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Particulate Matter ($PM_{2,5}$) Increases MDA Levels Serum of Workers at Surabaya Bus Station

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Abstract- Particulate matter ($PM_{2,5}$) in the air that are free radicals and enter through the respiratory station workers. Inability of antioxidants neutralize free radicals will increase MDA levels serum and cause oxidative stress. The aim of this study was to look at the differences in MDA levels serum and $PM_{2,5}$ influence on MDA levels serumon several main station attendant Surabaya. The design of this study was an analytic observational with cross-sectional study. The population in this study was bus station workers and administration workers, large of samples were 12 people in each group. Measurement of $PM_{2,5}$ with EPAM 5000 and MDA levels in serum using TBA test method. The results of t test analysis 2 free samples to show that there are differences in serum MDA levels were highly significant (ρ <0.05) in the bus station workers and administration workers. Multiple linear regression showed that there are significant $PM_{2,5}$ exposure and body mass index (ρ <0.05) on serum levels of MDA. The conclusion of this study is the $PM_{2,5}$ exposure can increased serum levels of MDA on several main bus station workers. Suggestions for health officials to control the station regularly and use a mask while on duty in the area of Surabaya station.

Keyword: Bus Station, $PM_{2,5}$, Free Radical, Malondialdehyde, Oxidative Stress

1. INTRODUCTION

Transportation in Indonesia showed a significant rise in the number. Air pollution is composed of a pollutant that can cause health problems such communities, particulate matter, carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2). Surabaya station is one of the public places with air pollution from the exhaust emissions.

PM2,5 have an aerodynamic diameter of less than 2,5µm, is part of the more dangerous because it has the ability to penentrasi deeper into the lungs and reach the alveolar. [1]

Constituent particles consisting of organic and non organic compounds, constituents of these can trigger the formation of ROS. Oxidant particles through the mechanism may increase seven times the activity of NF-κB in the human respiratory tract. NF-κB is a transcription factor that can induce genes in various proinflammatory cytokines and enzymes that result from mediators of inflammation and the immune system. [2] [3]

a oxygen having one unpaired electron to become reactive. high concentrations of ROS in the body will react with non-radical compounds and will spur the emergence of such a chain reaction of peroxide fat. These reactive oxygen species can also cause damage to the body of molecules, including proteins, carbohydrates and DNA. Due to the high possibility of damage caused by the biological systems that are radical oxygen compounds are considered to have contributed to aging factors and the incidence of other chronic diseases. [4] [5]

Oxidative stress occurs when the ROS is not sufficiently neutralized by antioxidants such as superoxide dismutase (SOD), Catalase (Cat), Gluthation Perokside (GPx). Malondialdehyde (MDA) is an indicator of lipid peroxides. The ratio of MDA can be used as an indicator of oxidative stress were measured in serum using the TBA test. If the value of MDA increased, then this indicates the high oxidative stress conditions. [6]

Serum MDA activity is influenced by characteristics such officer, age, smoking habits and body mass index (BMI). The aim of this study was to determine the effect $PM_{2,5}$ on MDA levels serum on workers at Surabaya bus station.

2. METHOD

The design of this study was an analytic observational research with cross-sectional study. The population in this study consisted of two groups, bus station workers and administration workers with size sample 12 people in each group with formula. [17]

$$n = \frac{2.\sigma^2.(Z_\alpha + Z_\beta)^2}{(\mu_1 - \mu_2)^2}$$

Spesification:

Z_α= adjusted standart deviasion α (1,96)
Z_β= adjusted standart deviasion β (0,84)
σ = SD response to the comparison group (0,81)
μ_1= the mean level of sample group (4,28)
μ_2= the mean of comparison group (3,34)

$PM_{2,5}$ were measured by Haz-Dust EPAM 5000 particulate air monitoring. MDA levels used TBA test method with spectrophotometric.

Data analysis using Mann-Whitney statistical program tets to show the differences in levels of serum and multiple linear regression to determine the effect $PM_{2,5}$ to MDA level serum

3. RESULT

Respondents in this study were bus station workers and administration workers with the criteria was male, has worked at least one year, did not suffer from diabetes. Characteristics of workers can be seen in Table 1.

Tabel 1. Characteristic Bus Satation and Administration Workers

Characteristic	Bus Station Workers		Administration Workers	
	n	%	n	%
Age (Years)				
21-30	0	0	7	29,2
31-40	1	4,2	5	20,8
>40	11	45,8	0	0
mean±SD	45,83±6,04		30,25±6,28	
Smoking Habits				
No smoking (0)	5	20,8	2	8,3
Rarely (1-200)	2	8,3	9	37,5
Medium (201-600)	5	20,8	1	4,2
mean±SD	164,8±171,3		50,3±71,1	
Mass Body Index				
Less (<18,4)	0	0	2	8,3
Normaly (18,5-25,0)	3	12,5	7	29,2
Obesity (>25,1)	9	37,5	3	12,5
mean±SD	28±4,33		22,43±3,58	

Table 1 shows that workers in the station with a mean age of 45.83 years, classified as light smokers (Index Briskman/IB) with a mean of 164.8 cigarettes/year and with a mean body mass index of 28kg/cm^2, including obesity. whereas the clerical workers 30.25 years, including light smokers of 50.3 cigarettes/year and a body mass index of 22.4 kg/cm^2 was normal.

Tabel 2. PM2,5 levels in the bus station and an administration

Level Measurement	Bus Station	Administration room
PM2,5	0,82 mg/m^3	0,11 mg/m^3
Temperature	33°C	29,3°C
Humadity	57,8%	67%

The results of $PM_{2,5}$ measured that the concentrations of $PM_{2,5}$ in Station showed a mean value of 0.829 mg/m^3. While the administration room obtained a mean value of 0.09 mg/m^3. $PM_{2,5}$ levels in Station above the threshold value. Based on the Decree of the Minister of Health of the Republic of Indonesia No. 1405 / Menkes / SK / XI / 2002 regarding Requirements Environmental Health Office Work and Industry at 0.15 mg/m^3 [17].

Levels of malondialdehyde (MDA) is a marker of oxidative stress by checking TBA test using spectrophotometric method. MDA level examination results are shown in Table 3:

Tabel 3. Results of Measurements of Serum Levels of MDA in Bus Station Workers and Administration workers

Malondialdehyde (MDA) Levels (nmol/ml)		
Workers	**mean±SD**	**ρ**
Bus station	9,44±2,94	0,01**
Administration	5,60±0,60	

**ρ<0,05= significant

Table 3 shows that the MDA levels serumin bus station workers higher than administration workers. It was caused by bus station workers exposed $PM_{2,5}$ which one pollutant that is free radicals. There are very significant differences bus station workers and administration workers (ρ <0.05).

Tabel 4. Analysis of The Effect of $PM_{2,5}$ Exposure to Increases MDA Levels Serum in Bus Station Workers and Administration Workers.

Variabel	MDA Level	
	β	ρ
Particulate Matter ($PM_{2,5}$)	1,143	0,046*
Age	0,313	0,164
Smoking Habits	0,142	0,575
Mass Body Index	0,543	0,028*

*ρ<0,05= significant

Based on the results of multiple linear regression analysis showed that $PM_{2,5}$ affect MDA (β = 1.143; ρ = 0.046). $PM_{2,5}$ exposured higher in the air can increases MDA levels serum. Cigarette smoke contains components of gases and particles that potential to cause free radical-induced oxidative stress

in the body, lipid peroxidation (MDA) and lower levels of endogenous antioxidants.[8]

Body Mass Index (BMI) (β = 0.543; ρ = 0.028). Workers in the station majority obesity. This study is in line with Selvakumar (2012) [9], shows that there is the influence of obesity with increased activity of MDA (β = 0.483; ρ = 0.003). Obesity not only associated with being overweight but always associated with type 2 diabetes metabolic disorders due to excess accumulation calories into fat and saturated fat release to various organs with high concentrations will cause chronic oxidative stress [10] [17]

4. DISCUSSION

$PM_{2,5}$ in the air can increase serum levels of MDA. Particles enter the body primarily through the respiratory system due to the direct adverse effect mainly occurs in the respiratory system. Particles larger than 5 microns will gather and stop especially on the nose and throat. 0.5-5 micron-size particles can gather in the lungs to reach bronchioli and only a small portion can only be issued by the cilia in about 2 hours. While the particle size of 0.5 microns will reach and gather in the alveoli. Activities Cleaning particles are very small yag of alveoli running very slow and imperfect when compared with activity in the larger channel. Even some particles exist which still remained in the alveoli and absorbed in the blood [11].

Lipid peroxidation can be described generally as a process in which oxidants such as free radicals attack the lipids containing double carbon, especially polyunsaturated fatty acids, especially (PUFAS / Polyunsaturated Fatty Acids). One of the consequences of uncontrolled oxidative stress (an imbalance between prooxidant and antioxidant levels in support prooksidants) are cells, tissues, and organs caused by oxidative damage. A high level of free radicals or reactive oxygen species (ROS) can cause direct damage to lipids. The main source of endogenous ROS production is mitochondria, plasma membrane, endoplasmic reticulum, peroxisomes and through various mechanisms, including enzymatic reactions or autooxidation of some compounds, such as catecholamines and hydroquinone. Different exogenous stimuli, such as ionizing radiation, ultraviolet rays, tobacco smoke, pathogen infection, environmental toxins, and exposure to herbicides / insecticides, is the source of the in vivo production of ROS [12].

Components of chemicals that exposure of air pollutants that cause oxidative stress and inflammation can be in the form of gases and particles. Contained in the oxidative potential of particles depend on particle composition, size, especially the ultrafine particle concentrations and other transition metals and organic chemicals such as semi-volatile and volatile (Delfino, 2011). reactive chemicals that are important can include organic components which themselves PM2,5 as quinones oxidize or PAH species that undergo bio-transformation by cytochrome P-450 1A1 to quinones, which can induce oxidative stress (Bonvallot, 2001).

Body Mass Index has been found to increase levels of serum MDA. ROS pathways in mitochondria increased in obesity. Within 24 hours it takes at least as much as 352.81 liters of oxygen. The purpose is filled with breathing less than 23 thousand times. The consequences of which are from the metabolic processes in biochemical systems (biological oxidation) in the body is able to produce free radicals as much as 2.5% of the total oxygen requirement 3,4kg / 24 hours. Though the biological oxidation can take place without oxygen, but all mammals requires absolute oxygen supply through breathing (respiration). Respiration is the process of formation of adenosine triphosphate (ATP) as an energy, which is obtained from a reaction between hydrogen and oxygen that then form water. Reaction energy formation known as oxidative phosphorylation takes place in the mitochondria. The process of respiration takes place in the mitochondria maatriks through a reaction which is then referred to as the respiratory chain. Thus, the formation of ROS within mitochondria is triggered by chronic electron leakage from normal respiratory chain. So, on the chest wall will decrease obesity and respiratory work will increase (Widayati, 2012; Limanan, 2013).

MDA is the end product produced by the decomposition of arachidonic acid and polyunsaturated fatty acids (PUFAS) greater peroxidation in the cell. The increase in free radicals causing overproduction of MDA. Malondialdehyde levels commonly known as a marker of oxidative stress and antioxidant status (Gawel, 2003).

5. CONCLUSION

$PM_{2,5}$ concentration in several main bus station is higher than in the administration is. $PM_{2,5}$ high and obesity was effects MDA levels serum in the bus station workers and administrative workers. MDA levels serum were high indicates oxidative stress in bus station workers.

6. SUGGESTION

Air quality monitoring on a regular basis to controlling air quality around the bus station. Workers in the station should be health checked regularly as early prevention and consume fruits and vegetables that contain lots of antioxidants to support the enzymatic antioxidants in the body.

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