ORIGINAL ARTICLE

Effect of Occupational Exposure on WBC Count and Oxidative Stress in Rice Mill Workers

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Abstract:

Background: There are several occupations where individuals are exposed to high concentration of dust particles. The exposed dust can be organic, inorganic, bacterial toxins, viruses or lipopolysaccharides. Exposure to rice husk causes activation of eosinophils and inflammation reactions. Cardiovascular diseases are associated with increased lipid peroxidation and decrease in levels of antioxidants. *Aim & Objectives:* Aim of the study was to evaluate the effect of occupational exposure on haematological and biochemical parameters of rice mill workers by analyzing blood cell Counts, Malondialdehyde (MDA), Nitric Oxide (NO) and Ascorbic acid. *Material and Methods:* A total of 134 eligible individuals who had been exposed to dust in rice mills for more than 5 years were included in the study group where as another 134 unexposed individuals constituted control group. Estimation of serum MDA, serum NO and plasma Ascorbic acid were done by using semiautoanalyzer. *Results:* There was no significant difference between Total Leucocyte Count of exposed and unexposed individuals. Lymphocyte, monocyte, eosinophil and basophil counts are significantly increased in exposed individuals. Serum levels of MDA, NO and Ascorbic acid are also significantly increased in exposed group compared with control group. *Conclusion:* The findings of our study clearly indicate that the rice mill workers are under high level of dust exposure which has deleterious effects on their blood and tissues. Increased MDA, NO and decreased Vitamin-C are probably due to high oxidative stress.

Keywords: Rice mill workers, White Blood Cell Counts, MDA, Nitric Oxide, Vitamin-C, Oxidative Stress

Introduction:

There are several occupations where individuals are exposed to high concentration of dust particles. The exposed dust can be organic, inorganic, bacterial toxins, viruses or lipopoly-saccharides. Exposure to rice husk causes activation of eosinophils and inflammation reactions as well as aggravation of asthma [1, 2]. Individuals who are exposed to cement dust were shown to have decrease in hemoglobin concentration with rise in lymphocyte count [3]. Martin-Ventura *et al* observed role of blood cells in chronic vascular disease. Pathological vascular modeling of arterial wall is found to occur in such diseases [4]. Cardiovascular diseases are associated with increased lipid peroxidation and decrease in levels of antioxidants [5]. On longstanding oxidative stress, high levels of lipid peroxides cause to the oxidative DNA damage and individuals will be at a greater risk of developing

cardiovascular diseases. Serum levels of Malondialdehyde (MDA), Nitric Oxide (NO) and Vitamin C are considered as markers of oxidative stress. Due to oxidative stress, MDA levels will be increased tremendously in cardiovascular diseases. NO related endothelial dysfunction is seen in cardiovascular deseases. Ascorbic acid, amost affective water soluble antioxidant is considered as first line of defense against oxidative damage [6-11]. Vitamin C inhibits initiation of lipid peroxidation and also reduces lipid peroxidation activated by leucocytes during inflammation [12, 13]. Hence, the present study was undertaken to determine the effect of dust induced oxidative stress by measuring leucocyte count and oxidative stress markers such as MDA, NO and Ascorbic Acid.

Material and Methods:

The study group comprised of rice mill workers of urban area in and around Raichur district. Prior permission from owners of rice mills was sought. Consent was taken from volunteered rice mill workers. A total of 134 eligible individuals who had been exposed to dust in rice mills for more than 5 years were included in the study group where as another 134 unexposed individuals constituted control group. Information in regard of duration of exposure, general health, disease history, details of habits like smoking and alcohol consumption were collected. For haematological parameters, 2ml of intravenous blood was drawn and collected in Ethylene Diamine Tetraacetic Acid (EDTA) tubes and processed in Complete Blood Cell (CBC) counter machine. For biochemical parameters, 6ml of intravenous blood was collected in plain tubes for estimation of serum MDA and serum NO. Two ml of blood was collected in EDTA tube for estimation of plasma ascorbic acid.

Estimation of serum MDA [14], serum NO [15] and plasma ascorbic acid [16] were done by using semiautoanalyzer. Sample size was calculated by taking proportion as prevalence with the help of the formula- $n= 4Pq/E^2$, where, 'n' is sample size, 'P' is prevalence(75%), 'q' is non prevalence(25%) and 'E^2' is probable error(7.5^2). A statistical analysis was done by using unpaired t-test with the help of Graph Pad Prism software. The anthropometric parameters of subjects were expressed as mean ± Standard Deviation (SD). The haematological and biochemical parameters were also expressed as mean ± SD with standard deviations.

Results:

Table 1: Anthropometric Parameters of Exposed and Unexposed Individuals

Parameters	Mean Values of Controls	Mean Values of Exposed
Age (years)	32.81	29.24 ***
Height (cms)	164.6	165.0
Weight (kgs)	60.87	59.21
BMI (kg/m^2)	22.43	21.75 *
Years of Exposure (years)	-	09.78

*Note: *-P<0.05, **-P<0.01, ***-P<0.001*

There was no significant difference between mean values of exposed and unexposed individuals (Table 1) except that the mean age of control individuals was higher than those of exposed group. Mean duration of exposure of rice mill workers was 9.78±0.56 years.

Table 2: Hematological Parameters of Study and Control Groups

Parameters	Control Mean ± SD (N=134)	Exposed Mean ± SD (N=134)
TLC (cells×10^3/cumm)	7.77 ± 0002.16	7.77 ± 002.14
Neutrophils (cells/cumm)	4560 ± 1889.31	4034 ± 1726.6*
Lymphocytes (cells/cumm)	2464 ± 844.43	2713 ± 886.61*
Eosinophils (cells/cumm)	261.4 ± 240.99	467.0 ±419.46***
Basophils (cells/cumm)	34.55 ± 20.69	43.06 ± 018.91***
Monocytes (cells/cumm)	450.0 ± 170.60	508.7 ± 208.71***

*Note: *-P<0.05, **-P<0.01, ***-P<0.001*

Neutrophil count (P<0.05) of Rice mill workers was significantly lower than the control, where as lymphocyte (P<0.05), eosinophil (P<0.001), monocyte (P<0.001), basophil (P<0.001) counts were significantly higher in Rice mill workers as compared to control (Table 2).

Table 3: Biochemical Parameters of Study and Control groups

Parameters	Control Mean ± SD (N=134)	Exposed Mean ± SD (N=134)
Serum MDA (µmol/l)	5.64 ± 2.090	7.01 ± 1.89***
Serum NO (µmol/l)	36.73 ± 14.15	51.03 ± 16.81***
Plasma Vitamin C (mg/l)	1.17 ± 0.260	0.86 ± 0.32***

*Note: *-P<0.05, **-P<0.01, ***-P<0.001*

Serum levels of MDA (P<0.001) and NO (P<0.001) of exposed individuals were significantly higher than those of control. Ascorbic acid (P<0.001) levels of exposed were significantly lower than those of control.

Discussion:

Present work was carried out to show the effect of occupational exposure of dust from rice mills on leucocyte count and oxidative stress. We found significant increase in absolute counts of lymphocyte (P<0.05), eosinophil (P<0.001), monocyte (P<0.001) and basophil count (P<0.001). Eosinophil and basophil counts of exposed individuals were significantly increased. It indicates allergic response. Lymphocyte and monocyte counts were also significantly increased. It indicates increased inflammatory reaction. These abnormal variations of eosinophil, basophil, monocyte and lymphocyte counts can lead to chronic inflammation and oxidative stress.

In the present study there was an increase in differential leucocyte count; total leucocyte count did not show any significant variation. This data shows that there is dust exposure related immune response too.

Tripathi *et al* [17] have shown that there was a significant abnormal variation in haematological paramaters of Rice mill workers of Lucknow district. Lim *et al* [1] have shown in their study, a significant increase in Eosinophil count of Rice mill workers, which indicated allergic reactions and inflammation. Kayab *et al* [2], Weller *et al* [18] have found the exposure to rice husk dust caused increase in eosinophil count as well as eosinophil-lymphocyte interaction in immune response. Study carried out by Olusegum *et al* [19] on cement factory workers also showed significant variations in Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH), lymphocyte and eosinophil counts.

In our study, we observed significant increase in Serum levels of MDA ($P<0.001$) and NO ($P<0.001$) of exposed group. There was a significant decrease in Ascorbic acid ($P<0.001$) level. These observations indicated increase in level of oxidants and decrease in levels of antioxidant vitamin-Ascorbic acid.

Several other researchers carried out studies on oxidative stress in cement factory workers, on painters, thermal plant workers, cotton mill workers and also on exercise. They observed increase in serum levels of MDA [20-23, 26], increase in serum level of NO [23-25] and also decrease in plasma Ascorbic acid level [20, 24, 26] in the study groups.

Conclusion:

The rice mill workers are exposed to high concentration of particulate matter. There is a significant increase in counts of eosinophils, monocytes, basophils and lymphocytes. There is no significant difference in neutrophils and total leucocyte counts. This data indicates the Rice mill workers have increased oxidative stress.

There is a significant increase in serum levels of MDA, NO and significant decrease in plasma concentration of ascorbic acid. MDA and NO are oxidants and Ascorbic acid is an antioxidant. To combat the increased oxidation, antioxidant ascorbic acid is utilized. When oxidant activity overwhelms the activity of antioxidants, antioxidant level will automatically be reduced.

Recommendations:

The rice mill workers should be educated regarding health hazards of dust exposure. They should be provided with masks and gloves which can reduce the consequences of dust exposure. The rice mill workers must undergo routine health check up.

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