Welding fumes exposure decreases forced vital capacity but not height among welders

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Abstrak

Latar belakang: *Asap pengelasan antara lain dapat menyebabkan penurunan kapasitas vital paksa (KVP). Tujuan penelitian ini adalah untuk mengidentifikasi beberapa faktor yang dapat berhubungan dengan KVP pada pengelas.*

Metode: *Studi ini menggunakan desain potong lintang pada subjek pengelas di pabrik mobil sekitar Jakarta tahun 2012. Responden dipilih secara purposif. Pemeriksaan KVP menggunakan spirometri. Data pajanan asap didapatkan dari data yang dimiliki perusahaan. Data demografi, kebiasaan, dan pekerjaan diperoleh dengan wawancara.*

Hasil: *Jumlah responden 124 dari 150, rentang umur 19-55 tahun dan telah bekerja antara 1-16 tahun. Data pajanan asap pada area pengelasan adalah 15 mg/m^3, Pajanan asap pengelasan cenderung menurunkan kapasitas vital paksa [koefisient regresi (r) = -0,004, 95% interval kepercayaan (CI) = -0,01;-0,00] dan makin tinggi tinggi badan cenderung KVP meningkat (r= 0,35; 95% CI = 0,02;0,05).*

Kesimpulan: *Pajanan asap pengelasan cenderung menurunkan KVP, sebaliknya semakin tinggi tinggi badan cenderung meningkatkan KVP.* ***(Health Science Indones 2012;1:41-4)***

Kata kunci: *pajanan asap pengelasan, tinggi badan, kapasitas vital paksa*

Abstract

Background: Welding fumes caused the decreasing of forced vital capacity (FVC). The study aimed to identify several factors related to FVC.

Methods: The subject of this cross-sectional study consisted of welders in an automobile manufacture outskirt of Jakarta in 2012. We used purposive sampling selection. The assessments of FVC were using spirometri. Exposure fumes value of the workplace based on the assessements of the factory. Demographic and employment data was selected from interview.

Results: A number 124 out of 150 welders which aged between 19-55 years who's had 1-16 years worked. Exposure fumes value was 15 mg/m^3 in the factory. The welding fume exposure decreased FVC [regression coefficient (r) = -0.004; 95% confidence interval (CI) = -0.01;-0.00]. On the other site, those who had more taller height had higher FVC (r = 0.035; 95% CI = 0.02;0.05).

Conclusions: Welding fumes exposure was decreasing the FVC, but those who had more taller height had higher FVC among welders. ***(Health Science Indones 2012;1:41-4)***

Key words: welding fume exposure rate, height, forced vital capacity

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One of the highest exposures among welder is welder fume produced by the welding process. The fume, which potentially harmful, would eventually get into the alveolar space and induces functional impairment, such as pulmonary vital capacity impairment (FVC).[1-5]

Aside from the welding fume, FVC deterioration among welder related to several risk factor, such as work duration, age, height and smoking.[1,6]

Several studies shown several risk factors related to the decreased FVC among welder. Erhobar et al. reported that the welders have pulmonary function impairment.[2] Moreover, Chinn et al. also reported an irreversible effect on forced expiration volume in one second (FEV_1) and lung capacity (FVC) among welding workers in 7 years follow-up. The study had also shown a relationship between smoking duration and welding activity with pulmonary function.[2,3] The other report by Pourtaghi et al. noted that there were 31.9% welders with FVC impairment in Iran.[7]

This study aimed to identify the correlation between welding fume exposure and several risk factors related to FVC among welder.

METHODS

This cross-sectional study was conducted among welder in a manufactory within the industrial area at Jakarta suburb in 2012.

The participating subjects were all welders who were willing to participate in the study which meet the inclusion criteria. The inclusion criteria were: (1) welder aged between 18-55 years; (2) did not have underlying disease (sinusitis, septum deviation, bronchitis, and pulmonary tuberculosis); (3) agreed to undergo a spirometri test, and (4) agreed to fill the informed consent form. Meanwhile, the dropout criteria were those who unfinished and off standard spirometri test quality.

The data collected consisted of structured interview with questionnaire to inquire several information, such as bio data, socioeconomic status and culture (marriage status, education level and work length), and continued with spirometri test. The spirometri test was performed as a following step, preparing a calibrated chest 101 spirometri device followed by subject data input, such as age, sex, body height and weight.

The spirometri test was done in the muffler manufacture in Jakarta for 5 days. Spirometri measurement was performed according to American Thoracic Society (ACT) guidelines. Prior to measurement, subjects were asked to stop smoking one hour before measurement. Subjects were also not allowed to have an excessive meal and spirogram reproducible result criteria were met (after three expiration).[10, 11]

The next step was putting the mouthpiece in the subject mouth and put the nose clipper on subject nostril (in order to produce a rhythmic respiration, subject were asked to breath normally for a moment before examination), subject then were allowed to have a relax breathing before the examiner asked to do forced expiration (uninterrupted). If the test procedure was done correctly, a curve and data will be shown on the spirometri monitor. The test was done twice. When the examination was finished, the mouthpiece was taken off and followed by data and curve verification and printing. Every measurement was performed minimally three times. The criteria for a reproducible spirogram result were (after the third measurement) two out of three FVC and FEV_1 result had variation less than 5% or 100 ml.

Forced vital capacity was maximum air volume that could be expired forcefully. The measurements were performed in 3 second forced expiration and has normal value 4 L (FVC 80% or more).

The measurement units in this study were as followed: age in years, height in centimeter, smoke duration in years, total fume exposure in mg year/m^3 and FVC in liters.

Total welding workers in this manufactory were 196 workers. Out of them, 46 welding workers were still in contract negotiation with the company. We had 150 welders agreed to participate this study. Out of 150, 26 subjects were excluded from this study because two subjects had asthma and one subject had common cold, while the rest did not meet the qualifying criteria for the spirometri measurement. Leaving 124 subjects who participated this study..

Linear regression was used for analysis using STATA released 9 program.

The Ethical Committee of Faculty of Medicine of Universitas Indonesia granted ethical clearance for this study.

RESULTS

As shown in table 1, FVC were likely homogeneous among subjects [coefficient of variation (CV) = 16.6%]. Smoking duration did not homogen (CV = 110.4%), meanwhile education level was the most homogeneous item (variation = 2.2%).

As shown in table 2, it seemed that there was negative correlation between age and smoking duration with FVC. Increased age and smoking duration might decrease FVC.

Table 3 (final model) shows that body height and total welding fume exposure were two dominant factor related to FVC. One unit of welding fume exposure decreased 0.004 of FVC. On the side, every 1 centimeters body height increment increased 0.035 L of FVC.

Table 1. Several demographic characteristics and other risk factors to the decreasing of FVC

	n	Mean	Std. Dev	Min	Max	Coef. var (%)
Age	124	27.96	6.03	19	41	21.6
Education (year)	124	12.02	0.27	12	15	2.2
Exposure (unit)	124	36.20	23.44	5	86	64.7
Employment (year)	124	6.75	4.35	1	16	64.4
Height (cm)	124	167.14	6.08	150	183	3.6
Smoking duration (year)	124	5.87	6.48	0	25	110.4
Forced vital capacity	124	3.55	0.59	2	5	16.6

Table 2. Age and smoking duration with forced vital capacity

Forced vital capacity	Regression coefficient	95% confidence interval	P
Age	-0.02	-0.04 ; -0.00	0.017
Konstanta	4.13	3.64 ; 4.62	0.000
Smoking duration	-0.01	-0.02 ; 0.00	0.119
constant	3.62	3.48 ; 3.76	0.000

Table 3. Significant correlation between forced vital capacity and other significant factors

Variabel	Regression coefficient	95% confidence interval	p
Exposure (year)	-0.004	-0.01 ; -0.00	0.047
Height (cm)	0.035	0.02 ; 0.05	0.000
constant	-2.17	3.55 ; 3.93	0.000

DISCUSSION

There were several limitations in this study, among others, time and sample limitation. The study which was a cross sectional study, and did not able to have all of the welders in the factory. In addition, our study only had one environmental data on welding fume exposure in the factory, which limits the comprehensive analysis.

Age has higher risk in decreasing FVC value. Older age decreasing FVC pathophysiologically. Accordingly, cells degenerate as part of aging process. Cell degeneration also a pose risk to lung tissue, which could impaired lung tissue elasticity.[13]

Smoking duration were also negatively correlated with FVC. Our finding was similar with the study conducted by Pourtaghi in Iran, which showed that there was relationship between smoking duration with cough and sputum production, thus could increase the risk of bacterial infection that might induce pulmonary functional impairment, known by measuring FVC among welder.[7,14]

Our finding also noted that welding fume exposure decreased risk of FVC among welder. Our finding did not differ with the study conducted in Iran (Pourtaghi G) which conclude that welding fume exposure level was a risk factor for pulmonary functional impairment.[7]

Our study also noted that there were correlation between welding fume exposure on FVC. In opposition, body height was dominant factor affecting FVC. Our finding was similar with the study conducted by Elizabeth (USA) that explained the effect of body height on FVC.[15]

In conclusion, welding fumes exposure tended to decrease the FVC, but those who had more taller height had higher FVC among welders.

Acknowledgments

The authors would like to thank the related company for allowing us to conduct the study using their workers, Special appreciation for all the subjects who participated in this study,

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