put forward suggestions in this study are as follows:

1. Surabaya City Fire Department should need to increase supervision on the use of personal protective equipment and safety of fire officers.

2. Require further investigation for officers who diagnoses decreased lung function to minimize the severity of the health problems and save the data.
3. For the Surabaya City Fire Department, the need to consider setting more appropriate job rotation for fire officers that had decreased lung function.
4. Need to provide self contained breathing apparatus for fire officers who carry out tasks in the field blackout.
5. The need for strict rules to be made smoke-free areas in the workplace.
6. For the fire officers need to raise awareness to stop smoking and can also implement good personal hygiene like washing clean work clothes before going home.
7. Fire officers are expected to perform regular exercise at least three times a week to improve fitness.

Reference:

1. Pallock ML, 1971. Effect of walking on body composition cardiovascular function of middle age man, journal of applied physiology 1971.101.30 no. 1.
2. Sunyono, 2001. Deteksi dini penyakit akibat kerja, EGC, Jakarta.
3. Mengkidi, 2006. Gangguan fungsi paru dan faktor yang mempengaruhi pada karyawan semen tonasa, eprints undip/15845.
4. Ministry of Health, 2003, Metod Penelitian, Jakarta Ghalia Indonesia.
5. Raharjo et al, 1994, Perubahan fungsi paru dan faktor yang mempengaruhi. Cermindunia kedokteran, http://www.whoma/ensormental_information/air/guidelines/html.
6. Tarwaka, 2008, keselamatan dan Kesehatan kerja, manajemen dan implementasi K3 di tempat kerja, harapan press Surakarta.
7. Yunus, 1997, faal paru dan olahraga, J. Respir. Indonesia, 1997;17, <http://library.usu.co.id>.
8. Budiono, Sugeng, A.M. 2005. Bunga Rampai Hiperkesdan KK. Badan penerbit UNDIP. Semarang