

# Evaluation of Renal and Liver Functions Tests in Car Paint Sprayers

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**ABSTRACT- Background:** Occupational health diseases affect more people every year. The present study is done evaluate the liver and renal function test in car paint sprayers in Indian settings. Environmental and occupational exposure to nephrotoxic substance causes impairment of renal and liver functions test.

**Methods:** Sixty subjects in the age group 18 to 45 year were divided into two groups (each group having thirty subjects). Group A consisted of healthy controls. Group B consist of healthy, car paint sprayers. Car paint sprayers had employment duration of 5 to 12 years. Anthropometric and were performed. Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS-17).

**Results:** The result of present study suggested that the values of AST, ALT, S. bilirubin and S. albumin were raised in subjects who were in Group B exposed to organic solvents (used for spraying car painting) when compared with Group A subjects.

**Conclusion:** The study confirms the spray pointing is an occupation which involves the risk of liver and renal impairment and confirms the need of regular examination. The present study results strongly recommend for following appropriate safety measure while spraying car painting using organic solvents irrespective of their smoking status and age.

**Key-words-** Renal and Liver function, Car spray painters, BSA, AST, Anthropometry

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## INTRODUCTION

Occupational health diseases affect more and more people every year. According to the International Labor Organisation (ILO), in 2000 an estimated amount of atleast 160 million people became ill as a result of occupational-related hazards or injuries<sup>1</sup>. Environmental and occupational exposure to nephrotoxic substances may cause renal tubular and glomerular impairments. Tubular toxicity is characterized by low molecular weight proteinuria, enzymuria, renal tubular antigens in urine, kal-likrien and other parameters such as glucosuria, mi-noaciduria, hyperphosphaturia, hypercalciuria, hypouricemia, hypophosphatemia and hypokalemia.<sup>2-3</sup>

The nephrotoxic effects of organic solvents were reported in car paint sprayers after intoxication with different halogenated hydrocarbons, petroleum distillates, ethylene glycol esters and diethylene glycol.<sup>4-5</sup> Acute heavy exposure has been suggested by case reports to result in Good Pasture's Syndrome.<sup>6-7</sup> Organic solvents are used in many industries and workplaces like printing, car paint sprayers and adhesives. Chronic exposure to solvents from repeated intentional heavy inhalation of toluene by 'glue sniffers' is well known to lead proximal and distal renal tubular disorders.<sup>8-12</sup> Many halogenated solvents eg. Carbon tetrachloride, chloroform and vinyl chloride are known to be hepatotoxins.<sup>11</sup> Increased levels of serum transaminases and gamma glutamyl transpeptidase (GGT) have been shown in workers in the printing industry exposed to toluene via the respiratory route. Liver biopsy in these workers has shown fatty liver following nonspecific mild inflammation.<sup>12</sup> Workers exposed to organic solvents have shown increased levels of transaminases and GGT, which indicate hepatic necrosis and cholestasis.<sup>13</sup> Some studies have shown increased levels of liver enzymes in painters and workers in the printing industry exposed to a mixture of aromatic solvents.<sup>10</sup> The oxidative metabolism in human liver changes with exposure to a mixture of organic solvents containing in toluene.

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## MATERIALS AND METHODS

This study was conducted in the Department of physiology, Santosh Medical College, Ghaziabad, India & Sudhanshu Automobile Company in Delhi, India. A written consent was taken from them. The duration of this study was May 2014 to May 2015.

The case controlled study was done with 60 car paint sprayers. The subjects in the present study [age group 18-45 years] were divided into two groups and they were further divided into the three subgroups. The group A having healthy, control subjects and group B having healthy car paint sprayers subjects with no present or past history of recurrent respiratory infection, non smokers, no clinical evidence of malnutrition and heart diseases.

The following measurements were carried on each subject:

1. Anthropometry
2. Liver and Renal function tests
3. Statistical analysis

### A. Anthropometry:

i) **Height:** It was measured with bare feet accurately to the nearest 0.5 cm. The subject was asked to stand against a standard meter scale with their calves lightly touching it.

ii) **Body weight:** It was recorded with the 'Avery' weight scale accurate to within 50gm.

iii) **Body Surface Area (BSA):** It was calculated from the height and weight of the subject using Du-Bois normogram. It was measured in square meters (m<sup>2</sup>).

**B. Liver and Renal Function tests:** These tests were assessed in the Biochemistry Laboratory by using auto analyzer of Erba Company. Model No.CHEM-5 plus V2.

## RESULTS AND DISCUSSION

Changes in Liver and Renal Function Parameters:

### Group A versus Group B Worker

Comparison of liver and renal Function parameters among Group A and Group B subjects are shown in Table 1. Serum aspartate transaminase (AST) and alanine transaminase (ALT) are two of the most reliable markers of hepatocellular/liver injury assessed using Liver function test. Total serum bilirubin is also one of key bio-marker which assesses liver function. The results of present study suggest that the level of ALT and total serum bilirubin were significantly higher in Group B subjects when compared with Group A subjects (Table 1), with statistical significant difference between Group B and Group A group. The level of AST was numerically higher in Group B subjects than Group A subject, with no statistical significant difference between Group B and Group A group. This indicates that

the liver injury is more likely to develop in subjects who Group B to car painting vapors than Group A subject. These results suggested that the elevation in liver enzymes (AST and ALT) and abnormal serum bilirubin in Group B subject was due to organic solvent which is used for spraying car painting.

**Table 1:** Comparison of Liver and Renal function parameters among Group A and Group B subjects

Parameters	Group A N= 19	Group B N= 15	P-value
Total Serum Bilirubin	0.61 (0.05)	0.84 (0.13)	**
Serum AST (GOT)	11.07 (0.42)	13.01 (0.54)	NS
Serum ALT (GPT)	11.68 (0.62)	19.87 (4.31)	**
Serum Albumin	39.85 (0.73)	42.72 (1.14)	NS

Value are expressed as Mean (SD),  
N= Number of subject in each group  
Group A: Unexposed Worker,  
Group B: Exposed Worker,  
\*\*P≤0.001,  
NS: Not significant

### Group A versus Group B Worker by Age group

Comparison of liver and renal Function parameters among Group A and Group B subjects by all age groups (18-25 year, 25-35 year and 35-45 year) is shown in Table 2. Similar trend of result (change in liver and renal function parameters) was observed when compared to Group B and Group A subject by age groups. For liver function parameters, the level of ALT and total serum bilirubin were significantly higher in Group B subjects when compared with Group A subjects of all age groups: 18-25 year, 25-35 year and 35-45 year, with statistical significant difference between Group B and Group A group. The level of AST was numerically higher in Group B subjects than Group A subject of all age groups: 18-25 year, 25-35 year and 35-45 year (Table 2), with no statistical significant difference between Group B and Group A group.

**Table 2:** Comparison of Liver and Renal function parameters among Group A and Group B subjects by all age groups (18-25 year, 25-35 year and 35-45 year)

Parameters	Group A N= 19	Group B N= 15	P-value
<b>Age Group (18-25 year)</b>			
Total Serum Bilirubin	0.61 (0.05)	0.84 (0.13)	**
Serum AST (GOT)	11.07 (0.42)	13.01 (0.54)	NS
Serum ALT (GPT)	11.68 (0.62)	19.87 (4.31)	**
Serum Albumin	39.85 (0.73)	42.72 (1.14)	NS
<b>Age Group (25-35 year)</b>			
Total Serum Bilirubin	0.61 (0.05)	0.84 (0.13)	**
Serum AST (GOT)	11.07 (0.42)	13.01 (0.54)	NS
Serum ALT (GPT)	11.68 (0.62)	19.87 (4.31)	**
Serum Albumin	39.85 (0.73)	42.72 (1.14)	NS
<b>Age Group (35-45 year)</b>			
Total Serum Bilirubin	0.61 (0.05)	0.84 (0.13)	**
Serum AST (GOT)	11.07 (0.42)	13.01 (0.54)	NS
Serum ALT (GPT)	11.68 (0.62)	19.87 (4.31)	**
Serum Albumin	39.85 (0.73)	42.72 (1.14)	NS

Value are expressed as Mean (SD), N= Number of subject in each group

Group A: Unexposed Worker, Group B: Exposed Worker, \*P≤0.01, \*\*P≤0.001, NS: Not significant

For renal function parameters, the serum albumin was numerically higher in Group B subjects when compared with Group A subjects of all age groups: 18- 25 year, 25-35 year and 35-45 year (Table 2), with no statistical significant

difference between Group B and Group A group. This indicates higher risk of liver injury in Group B subjects of all age groups than Group A subjects.

**Group A versus Group B Worker by Smoking status**

Comparison of liver and renal function parameters among Group A and Group B subjects by smoking status (Smoker and non-Smoker) is shown in Table 9. Similar trend of re-

sult (change in liver and renal function parameters) was observed when compared to Group B and Group A subject by their smoking status: smoker and non-smoker. For liver

function parameters, the level of ALT and total serum bilirubin was significantly higher in Group B subjects when compared with Group A subjects who are current smoker and non-smoker (Table 3), with statistical significant difference between Group B and Group A group. The level of

AST was numerically higher in Group B subjects than Group A subject who were current smoker and non-smoker (Table 3), with no statistical significant difference between Group B and Group A group.

**Table 3:** Comparison of Liver and Renal function parameters among Group A and Group B subjects by smoking status (smoker and non-smoker)

parameters	Group A	Group B	P-value
<b>Smokers (N= 11, 15)</b>			
<b>Total Serum Bilirubin</b>	0.51 (0.05)	0.76 (0.10)	**
<b>Serum AST (GOT)</b>	10.30 (0.44)	13.05 (0.66)	NS
<b>Serum ALT (GPT)</b>	10.70 (0.70)	20.64 (3.62)	**
<b>Serum Albumin</b>	39.08 (0.68)	42.83 (1.13)	NS
<b>Smokers (N= 19, 15)</b>			
<b>Total Serum Bilirubin</b>	0.61 (0.05)	0.84 (0.13)	**
<b>Serum AST (GOT)</b>	11.07 (0.42)	13.01 (0.54)	NS
<b>Serum ALT (GPT)</b>	11.68 (0.62)	19.87 (4.31)	**
<b>Serum Albumin</b>	39.85 (0.73)	42.72 (1.14)	NS

Value are expressed as Mean (SD), N= Number of subject in each group  
 Group A: Unexposed Worker, Group B: Exposed Worker, \*\*P<0.001, NS: Not significant

For renal function parameters, the serum albumin was numerically higher in Group B subjects when compared with Group A subjects who are current smoker and non-smoker (Table 3), with no statistical significant difference between Group B and Group A group. This indicates higher risk of liver injury in Group B subjects irrespective of their smoking status (smoker and non smoker).

**Non-smoker versus Smoker Worker**

The comparison of liver and renal function parameters test results between nonsmoker and smoker subjects are

summarized in Table 4. The results of present study revealed that there was no significant difference in liver and renal function test results between smokers and Non-smokers subjects (Table 4). On comparing liver and renal function parameters between smoker and non-smoker subjects, the level of Serum AST and total serum bilirubin was slightly lesser in smokers than non-smoker subjects. Similar kind of trend was observed for Serum ALT and Serum Albumin, there was slight increase in level of Serum ALT and Serum Albumin in smokers than non-smoker subjects.

**Table 4:** comparison of Liver and Renal function parameters test results between non-smoker and smoker subjects

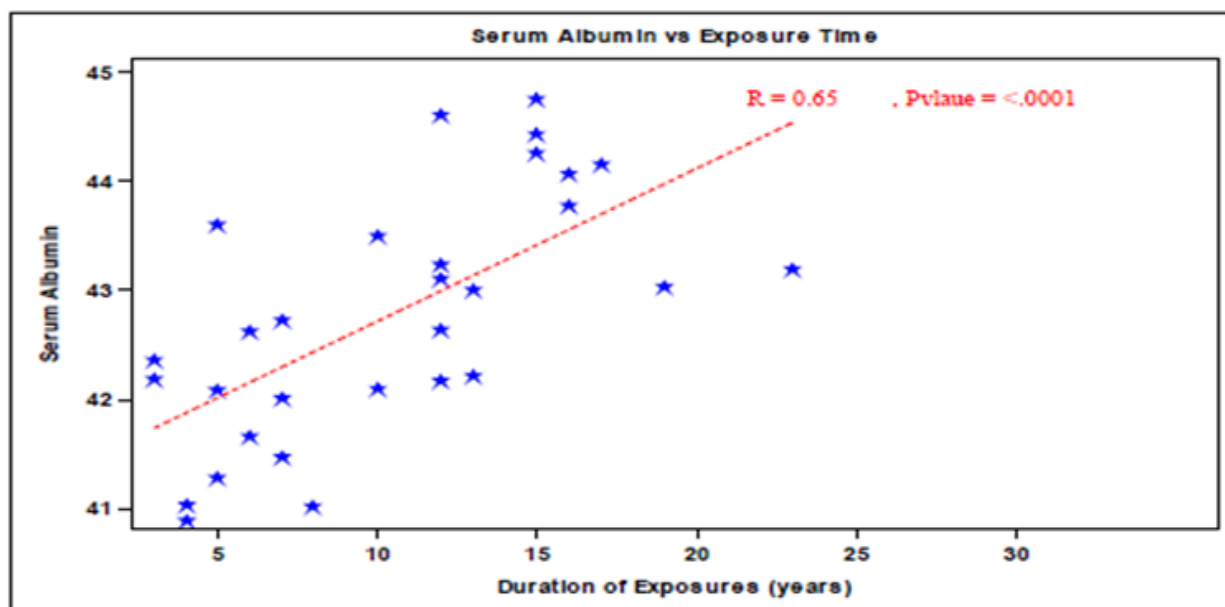
Parameters	Non Smokers N= 34	Smokers N= 26	P-value
Total serum Bilirubin	0.71 (0.15)	0.66 (0.15)	NS
Serum AST (GOT)	11.93 (1.08)	11.89 (0.50)	NS
Serum ALT (GPT)	15.29 (5.01)	16.43 (5.71)	NS
Serum Albumin	41.12 (1.71)	41.24 (2.12)	NS

Value are expressed as mean (SD),  
 N=number of subject in each group  
 NS: Not significant

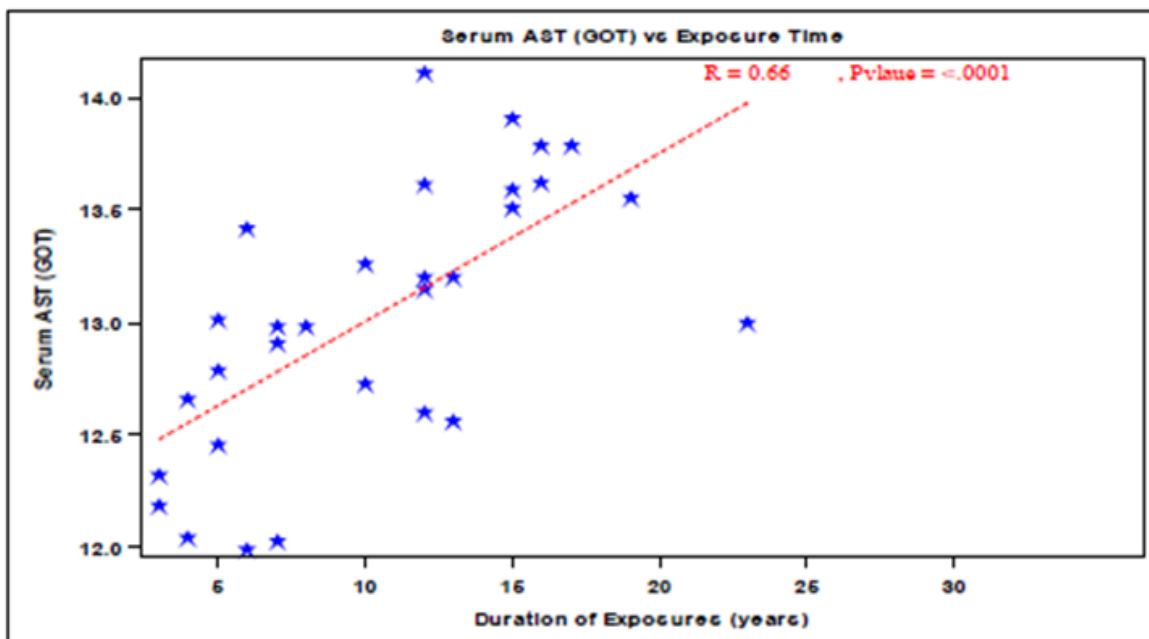
Overall, there were no meaningful differences in any of liver and renal function parameters. This indicates that the liver and renal function amongst smoker and non-smoker subject were similar.

**Correlation of the Liver and Renal Function Parameters with duration of exposure to painting solvents (years) in Group B**

The correlation between all the liver function parameters (total serum bilirubin, AST and ALT) and renal function parameters (albumin) with duration of exposure to organic solvents used for spraying car painting is shown in (Fig 1). Overall, the correlation between total serum bilirubin and duration of exposure to painting solvents was negative, whereas the correlation of AST, ALT and albumin with duration of exposure to painting solvents was positive. This indicates that the level of total serum bilirubin was decreased as duration of exposure to painting solvents increased, whereas the level of AST, ALT and albumin was decreased as duration of exposure to painting solvents increased. Strong positive correlation was observed for albumin ( $r= -0.65$ ) and AST ( $r= -0.66$ ) with significant p values ( $p<0.05$ ) for each parameter, which indicate that the relation of albumin and AST level with duration of exposure to painting solvents was statistically significant (Fig 2).



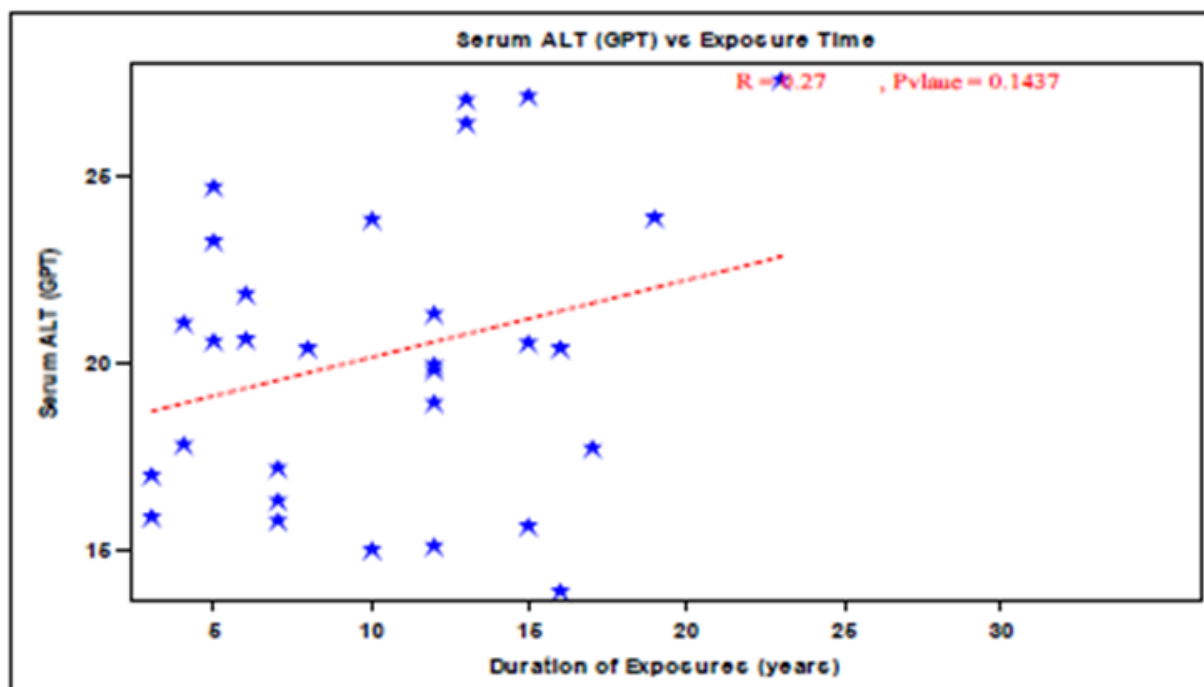
**Fig. 1:** Correlation between duration of exposure (years) to painting solvents and change in albumin in car paint workers



**Fig. 2:** Correlation between duration of exposure (years) to painting solvents and change in AST in car paint workers

Weak positive correlation was observed for ALT with duration of exposure (years) to painting solvents [ $r= 0.27$ ] with non-significant p values ( $p>0.05$ ), 70 which indicates that

there was no significant relationship between duration of exposure to painting solvents and ALT (Fig 3).



**Fig. 3:** Correlation between duration of exposure (years) to painting solvents and change in ALT in car paint workers

Weak negative correlation was observed for total serum bilirubin with duration of exposure (years) to painting solvents [ $r= -0.23$ ] with non-significant p values ( $p>0.05$ ), which indicates that

there was no significant relationship between duration of exposure to painting solvents and total serum bilirubin [Fig. 4].

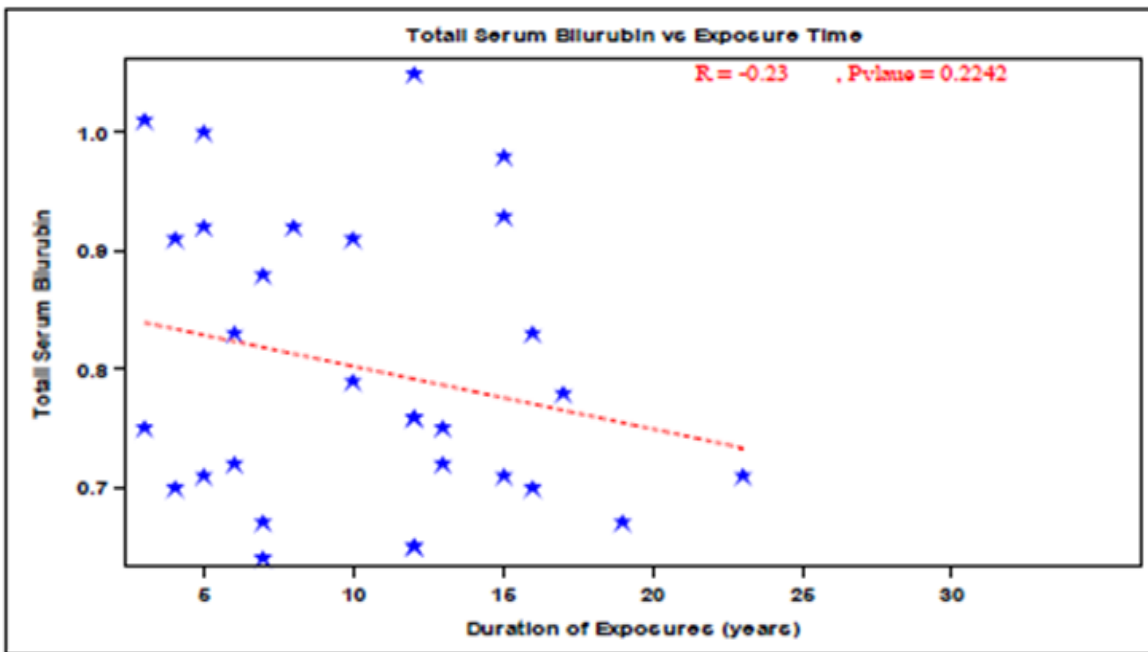


Fig. 4: Correlation between duration of exposure (years) to painting solvents and change in total serum bilirubin in car paint workers

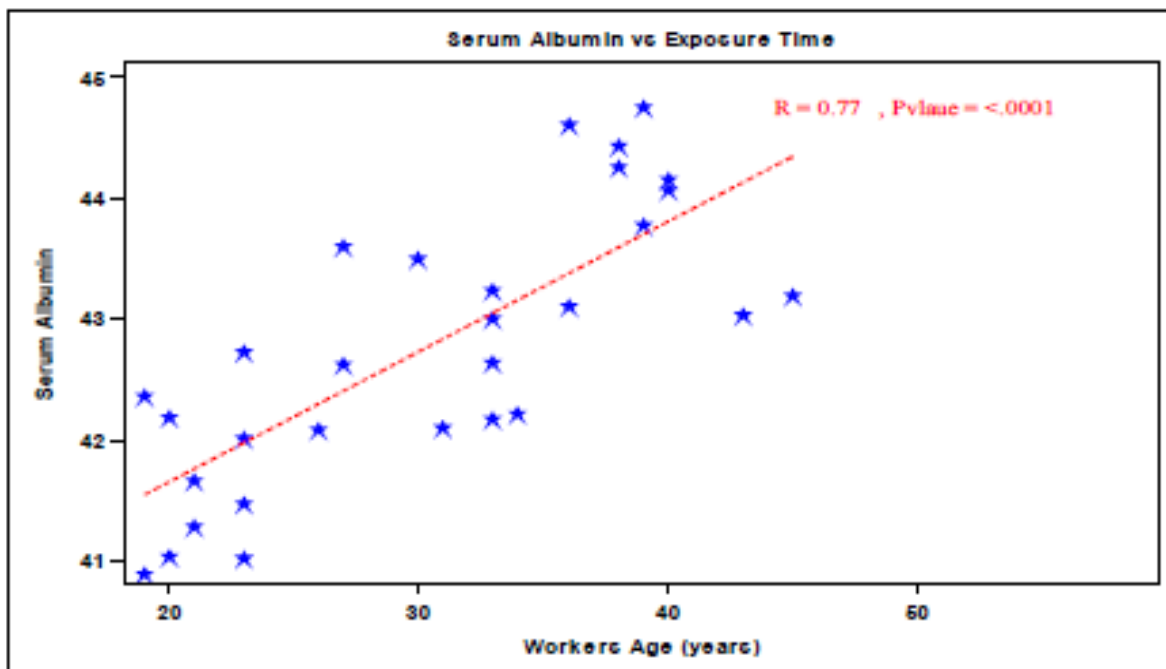
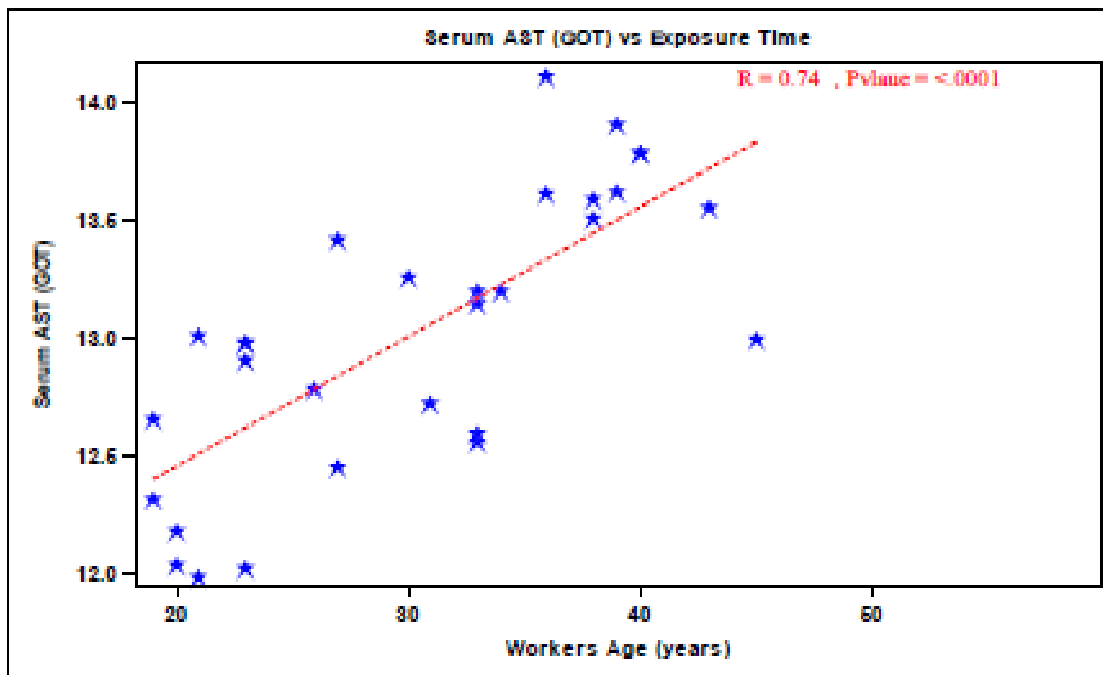
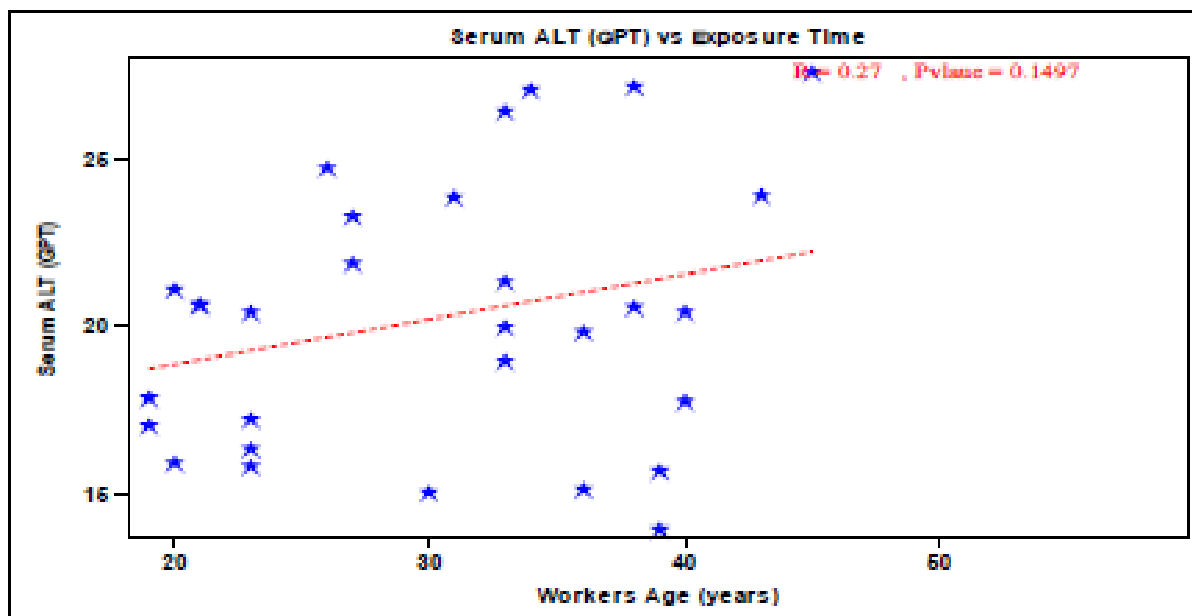


Fig. 5: Correlation between age of car paint workers and change in albumin in car paint workers



**Fig. 6:** Correlation between age of car paint workers and change in AST in car paint workers

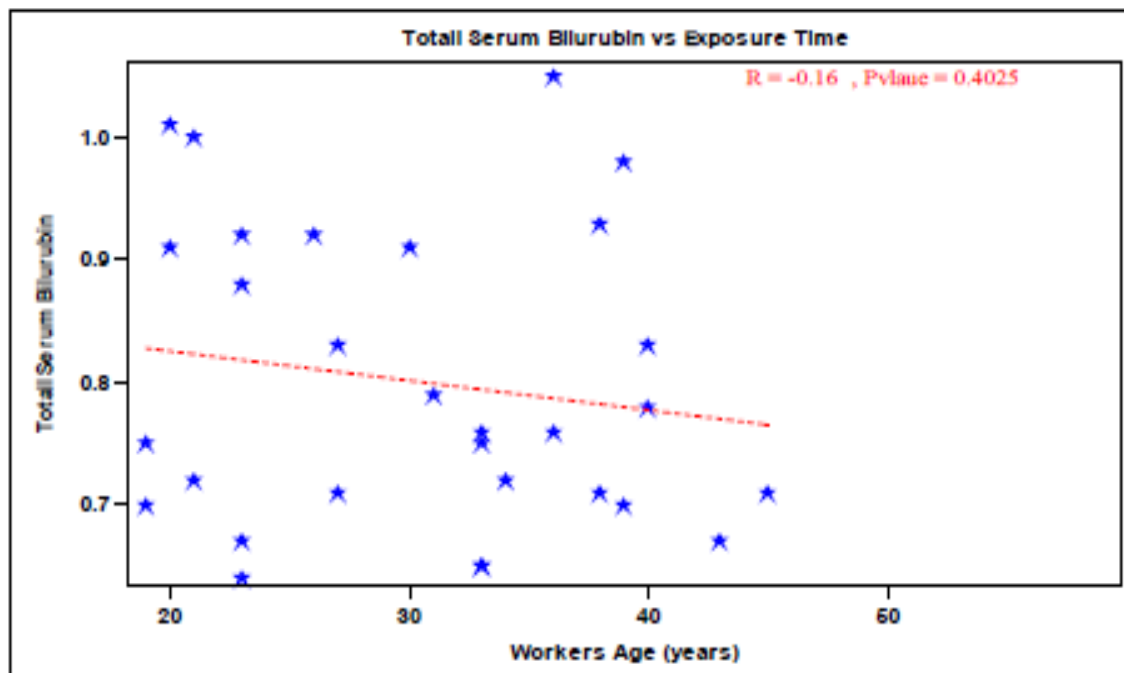
Weak positive correlation was observed for ALT with duration of exposure (years) to painting solvents [ $r= 0.27$ ] with non-significant p values ( $p>0.05$ ), which indicates that there was no significant relationship between duration of exposure to painting solvents and ALT [Fig. 7].



**Fig. 7:** Correlation between age of car paint workers and change in ALT in car paint workers

Very weak negative correlation was observed for total serum bilirubin with age of car paint sprayers [ $r= -0.16$ ] with non-significant p values ( $p>0.05$ ), which indicates that there was no significant relationship between age of car paints prayers and total serum bilirubin [Fig. 8].





**Fig. 8:** Correlation between age of car paint workers and change in total serum bilirubin in car paint workers

## DISCUSSION

In the present studies, the results suggested that the liver and renal impairment was more likely to occur in subjects who exposed to car painting vapors than unexposed subjects which were primarily due to exposure to organic solvents. The cell damage causes elevation of SGPT due to enzyme leakage. The elevation of enzyme correlates with the number of cells damaged.<sup>14-16</sup> In the present study, the mean SGPT level for workers was  $104.4 \pm 49.46$  IU/L, much higher than the control group who were not exposed to such environment. There was no significant difference in liver and renal function test results between smokers and non-smokers subjects. The level of serum AST and total serum bilirubin was slightly lesser in smokers than non-smokers. Similar trend was observed for serum ALT and serum albumin. In the workers, the liver seems to remain largely undamaged from inhalation exposure to a commonly used mixture of solvents. In many workers, this seems to be true even for high exposures for limited periods.<sup>17</sup> The correlation between total serum bilirubin and duration of exposure to painting solvents and age of car paint sprayers was negative [inverse in proportion] whereas the correlation of AST, ALT and albumin with duration of exposure to painting solvents was positive (directly proportional).

## CONCLUSIONS

The present findings confirm that the spray painting is an occupation which involves the risk of liver and renal impairment and also confirms the need of regular medical examination and for following appropriate safety measures while car painting using organic solvents irrespective of their smoking status and age; however it is highly recommended to the subjects who are chronic smokers. The

smoking populations of workers who ignore to follow standard protection measures during car painting are at a very high risk for developing pulmonary impairment.

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