

## Article

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## Effects of exposure to textile dye on serum Alkaline Phosphatase and Gamma Glutamyl Transferase levels in textile industry workers

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### Abstract

**Background:** The textile dyeing industry uses large number of chemicals, acids and dyes. The workers are exposed to these chemicals during their daily work activities. Chronic exposure to these chemicals may have adverse effect on the liver functions, as liver plays an important role in detoxification of these chemicals. **Objective:** To assess serum Alkaline Phosphatase (ALP) and Gamma glutamyl transferase (GGT) levels of the industrial workers exposed to textile dyes. **Methods:** This cross sectional study was carried out in the Department of Physiology, Dhaka Medical College, Dhaka from July 2016 to June 2017 on 25 apparently healthy male workers aged 20-40 years working in a textile dye factory for 2 years or more. Similar age, sex, BMI & socioeconomically matched 25 apparently healthy non exposed workers were enrolled as control. Serum ALP and GGT levels were estimated by autoanalyzer. For statistical analysis unpaired Student's t-test were performed. **Results:** Serum ALP and GGT levels were significantly higher in textile dye exposed workers than those of control group ( $p < 0.05$ ). **Conclusions:** This study reveals that exposure to textile dyes have deteriorating effect on liver function.

**Key words:** Textile dyes, textile industry workers, liver enzymes.

### Introduction

An occupational disease is any disease contracted primarily as a result of an exposure to risk factors arising from work activity.<sup>1</sup> In Bangladesh, about 1727 workers died and 2307 workers were injured in different workplace accidents in the year 2013.<sup>2</sup> From ancient period,

the textile and clothing industries are the growing and widest industries around the world. In Bangladesh, textile industry is the second largest industry after agriculture in terms of number of persons employed. It is the main source of employment and export for our country.<sup>3-4</sup>

For any fabric, color is the main attraction. Adding color to textile products like fibers, yarns and fabrics is called dyeing. A variety of chemicals are used by the textile processing industry for dyeing and printing. The exposure includes not only the dyes, but also different organic solvents (formaldehyde, benzene, toluene, styrene etc.), bleaching agents, acids, alkalies etc. These chemicals are toxic in nature due to their chemical structure.<sup>5</sup>

Skin contact, ingestion and inhalation are the important routes by which these chemicals can enter in to the body. Systemic adverse effects occur when they distributed throughout the body by blood.<sup>6-8</sup> Short term exposure to these chemicals shows little or no effects to workers. However, chronic exposure to textile dyeing chemicals can lead to different type of diseases. Skin allergies (dermatitis, pruritus etc.), respiratory diseases (rhinitis, asthma, bronchitis etc.), allergic conjunctivitis, headache, depression and musculoskeletal disorders are most common. Chronic exposure may also lead to different cancers like hepatocellular, nasal, esophageal, lung, gastric, colon and rectal.<sup>6,9</sup>

Liver is the main organ responsible for bio-transformation and detoxification process of these chemicals and solvents used in textile processing industries. As a result, it becomes the prime target organ for the chemical induced tissue injury.<sup>7</sup> On the basis of this background, the present study was designed to assess the serum ALP and serum GGT levels in textile processing and dyeing industry workers.

### Methods

This cross sectional study was carried out from July 2016 to June 2017 in the Department of

Physiology, Dhaka Medical College, Dhaka to observe the effect of exposure to textile dye on serum ALP and GGT levels in 25 apparently healthy workers aged 20-40 years. They were enrolled from dyeing section of a textile industry working for 2 years or more by purposive sampling. Age, sex, BMI & socio-economically matched 25 apparently healthy non exposed workers were enrolled as control from different section of that industry.

The protocol of this study was approved by the Research Review Committee and Ethical Review Committee of Dhaka Medical College, Dhaka. Those who have history of previous or current viral hepatitis and blood transfusion within last 3 months; regular alcohol consumption and regular smoking were excluded from the study. After briefing about the study, informed written consent was taken from each subject. Detail family, medical history and socioeconomic information were recorded in a preformed data sheet and thorough physical examination was done. Anthropometric measurement including height and weight were taken and BMI were calculated. Blood pressure was also measured. Then venous blood was collected under aseptic precautions for estimation of serum ALP and GGT levels by auto analyzer.

For statistical analysis unpaired Student's t-test were performed by computer based statistical software SPSS version 22. Data were expressed as mean±SD. The p value <0.05 was taken as level of significance.

### Results

General characteristic of all subjects are presented in Table I. Both groups were comparable in respect of age, BMI and socioeconomic condition. The mean ±SD serum ALP level and GGT level was significantly higher (P value < 0.001) in dye exposed worker compared to non-exposed worker. (Table II).

**Table I:** General characteristics of the subjects in both groups (N=50)

Parameters	Groups	
	Dye Exposed (n= 25)	Non Exposed (n=25)
Age ( years)	26.60±6.13	29.16 ± 4.75
BMI (kg/m <sup>2</sup> )	22.24 ± 3.45	23.51 ± 3.09
Socioeconomic condition		
Low	25 (100%)	25 (100%)
Systolic BP (mm Hg)	113.60 ± 4.90	117.00 ± 8.16
Diastolic BP (mm Hg)	64.00 ± 6.92	67.00 ± 8.66

Results are expressed as mean and standard deviation (mean ± SD). Unpaired Student's t-test was done to compare between the groups. *p* value < 0.05 was accepted as level of significance. N = Total number of subjects. n = Number of subjects in each group.

**Table II:** Study parameters of the subjects in both groups (N=50)

Laboratory parameters	Groups	
	Dye Exposed (n= 25)	Non Exposed (n=25)
Serum ALP (U/L)	117.44 ± 34.04***	62.44 ± 7.93
Serum GGT (U/L)	46.88 ± 16.60**	37.19 ± 3.69

Results are expressed as mean and standard deviation (mean ± SD). Unpaired Student's t-test was done to compare between the groups. *p* value < 0.05 was accepted as level of significance. n = Number of subjects in each group, ALP= Alkaline phosphatase, GGT=Gamma Glutamyl Transferase. \*\*\**p*<0.001.

## Discussion

This study demonstrated significantly higher serum ALP among dye workers than that of non-exposed adult. Almost similar types of results were found by many researchers.<sup>10-12</sup> On the other hand, many researchers of different country did not find any significant change of serum ALP level in between two groups.<sup>13-14</sup> The mean serum GGT level was significantly higher in exposed dye workers than that of adult healthy non-exposed workers. This finding was in agreement with the study of many researchers of different countries.<sup>12-13,15</sup> However no significant change in GGT was found by some authors.<sup>16</sup>

Significantly increased serum ALP and GGT level in these group of workers having

occupational exposure to fabric dyeing is most likely due to hepatocellular and canalicular membrane damage. The damage is caused by injurious intermediate metabolites (epoxides, carbonium, notrenium etc.) produced during biotransformation of the dyes and associated chemicals in liver. These injurious intermediate metabolites bind with liver CYP 450 enzyme and activate them, resulting further production of the intermediate metabolites. All these intermediates bind with cellular proteins, DNA & RNA and damage them.<sup>17-19</sup>

Again, several studies showed these injurious metabolites may cause bile canalicular membrane damage and disruption of transport protein by binding with them. These may result impaired bile

secretion and flow so there may be cholestasis. Thus, there is accumulation of bile acids, bile salts and cholesterol in hepatocytes. These causes further damage of the membrane by reducing their fluidity and also impairs the functions of membrane proteins leading to release of hepatic sinusoidal and canalicular enzymes in blood<sup>20-22</sup>.

### Conclusion

After analyzing the results of the study, it can be concluded that textile dye and associated chemicals has injurious effect on liver enzymes in the workers.

**Conflict of interest** None

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