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Study on the effect of Industrial Pollution on Liver Profile in People Living in and Around Industrial Areas

Sridevi Tirumalaraju[1,3], Chandana Lakkaraju[2] , P.P.Reddy[1,3], Hema Prasad Mundluru[2] and Prashanth .CH[3]

[1] Mahathma Gandhi national Institute of Research and Social Action, Hyderabad, India
[2,]Institute of Genetics and Hospital for Genetic Diseases, Begumpet, Hyderabad, India
[3]Bhagawan Mahavir Medical Research Centre, Hyderabad, India

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Abstract

The study includes investigations on liver parameters such as total bilirubin, direct bilirubin, SGOT, SGPT, ALP, total protein, albumin, etc., in people living in and around bollarum industrial area, Hyderabad who are exposed to various industrial pollutants. The subjects were divided in to 4 age groups of <20, 21-40, 41-60 and above 60 years and the results were compared with control group. Results showed significantly higher ($p<0.05$) levels of total bilirubin, direct bilirubin, SGOT, SGPT and ALP in subjects compared to controls which indicate the adverse effect of the industrial pollutants on liver in people living in and around the industrial area.

Keywords: *SGPT, SGOT, ALP, Bilirubin, Liver, Industrial Pollutants*

Introduction

Industries are one of the leading causes of pollution worldwide. Industrial pollution hurts the environment in a range of ways, and it has a negative impact on human lives and health. Pollutants can kill animals and plants, imbalance ecosystems, degrade air quality radically, and generally degrade quality of life (1). Factory workers and people living near the industrial areas with uncontrolled industrial pollution are especially vulnerable. Epidemiological studies on Industrial workers are important to understand health problems and genetic effects in workers exposed to chemicals at the work environment. Studies carried out all over the world established ill health effects, cytogenetic and DNA damage in the industrial workers (2,3). It is also highly pertinent to understand the health problems in people living in and nearby industrial areas.

Liver is one of the most important human organs which are responsible for the metabolism of drugs and toxic chemicals. Toxic metabolites generated through the metabolism are the main cause of liver damage. So liver is badly affected by industrial pollution. The epidemiological studies carried out revealed malfunction or liver damage in people living near industrial sites due to exposure to industrial pollutants (4). Hence the present study was aimed to investigate the liver parameters in blood of the people living in and around bollarum industrial area, Hyderabad.

Various epidemiological studies revealed that fine particles are associated with most health problems, such as cardiac and pulmonary diseases (5, 6, 7), diabetes (8), premature birth and low birth weight (9), cancer (10) and non-alcoholic fatty liver disease (11). Much like particulate matters, ambient SO_2 concentration was associated with mortality, lung cancer, respiratory diseases (12, 13) and stillbirths (14). Further, the ambient NO_2 concentrations were associated with pulmonary defects (15, 16), cardiovascular complications (17), mortality (18) and offspring's birth weight (19). The serum enzymes SGPT, SGOT and ALP levels were considered to be specific for hepatocellular damage with a few exceptions (20). Elevations of the serum SGOT were reported in viral hepatitis as well as other liver diseases (21, 22). SGPT and SGOT are the liver enzymes that catalyse the transfer of amino groups to form the hepatic metabolites pyruvate and oxaloacetate, respectively.

Both the SGPT and SGOT are released from damaged liver cells into the blood after hepatocellular injury or death leading to their higher concentration in serum (23). Till now, several investigations were done to study the effect of environmental pollutants on pulmonary diseases. Thus, in this study we have evaluated the impact of industrial pollutants on liver abnormality or injury of the population living near bollarum industrial area. The study carried out by Bai *et al*. (2004) (24) through haematoxylin eosin (HE) staining and transmission electron microscopy (TEM) study found that SO_2 inhalation can cause liver injury. Likewise, exposure to

NO_2 also affects the microsomal electron-transport systems in the liver.

Materials & methods

The Study was carried out in people living in Bollaram Industrial area, Hyderabad which is well known for both small scale and large industries. This area was taken as experimental site, because of the magnitude of the environmental problems due to liberation of indiscriminate industrial effluents.

Collection of blood

Blood samples were drawn from the people living in and around the industrial area (study subjects) and from people living in the outskirts of the city and away from industrial zone (controls). 5ml of intravenous blood was drawn from both the study and control subjects in to plain vacutainer tubes (Clot activator tube). The samples were transported to the laboratory in a chiller ice box (Tarson) at 0ºC, centrifuged and collected serum immediately for liver profile. Nitrile gloves were used throughout the sampling procedure to prevent any kind of infection

Analysis For liver profile

Blood samples were analysed for liver profile to determine the possible effect of exposure on liver in people living in industrial area.

Total and direct bilirubin levels were estimated by modified Jendrassik and Grof's method (End Point)) at 540nm, SGOT and SGPT enzyme levels by modified IFCC ((UV Kinetic) method at 340nm, ALP levels by PNPP DEA method at 405nm, total protein levels by Biuret method (End point) at 540nm and albumin levels by BCG method (End point) at 620nm. All these parameters were estimated by using semi auto analyser (Microlab 300).

Statistical analysis

The association of total bilirubin, direct bilirubin, SGOT, SGPT, ALP, total Protein, albumin with the exposed/unexposed population was determined by Student's t-test. The results were analysed by using student t-test (Medcalc software) to determine the significance of differences between the controls and subjects.

Results

The values of liver profile of the people living in industrial area (bollarum, Hyderabad) are compared with the normal people who are residents of other town where no industries are located are shown in table 1.

Table 1 Liver profile analysis of people living in and around the industrial area and non-industrial area

		< 20 YEARS		21- 40 YEARS		41 -60 YEARS		> 60 YEARS		ALL AGE GROUPS	
		Controls	Subjects	Controls	Subjects	Controls	Subjects	Controls	Subjects	Controls	Subjects
S.No.	Investigation	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
		N=10	N=17	N=89	N=97	N=45	N=33	N-10	N=3	N=154	N=150
	Liver profile Total										
1	Bilirubin(mg/dl)	0.734±0.116	0.908±0.446	0.734 ± 0.116	0.906 ±0.445*	0.734±0.116	0.899±0.443*	0.729±0.125	0.928±0.468	0.734±0.116	0.906±0.446*
2	Direct Bilirubin(mg/dl)	0.139±0.036	0.220±0.226	0.139 ±0.036	0.220 ± 0.226*	0.138±0.036	0.215±0.223*	0.140±0.041	0.234±0.242	0.139±0.036	0.220±0.227*

3	Indirect Bilirubin(mg/dl)	0.595±0.113	0.687±0.280	0.595 ± 0.113	0.686 ± 0.280*	0.595±0.113	0.683±0.282*	0.589±0.121	0.694±0.291	0.595±0.113	0.686±0.280*
4	SGOT(IU/l)	22.31±6.113	26.98±9.030	22.17 ± 6.181	27.01 ± 9.01*	22.32±6.137	27.09±9.145*	23.60±5.730	26.711±8.779	22.31±6.113	27.019±8.956*
5	SGPT(IU/l)	22.49±6.383	25.33±10.85	22.28 ± 6.407	25.36 ± 10.82*	22.43±6.382	25.68±10.89	24.0 ±5.986	25.66±9.559	22.496±6.383	25.367±10.83*
6	ALP(IU/l)	189.4±30.76	200±67.94	188.6 ± 30.94	200.5 ± 67.85	188±31.13	200± 68.22	190±27.641	202.6±68.14	189.4±30.765	200.5±67.45*
7	Total Protein(g/dl)	7.156±0.631	7.188±0.818	7.151 ± 0.627	7.191 ± 0.816	7.148±0.630	7.195±0.826	7.095±0.726	7.150±0.881	7.156±0.631	7.191±0.628
8	Albumin(g/dl)	4.22±0.432	4.242±0.516	4.219 ± 0.429	4.245 ± 0.516	4.216±0.430	4.24±0.507	4.208±0.504	4.185±0.515	4.220±0.432	4.245±0.418

Mean ± SEM; *P<0.05
P<0.05= Significant,
N = number of samples

Table I shows the comparison of liver profile values of subjects and controls in different age groups. Almost all the liver parameters *viz.,* total bilirubin, direct bilirubin, SGOT, SGPT, ALP, were raised in the subjects when compared to the controls. The mean values of all the liver parameters are high in the subjects when compared to controls. The increase is high in case of total bilirubin (0.906±0.446 in subjects 0.734±0.116 in controls) direct bilirubin (0.220±0.227 in subjects and 0.139±0.036 in controls) ALP (200.5±67.45 in Subjects, 189.4±30.765 in controls), SGPT (25.367±10.83 in subjects, 22.496±6.383 in controls), SGOT (27.019±8.956 in Subjects in 22.31±6.113in Controls).

The statistical analysis of the results showed that the differences for total bilirubin, direct bilirubin, ALP, SGOT, SGPT were found to be significant ($p<0.05$) between the subjects and the controls. However the differences in total proteins and albumin between the two groups are not significant. The age wise analysis of the subjects for the above parameters carried out also showed significant differences for the above parameters except in <20 years,>60 age group where none of the liver profile parameters showed an increase.

Discussion

The present study carried out in Bollarum Industrial area showed significant adverse effect on liver function in people living in and around the industrial area .Some people were the employees in various industries and had direct contact with the chemicals that are used in their respective industries. Some others were the residents of this area but had no direct contact. It is possible that these people are indirectly exposed to the industrial pollution as they have been living in this area. The industrial waste was let in to small canals in and around this industrial area and hence the inhabitants or residents living in this area are at high risk. The results of the present study were compared with the earlier studies which were carried out on Industrial workers for liver abnormalities.

Muhammad Mashhood Ahsan *et al* . (2006) (25) also showed liver damage in tannery workers. They observed an increase in ALP in the 21-40 years age group and a significant decrease in ALP in young (1-20 years) and old age group (41- 60 years) tannery workers. They also observed an increase in the SGOT, SGPT values in the workers compared to control population. Tapan Dey *et al*

(2015) (26) evaluated the impact of air pollutants such as NO_2, RSPM and SPM present in air surrounding the oil drilling sites on liver abnormality or injury of the population living near those sites. The study found that the presence of air pollutants in the environment does play an important role in liver abnormality or injury to the inhabitant as compared to control groups residing in non-industrial area. The study carried out by Bai *et al*. (2004) (27) through haematoxylin eosin (HE) staining and transmission electron microscopy (TEM) analysis found that SO_2 inhalation can cause liver injury. They also indicated exposure to NO_2 also affects the microsomal electron-transport systems in the liver (28). Modhir *et al*. (2014) (29) also showed an increase in albumin in female cement workers as compared to control group indicating liver abnormality. Aydin *et al*. (2010) (30) observed association of occupational cement dust exposure with an increased risk of liver abnormalities, pulmonary disorders and carcinogenesis and decreased antioxidant capacity. Jong Won Kim *et al*, (2014) (31) study provided ample evidence on the role of air pollutants on liver diseases in man and also in animal models.

The ill effects on liver might be attributed to joint effect of industrial pollutants and hence the management of the industries have to take appropriate measures to control the environmental pollution due to industrial wastes. The results of the present study showed adverse effect on liver and further studies are warranted on a large sample size to derive definite conclusions.

Conclusion

People who are living in and around industrial area are frequently exposed to various industrial pollutants and these pollutants have significant impact on liver function and liver damage. Thus the study suggested that long term exposure to the industrial chemicals and stay in industrial residential area might cause liver abnormalities in the population.

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References

[1]. Talkhan OF, Abd Elwahab SA, Shalapy EM. (2016). Biochemical studies on the effect of different water resources in Hail region on liver and kidney functions of rats. Environ Monit Assess. Aug;188(8):484

[2]. Batista NJ, de Carvalho Melo Cavalcante AA, de Oliveira MG, Medeiros EC, Machado JL, Evangelista SR, Dias JF, Dos Santos CE, Duarte A, da Silva FR, da Silva J(2016) Genotoxic and mutagenic evaluation of water samples from a river under the influence of different anthropogenic activities. chemosphere.08.091. 2016 Aug 30.

[3]. Försti A, Frank C, Smolkova B, Kazimirova A, Barancokova M, Vymetalkova V, Kroupa M, Naccarati A, Vodickova L, Buchancova J, Dusinska M, Musak L, Vodicka P, Hemminki K.(2016). Genetic variation in the major mitotic checkpoint genes associated with chromosomal aberrations in healthy humans. Cancer Lett. 1;380(2):442-6..canlet.2016.07.011. 2016 Jul 15.

[4]. Jonderko G, Kujawska A, Langauer-Lewowicka H: Studies of early symptoms of the toxic influence of manganese. Med Pracy 1971, 1:22.

[5]. Cendon S, Pereira LAA, Braga ALF, Conceic GMS, Junior AC, Romaldini H, *et al*. Air pollution effects on myocardial infarction. Rev Saude Publica 2006; 40:414–9. PMID: 16810364

[6]. Villeneuve P, Chen L, Rowe B, Coates F. Outdoor air pollution and emergency department visits for asthma among children and adults: A case crossover study in Northern Alberta, Canada. Environ Health 2007; 6: 40–55. PMID: 18157917

[7]. Modig L, Jarvholm B, Ronnmark E, Nystrom L, Lundback B, Andersson C, *et al*. Vehicle exhaust exposure in an incident case control study of adult asthma. Eur Respir J 2006; 28:75–80. PMID: 16540504

[8]. Filho MAP, Pereira LAA, Arbex FF, Arbex M, Conceic GM, Santos UP, *et al*. Effect of air pollution on diabetes and cardiovascular diseases in Sao Paulo, Brazil. Brazilian J Med Biolo Research 2008;41:526–532. PMID: 18560673

[9]. Brauer M, Lencar C, Tamburic L, Koehoorn M, Paul D, Karr C. A cohort study of traffic related air pollution impacts on birth outcomes. Environ Health Perspect 2008; 116(5): 680–686. doi: 10.1289/ehp 10952 PMID: 18470315

[10]. 10. Nielsen OR, Hertel O, Thomsen BL, Olsen JH. Air pollution from traffic at the residence of children with cancer. Am J Epidemiol 2001; 153:433–443. PMID: 11226975

[11]. Tan HH, Fiel MI, Sun Q, Guo J, Gordon RE, Chen LC, *et al*. Kupffer cell activation by ambient air particulate matter exposure may exacerbate non-alcoholic fatty liver disease. J Immunotoxicol 2009; 6(4):266–275. doi: 10.1080/15476910903241704 PMID: 19908945

[12]. 12. Smargiassi A, Kosatsky T, Hicks J, Plante C, Armstrong B, Villeneuve PJ, *et al*. Risk of Asthmatic Episodes in Children Exposed to Sulfur Dioxide Stack Emissions from a Refinery Point Source in Montreal, Canada. Environ Health Perspect 2009; 117: 653–659. doi:10.1289/ehp.0800010 PMID: 19440507

[13]. Osterman JW, Greaves IA, Smith TJ, Hammond SK, Robins JM, Theriault G. Respiratory symptoms associated with low level sulphur dioxide exposure in silicon carbide production workers. Br J Ind Med 1989; 46:629–635. PMID: 2789966

[14]. Faiz AS, Rhoads GG, Demissie K, Kruse L, Lin Y, Rich DQ, *et al*. Ambient air pollution and the risk of stillbirth. Am J Epidemiol 2012;176(4):308–316. doi: 10.1093/aje/kws029 PMID: 22811493

[15]. 15.Belanger K, Holford TR, Gent JF, Hill ME, Kezik JM, Leaderer BP. Household levels of nitrogen dioxide and paediatric asthma severity. Epidemiology 2013; 24(2):320–330. doi: 10.1097/EDE.0b013e318280e2ac PMID: 23337243

[16]. Roger LJ, Horstman DH, McDonnell WF, Kehrl HR, Ives PJ, Seal E, *et al*. Pulmonary function, airway responsiveness and respiratory symptoms in asthmatics following exercise in NO2. Toxicol Ind. Health 1990; 6:155–171. PMID: 2349573

[17]. Williamsa R, Brookb R, Bardb R, Connera T, Shinc H, Burnett R. Impact of personal and ambient-level exposures to nitrogen dioxide and particulate matter on cardiovascular function. Int J Environ Health Res 2012; 22(1): 71–91. doi: 10.1080/09603123.2011.588437 PMID: 21711166

[18]. Tao Y, Huang W, Huang X, Zhong L, Lu SE, Li Y, *et al*. Estimated acute effects of ambient ozone and nitrogen dioxide on mortality in the pearl river delta of Southern China. Environ Health Perspect 2012;120:393–398. doi: 10.1289/ehp.1103715 PMID: 22157208

[19]. Lepeule J, Caini F, Bottagisi S, Galineau J, Hulin A, Marquis N, *et al*. Maternal exposure to nitrogen dioxide during pregnancy and offspring birth weight: comparison of two exposure models. Environ Health Perspect 2010; 118: 1483–1489. doi: 10.1289/ehp.0901509 PMID: 20472526

[20]. Minuk GY. Canadian association of gastroenterology practical guidelines: Evaluation of abnormal liver enzyme tests. Can J Gastroenterol 1998; 12 (6): 417–421. PMID: 9784897

[21]. Ritis FD, Giusti G, Piccinino F, Cacciatore L. Biochemical Laboratory Tests in Viral Hepatitis and other Hepatic Diseases Evaluation and Follow-Up. Bull. Wld Hlth Org 1965; 32:59–72.

[22]. Wroblewski F. The clinical significance of transaminase activities of serum. Am J Med 1959; 27: 911–923. PMID: 13846130

[23]. American Gastroenterological Association Clinical Practice Committee. AGA technical review on the evaluation of liver chemistry tests. Gastroenterology 2002; 123: 1367–1384 PMID: 12360498

[24]. Bai JY, Meng ZQ. Sulfur dioxide-induced liver pathology. Zhonghua Bing Li Xue Za Zhi 2004; 33(2):155–157. PMID: 15132855

[25]. Muhammad Mashhood , FARAH R. SHAKOORI., 2006. Biochemical and Haematological Abnormalities in Factory Workers Exposed to Hexavalent Chromium in Tanneries of Kasur District Pakistan J. Zool., vol. 38(3), pp. 239-253.

[26]. Tapan Dey, Kabita Gogoi, Balagopalan Unni., Role of Environmental Pollutants in Liver Physiology: Special References to Peoples Living in the Oil Drilling Sites of Assam Plos one. 2015; 10(4): e0123370. Apr 13. Doi : 10.1371/journal.pone.0123370 PMCID: PMC4395329

[27]. Bai JY, Meng ZQ. Sulfur dioxide-induced liver pathology. Zhonghua Bing Li Xue Za Zhi 2004; 33(2):155–157. PMID: 15132855

[28]. Takahashi Y, Mochitate K, Miura T. Subacute effects of nitrogen dioxide on membrane constituents of lung, liver, and kidney of rats. Environ Res 1986; 41(1):184–194. PMID: 3019657

[29]. Modhir N. A**.,**Study of some Biochemical Changes in the Blood Serum of Sadet-Al-Hindiah/Cement Factory Workers /Babylon/Iraq International Journal of Multidisciplinary and Current Research 15 July 2014, Vol.2

[30]. Aydin S, Croteau G, Sahin I, Citil C (2010). "Ghrelin, nitrite and Paraoxonase/Aryl esterase concentrations in cement plant workers." J. Med. Biochem. 29(2):78-83.

[31]. Jong Won Kim, Surim Park, Chae Woong Lim, Kyuhong Lee and Bumseok Kim *et al*. The Role of Air Pollutants in Initiating Liver Disease. *Toxicol. Res.2014* Vol. 30, No. 2, pp. 65-70 (2014) doi.org/10.5487/TR.2014.30.2.065.a