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# Effect of Sulphur dioxide Pollution on Immunoglobulins of the Industrial Workers and the Residents of the Vicinity

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**Abstract**: Air pollution is caused by the increased concentration of any of its constituent above the normal value and this type of situation prevails in highly industrialized areas. $SO_2$ is among the air pollutants which produces bad effects on human health. The value of IgG in industrial workers were high and IgM was low which might be due to repeated exposure to $SO_2$ pollutant, IgM production was switched over to IgG which results in high level of IgG and low level of IgM. IgA level was low, which might be due to the transportation of circulatory IgA to the epithelial surface for defence.

**Keywords:** Sulphurdioxide, S0, air pollution, immunoglobulins, industrial workers, IgG, IgM, IgA

## Introduction

The atmosphere has always served as a disposal area. Waste material injected into the air can be dispersed and diluted, then settle to the ground. However there is a point at which the atmosphere becomes overloaded with the pollutants and their concentrations attain an objectionable level. Any increase in concentration of a constituent of air above its normal value/level could be considered as instance of air pollution (Gilman et al., 1985).

The most dangerous among pollutants are those of sulphur compounds such as sulphur dioxide ($SO_2$), sulphur trioxide ($SO_3$), sulphurous acid ($H_2SO_3$) and sulphuric acid ($H_2SO_4$). Sulphur oxide comes from fuel oil, coal combustion, petroleum refining and from chemical and metallurgical industries was investigated by (Dreisbach, 1977). Sulphur dioxide is a colorless gas. At high concentrations it has a pungent and irritating odour. The main sources of sulphur dioxide are fuel burning and metal ore processing. The data collected by mobile laboratory of Environmental Pollution Agency, (EPA) of Pakistan indicates that dust and smoke are exceeding the W.H.O ambient air quantity, standards. The average figure of $SO_2$ detectable by the laboratory is 3 ppm in atmosphere (Hasan, 1994).

Schwartz et al. (1988) reported that Sulphur dioxide has dangerous effect on human health and is significantly related to chest discomfort. Gorkin et al. (1970) studied that $SO_2$ causes immune suppression and increases the sick rate. It also decreases the functional state of the nervous system. Complex composition of blood is not constant but it changes during stress, starvation, exercise, as a result of injury or disease and environmental disorders (Russel et al., 1982).

Faisalabad is a major industrial city of Pakistan having different types of industries producing $SO_2$. A Sulphuric acid plant is situated in the heart of the city which is a large source of $SO_2$ pollution. Prolonged exposure to $SO_2$ mainly caused respiratory diseases and least work has been done regarding immunosuppressive effects engendered by $SO_2$ pollutant, it is deemed to study the effect of $SO_2$ on different blood parameters in the industrial workers of Faisalabad and also in the individuals living in the vicinity. The effect of $SO_2$ pollution of samples were studied on Immunoglobulin (IgG), immunoglobulin M (IgM), and Immunoglobilin A (IgA) taken from polluted and non polluted areas.

## Materials and Methods

Seventy persons living in assumed polluted atmosphere, in the vicinity, and those living in apparently pollutant free atmosphere were included in this study. Blood samples were collected with the following distribution.

15 from industry related to sulphur dioxide i.e. Lyallpur Chemicals and Fertilizers, Ltd, (LCF), Faisalabad. 15 from industry not directly related to sulphur dixode i.e. Rafhan Maize Products, (RMP), Faisalabad. 20 from those working and living in the vicinity of the industry i.e., Morafco industries, Faisalabad. 20 from apparently pollutant free area which is a remote area from $SO_2$ producing factory i.e. University of Agriculture, Faisalabad (control group) History of each individuals i.e. name, age, marital status and annual income was recorded. Serum was separated from 5 ml of blood sample in which EDTA was not added, after proper coagulation for 1-2 hours. Serum was subjected to the analysis of immunoglobulins.

The concentration of IgG in the test sera was determined through automated analysis (BM/Hitachi 911) based on immunoterbidimetric reaction engendered by the complexes of serum antibody (SAB) with the Goat anti human IgG. The procedure employed the end point method comprising 1:20 dilution of the test serum (15 ul) in 0.9 percent NaCl solution. The diluted concentration of serum IgG was made to react with standard amount of goat anti human IgG solution in this buffer for a specified length of time. The reaction, yielding specific complexes, was brought to halt using specific stop reaction.

Concurrently, the precimat IgG was also diluted likewise to serve as a positive/control in the test substituting for serum IgG verses goat anti human IgG in the reaction set-up. The turbidimetric values were recorded at visible and at U.V to record normal range H and normal range L respectively at programmed channel setting.

The respective concentrations of serum IgM and IgA were monitored following the same protocol. Using standard precimat IgM and IgA as positive controls separately.

## Results and discussions

Considering all parameters constant except age, a comparison was made between concentrations of IgG, IgM and IgA of individuals to their age. IgG, IgM and IgA were studied in industrial and control groups. The average values of IgG for workers who were exposed to $SO_2$ pollution i.e. LCF industry, workers of RMP, those who were working in Morafco and living in the vicinity of the pollution and those of control group were 1742.06, 1414.7, 1391.2, 1313 mg/dl. The difference among these average values is shown by bar chart (Fig. 1).

Forty percent workers of L.C.F industry were bearing high concentration of IgG, which is an alarming situation. Only 7 percent of the subjects of RMP had IgG more than the normal range. Remaining 93 percent of workers in AMP , 60 percent of the L.C.F industry and all of the Morafco employee and control group were enjoying the normal values of IgG.

Statistically the analysis of variance (ANOVA) indicated that the concentration of IgG in the industrial workers was significantly different ($p < 0.05$) from the control group. The IgG levels in LCF workers was significantly higher than control groups but in case of
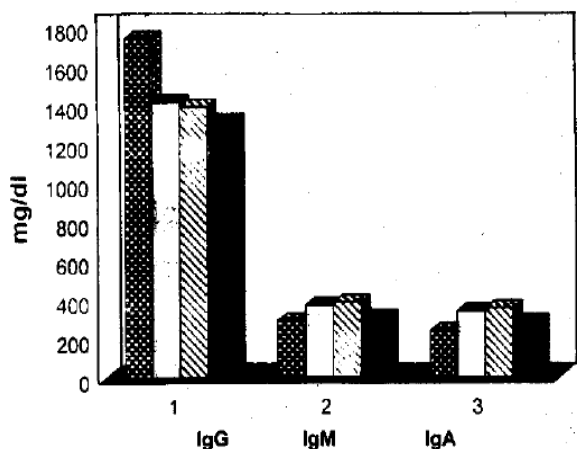
Fig. 1: Studies of SO$_2$ on immunoglobulins of industrial residents of Faisalabad

Table 1: Comparison between youth and elderly groups of industrial workers and control w.r.t. their age and immunoglobulins

| | Industrial Workers | |
| --- | --- | --- |
| | Youth grorp 25-35 years (Mean Values) | Elderly group 36-46 years (Mean Values) |
| IgG | 1853 mg/dl | 1714.25 mg/dl |
| IgM | 181 | 316.0 |
| IgA | 225 | 240.9 |
| | Control group | |
| IgG | 1248 mg/dl | 1274.6 mg/dl |
| IgM | 326 | 252.4 |
| IgA | 266 | 332.0 |

IgM the level decreased as compared to other groups. Such elevated rate of IgG synthesis and lower IgM values in L.C.F group is indicative of morbid state when there is continuos exposure to extraneous agents. These results are somewhat contradictory when compared with those of Gorkin *et al.* (1970) who investigated that SO$_2$ causes immune suppression and increases the sick rate. Bokina *et al.* (1981) also reported the effect of SO$_2$ on the development of pathological condition caused by a general reduction in body resistance. But our results have shown that only IgG has increased which shows that a long exposure to SO$_2$ hashelped developing an immune response in the form of IgG. In such conditions where there is persistent and continuos exposure to toxicants, such as SO$_2$, immunoglobulin production is switched over to IgG formation instead of IgM. It is due to the fact that IgM is a pentameric molecule with J chains which require a complex procedure for synthesis and thus body has to produce IgG (monomeric molecules) to come up with the stress conditions as described by Russel *et al.* (1982). The present findings, therefore, strongly represent that continuos exposure to SO$_2$ affected the immunoglabulin levels.

Blood of industrial and control group was analyzed for IgM. The average values of IgM were 289.3, 369.2, 383.4 and 307 mg/dl for L.C.F industrial workers, RMP's workers, Morafco's workers and control group respectively. Difference among these mean values is represented by bar chart (Fig. 1). The results showed that 40 percent of LCF industrial workers had abnormal i.e. high values of IgM, workers of RMP had 73.3 percent, for individuals of Morafco the value was 65 percent and 55 percent of the control group had elevated level of IgM.

The results were statistically non-significant for industrial workers and control group. However the trend shows that IgM values for L.C.F industrial workers were lower as compared to the other groups where the IgM levels increased with respect to the control group. This is an indication of morbid state due to repeated exposure to SO$_2$. IgM are the first immunoglobulins produced after any inflammatory response. The results thus suggest that in case of RPM and Morafco workers the effect of SO$_2$ is not greater as compared to the L.C.F industrial workers, where the workers are constantly exposed to SO$_2$.

Analysis of blood was carried out for IgA. The average value for industrial workers was 237.7 mg/dl, for workers of AMP was 339.4 mg/dl. Average value of those working and living in the vicinity of the industry was 353.4 mg/dl and those of control group was 282.85 mg/dl. Bar chart (Fig. 1) showed least value of IgA for LCF industrial workers as compared to other groups. ANOVA for industrial and control group was found to be significant (p < 0.05). The trend is similar to that of IgM levels. The lower levels of IgA in industrial workers as compared to control group may be due to the fact that IgA dimers form a complex with a polypeptide, called secretory component and are transported to the epithelial surfaces of the gastrointestinal tract, mammary gland mouth and skin, where they are involved with the protective response due to potential exposure to the toxicant. So definitely the level of circulatory IgA decreases during morbid state.

The individuals were divided into two age groups 25-35 and 36-46. The average values of these groups showed the elevated level of IgG in youth group of both control and industrial workers but the elevated level of IgG in industrial workers showed diseased state caused by SO$_2$ presented in Table 1. These levels decreases in elderly group showing that with increase in age the immunity decreases and the cells become not so active as in youth.

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