Scholars Journal of Applied Medical Sciences (SJAMS) **ISSN 2320-6691 (Online)**
Sch. J. App. Med. Sci., 2014; 2(5F):1913-1916 **ISSN 2347-954X (Print)**

(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com **DOI:** 10.36347/sjams.2014.v02i05.085

Research Article

Correlations Exposure CO, SO_2, NO_2, Metal Fume and Vapor with Lung Disfunction of Blacksmith

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Abstract: The study was analytic observational, and cross sectional design conducted in the sub Districts of Daha Utara and Daha Selatan. Blood sampling, measuring of CO, SO_2, NO_2 gases, metal fume and vapor, and Forced Vital Capacity (FVC), Forced Expiratory Volume$_1$ (FEV_1) and Mixed ($FVC+FEV_1$) were conducted at Kandangan hospital, and Balai Hiperkes and keselamatan Kerja South Kalimantan Province, respectively. The population of studies was the entire blacksmiths in sub districts of Daha Utara and Daha Selatan. The sampling procedure was based on purposive sampling predefined by inclusion and exclusion criteria with a sample of 38 units and 38 blacksmiths. Result were analyzed observational, and cross sectional design using Pearson correlation test, logistic regression, and test of Partial Least Square (PLS). Pearson correlation test showed a significant correlation exists due to exposure of CO, NO_2, and metal fume. This was indicated by the FVC with p:< 0.05, although SO_2 and metal fume was not significant. The results of logistic regression showed: (1) a significant correlation due to exposure of CO, SO_2, NO_2, metal fume, and vapor indicated by the FEV_1 with p:< 0.05; (2) a significant correlation due to exposure of CO, SO_2, NO_2, metal fume, and vapor with the mixed disfunction ($FVC +FEV_1$) with p:< 0.05. In conclusion, This study demonstrates the presence of a positive and significant correlation due to exposure of CO, NO_2, and vapor leading to FVC, FEV_1, and mixed type. Exposure of SO_2 and metal fume gives positive and significant correlation with the occurrence of the FEV_1, however there is not significant correlation with the occurence of FVC.
Keywords: CO, SO_2, NO_2, metal fume and vapor exposure, restrictive(FVC), obstructive (FEV_1) and mixed.

INTRODUCTION

Blacksmith centers is located in the sub District of Daha Utara and Daha Selatan, and District of Hulu Sungai Selatan, South Kalimantan Province. This centers has been producing agricultural tools, household tools, souvenirs, ships wheel, since many years ago. The manufacture process of metal tools began with the metal burning in a furnace with a combustion temperature of around 600^{o}C - 900^{o}C by using fuel from wood and charcoal, while the average temperature is 34^{o}C in the working environment[1-2].

The workers have been doing their job daily without any personal protection, continously exposed to various pollutants such as CO, SO_2, NO_2, metal fume and vapor, and Diesel Exhaust Particles (DEP) [1]. The continous irritation by those pollutans along the mucosa of the upper respiratory tract produces mucosal inflammations. Consequently, there will be an increased permeability of this layer and enable the antigenic particle and allergens fron environment easily enter the mucosa. Exposure of allergenic substances to some people induces allergic reaction[3-4].

Other previous studies were cross sectional studies by loaking medical record of the employees at the nickel mining and processing at the site plant. These employees were more likely had experienced on lung disfunction compared to employees outside of the site plant OR=5 times (95%), CI=1.331-17.998, prevalence=39.2% - 73.6% with a risk of 5 times[5].

Exposure of CO, SO_2, NO_2, metal fume, and vapor or DEP of exposure to received in a long period of time will affect on lung function and immune response. Lung disfunction suffered by on blacksmiths is restrictive, obstructive or mixed type. Based on the above case studies, we were interested to investigate the correlation of CO, SO_2, NO_2, metal fume, and vapor exposure with lung disfunction on the subjects. The study hypothesis was that a positive correlation between CO, SO_2, NO_2, metal fume, and vapor of exposure with lung disfunction. The studies was the analytic observational, with cross sectional study design.

METHODOLOGY

The studies was conducted over the period of 20 months from February - November of 2011 - 2013. The

study was conducted at the unit of blacksmiths, namely in (a) district of Daha Utara, at Desa Panggandingan. (b) District of Daha Selatan, at Desa Sungai Pinang and Desa Tumbukan Banyu. Blood sampling was dose to measure of CO, SO_2, NO_2 gases, metal fume, and vapor. Examination by using spirometry was conducted at Balai Hiperkes and Keselamatan Kerja South Kalimantan Province. The inclusion criteria of the subjects were as follow age 25 - 50 years, working period of at least 5 years, had never worked on a similar job before, never smoking. While the exclusion criteria were those who refused to participate in the study, had an allergy, pulmonary tuberculosis and other lung infections. Techniques of sampling in this study was purposive sampling that meet the inclusion and exclusion criteria were 38 units, and 38 blacksmiths.

The independent variables were CO, SO_2, NO_2, metal fume, and vapor, while the dependent variables were restrictive, obstructive and mixed type and the controlled variables were age and year duration of work. Chemicals and equipment used in this study were water bath, spectrophotometry brand Biosystem BTS-305 type, brand hetto oven, pH meter (cyberscan), vortex mixer VM-300, fridge (sharp), glassware (pyrex), gas analyzer (Factory by; USA, Tech), and spirometry on calibration.

RESULT AND DISCUSSION

The results of this study indicated that the mean of air parameters quality at workplace were CO=11.539 mg/Nm^3, SO_2=0.013 mg/Nm^3, NO_2=0.033 mg/Nm^3, metal fume=5.479 mg/Nm^3*, and vapor=5.924 mg/Nm^3* (notice:* Above the threshold value by SE Menaker No. 01/Men/1997 with ≤5 mg/Nm^3). For restrictive morning conditions there were 28 (74%) respondents abnormal with the details there were 20 (53%) respondents had a restrictive light and there were 8 (21%) respondents have been affected restrictive was, while there were 10 (26%) responders normal. Later in the afternoon found 28 (74%) abnormal respondents with the details there were 15 (40%) respondents had a restrictive light and 13 (40%) respondents who have restrictive was, then normal there were 10 (26%) respondents. Having performed a paired t- test a significant difference (p: 0.001< α) between restrictive morning with afternoon. For obstructive in the morning there were 9 (24%) respondents with details of existing 8 (21%) respondents had obstructive light and there was 1 (3%) respondent had obstructive moderate, then the afternoon there were 24 (63%) respondents who experience obstructive to the details there are 22 respondents (58%) had obstructive ligth, and there were 2 (5%) respondents who experienced obstructive being. Having performed a paired t- test a significant difference with (p: 0.004< α) between obstructive morning with afternoon. For the mixed abnormalities in the morning there were 8 (21%) respondents have been affected, and in the afternoon there were 22 (58%) respondents were susceptible to interference. Having performed a paired t -test was not significant (p: 0.431> α) in the morning or in the afternoon.

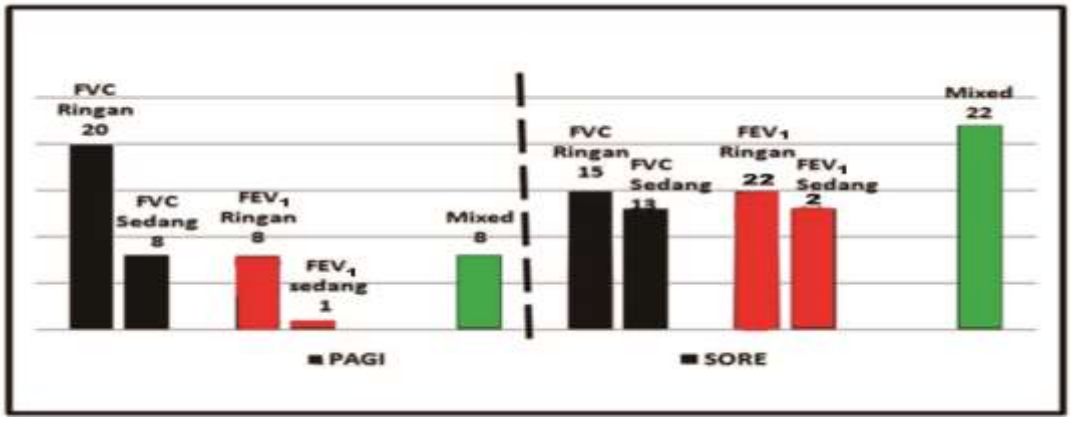

Fig-1: Differences in Lung Disfunction Blacksmith Morning and Evening .
(Ringan=Light, Sedang=medium, Pagi=Morning, Sore=Evening)

For a CO, NO_2, and vapor of exposure with restrictive a significant correlation (p value: 0.026., p value: 0.029, and p: 0.003< α). As for the parameters to SO_2, and metal fume not significant correlation (p: 0.173 and p: 0.359> α). For a CO, SO_2, NO_2, metal fume, and vapor of exposure with obstructive a significant correlation (p: 0.049< α). For a CO, SO_2, NO_2, metal fume, and vapour of exposure with of mixed has a significant correlation (p: 0.037< α). For a CO, SO_2, NO_2, metal fume, and vapor of exposure with total IgE has a significant correlation (p: 0.043< α).

Factors contributing to the overall relationship exposure of CO, SO_2, NO_2, metal fume and vapor with restrictive, obstructive and mixed. Blacksmiths is the source of risk or potential hazards and the characteristics of pollutants that always exposes blacksmiths in the work every day, where they work is always close to the source of danger as well as the high temperatures (mean 34^0C) as a result of various combustion process that has lasted long enough where exposes blacksmith is also in the works are not using

and Occupational Health and Safety principles which adversely affects health, especially the occurrence of various infections and allergies.

Goldsmith *et al*. [6] reported that the gas is distributed in the body especially in the lungs and are stored in a long time. The above factors, combined with the likely reaction of the gas is released into the air and bind with other substances. Devalia *et al*.[7] also explains that the gas or substances that are released into the air will react with each other and supporting each other in decreasing lung function. Zein *et al*. [8] suggest that the disease appear due to metal fume exposure, namely metal fume fever leading to the development of respiratory disease. Buerke *et al*. [9] reported the presence of interstitial pulmonary fibrosis (IPF) after long-term exposure, increasing the prevalence of weight or many in the workplace that has poor ventilation. Erhabor *et al*. [10] reported that 40.9% were working in the welding industry, many were suffered from restrictive lung disease (interstitial lung disease). Other possible factors were less clean or hygienic work environment and no exhauster available. Consequently, those pollutants exposes intensively to the blacksmiths, and other possibilities for the pollutants of combination in the air, causing a reaction and pollutants become more reactive, corrosive and toxic if blacksmiths inhaled. This is consistent with the experts of opinion who say that the particles or a mixture of composition of organic and inorganic agents to lower lung function in reaction contribute, and increased disorders other, respiratory particularly passages, including transition metals during the combustion process, and Polycyclic Aromatic Hydrocarbons (PAH) derived from combustion processes various kinds of metals combustion, as well as a source of bacterial endotoxin[11-12].

Some of the particles and target cells influence each other, such as transition vanadium and copper metals are found capable of mediating cytokine gene expression induced by residual oil and ash that pollutes the air in the work environment of the particle emission sources[13]. Lipopolysaccharide (LPS) appears to be the main element or part of the Urban Air Pollution (UAP)[14-15]. Other aspect possibly influence the blacksmiths was physical exhaustion as indicated by fatique and pain. This condition also reduced immunity and finally many symptoms appear, such as throat, cough, night fever etc. Mis perception among the blacksmiths on the concept of health and sick for instance, they believe that they are shill healthy because they are able to work. Body condition of blacksmith are always forced to work, always adjacent to the source of pollutants and the working environment of heat (34^oC) due to the burning of materials of various types such as ironwood, charcoal, iron plate, then an entry point for a pollutants of variety that is corrosive and toxic work environment, which is certainly more endurance and the emergence of a variety of pulmonary function abnormalities. This is consistent with studies many suggest the role of fuel due to the blacksmith of activity capable inflammation of causing. In the particles from the combustion or DEP (Diesel Exhaust Particles)[16]. Several studies of the pollutants of interaction have been involved either directly or indirectly to immune system cells such as lymphocytes and mastosit [17]. Thus, if the DEP, metal fume, gas and other pollutants synergize with allergens will affect on mast cells and lymphocytes to produce of IL-4 and IgE, and also induce the secretion of chemokines from epithelial cells. Mononuclear alls will be recruited and activated to molecule in inflammatory reactions[18].

Presence of excessive pollutants exceeded the threshold value of the metal fume, and vapour based on SE Menaker No. 01/Men/1997< 5 mg/Nm^3, will be corrosive and toxic. Other reaction many occur between CO, SO_2, and NO_2 of pollutants and made worse condition in the working environment. The temperature of a hot working environment (34^oC), physical condition also accelerated blacksmith to get tired, so the immune system decreases.

The studies [18, 19, 20] describes the CO, SO_2, NO_2, metal fume, and vapor levels in the work environment is toxic to the every day to exposed for a long time and continuously, and will inflammatory effects, the increase in cytokine product, and lung injury, this is the main entrance to the disorder or other body reactions including allergies and the various pulmonary infections and other respiratory tract. This is likely due to DEP (Diesel Exhaust Particles) of exposure, and due to incomplete combustion, which uses fuel wood and charcoal ironwood type, and also where iron plate burnt potentially very have toxic effects if burned at a high temperature (>600^oC), and will be pneumosiderosis, neutrophilic inflammation, as well as a blacksmith constantly exposed to any work in a long time, providing the potential for interference with the lung function, other infection, and immunoglobulins levels.

CONCLUSION

In conclusion, this study suggests the presence of a positive and significant correlation due to exposure of CO, NO_2, and vapor to the obstructive and mixed type. Exposure of SO_2 and metal fume gives positive and significant correlation with the occurrence of the obstructive and mixed type, however there is not significant correlation with the occurrence of restrictive, with $\alpha = 0.05$.

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