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Effects of Stone Dust Exposure on Some Liver and Kidney Related Serum Parameters of Stone Crush Plant Workers

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Abstract

In the present study the effects of stone dust exposure on liver and kidney related serum parameters were assessed in workers of stone crush plants in various localities of Swat and Dir (L) districts of Khyber Pakhtunkhwa, Pakistan. The liver and kidney related serum parameters included Glutamate Pyruvate Transaminase (GPT), Alkaline Phosphatase (ALP), bilirubin and creatinine. Blood samples were collected from 66 exposed workers and 66 unexposed persons (control). The mean values of liver related parameters i.e. serum GPT, ALP and bilirubin of workers were significantly higher than control persons ($P<0.05$). The mean value of kidney related parameter i.e. creatinine of workers was significantly higher as compared to control persons ($P<0.05$). From the present survey it was concluded that continuous exposure to stone dust can cause abnormal alterations in the normal levels of serum GPT, ALP, bilirubin and creatinine.

Keywords: GPT, ALP, Bilirubin, Creatinine

1. Introduction

Stone crushing plants constitute an important industrial sector in Pakistan. They are engaged in producing crushed stone of various sizes which acts as raw material for the construction of roads, highways, bridges, buildings, canals etc. Like other parts of the country Stone crush plants are also operating in Swat and Dir districts of Khyber Pakhtunkhwa. Stone crush industry contributes to the national Gross Domestic Product (GDP).

During the operation of stone crush plants a large amount of airborne particulate matter is generated. Dust particles are small dry particles ranging in size from 1 to 100 micrometers in diameter. They may be air borne depending on their origin, physical characteristics, and ambient conditions. Whenever dust particles are deposited either on the head or in lungs they have the potential to cause harm either locally or subsequently elsewhere in the body (WHO, 1999). Workers in developing countries are often exposed to dust though they may not be aware of its dangers (Fatusi & Erbabor, 1996). Rotary drill operators, front-end loader operators, truck drivers, and crusher operators are permanently exposed to stone dust (Chekan & Colinet, 2002). Stone dust contains silica, lead, asbestos and airborne solids etc. (Levin, 1994).

Silica is abundant in nature and composes about 12% of the earth's crust. Silica is responsible for causing the oldest and most dreaded of occupational diseases, silicosis (Chattopadhyay & Gangopadhyay, 2006). Silicosis is characterized by respiratory damage which ranges from reversible functional changes to irreversible damage of the lungs, and in, some extreme exposures, causes lung cancer (Mathur&Choudhary, 1996).Silicosis occurs as a result of the inhalation and deposition of crystalline silica particles in the lung parenchyma (Oxman, et al., 1993). The most important factor in the development of silicosis is the dose and percentage of respirable silica contained in the inhaling dust. Other important factors are particle size, the crystalline or non-crystalline nature of the silica, the dust exposure duration, and time period from first exposure to diagnosis (Ziskind, 1976).Silica also causes many other serious health problems (Ampian, 1992;CDC, 1995;ATS 1997).

Asbestos is a naturally occurring hydrated mineral silicate that crystallizes in fibrous form (Mossman et al., 1990).Asbestos fibers can enter the air, water and soil from the weathering of natural deposits and the wearing down of manufactured asbestos products. People are most likely to be exposed to asbestos through inhalation of airborne fibers. Exposure to asbestos fibers lead to asbestosis, lung cancer, and mesothelioma (Petoet al., 1982). Asbestosis is an interstitial pulmonary fibrosis, which reduces the lung capacity to deliver oxygen in proper way to the whole body because the lung tissue loses its ability to function. It is characterized by the airway obstruction, air trapping and reduced vital capacity (Kilburn, 2000). Epidemiological surveys and experimental studies established that asbestos is a carcinogen as well as co-carcinogen (Mossman et al, 1996).

Lead is ubiquitous in the environment, but as a pollutant it is essentially of anthropogenic origin (Onianwa&Fakayode, 2000).The toxicity of lead is well known and lead has been described as the most severe environmental contaminant to arise in human civilization (Smith &Flegal, 1995; Nnorom&Osibanjo, 2000).

Coarse airborne particles have been shown to have an adverse effect on health (Brunekreef& Forsberg, 2005; Sandstrom et al., 2005). Particles that remain in the body for a long time increase the potential to cause disease. During work on hard rock such as granite, grit-stones, or sandstones may expose workers to very dangerous levels of respiratory dust. The accumulation of insoluble particles in the lungs leads to impaired clearance. This so-called 'dust overload' condition may occur as a result of prolonged occupational exposures, even at relatively low levels. Exposure to dust is also known to cause various types of dermatoses (WHO, 1999).

Hazardous dust in the work environment also contains cadmium (Ugbogu et al., 2009). High exposure to cadmium may cause kidney damage. Severe cadmium poisoning causes osteoporosis (Jarup et al., 1998; Jin et al., 2004; Olsson et al., 2005).

Many reports show that the workers exposed to stone dust mostly suffer from severe lung diseases which are associated with cardiovascular complications because the lungs are directly exposed to the inhaling stone dust. But there are also reports about the transposition of toxic elements and their compounds contained in stone dust from the lungs to other tissues and organs including liver (Osorioet al., 1987). Therefore a study was arranged to find out the adverse effects of stone dust exposure on liver and kidneys of stone crush plant workers by estimating their serum Glutamate pyruvate transaminase(GPT), Bilirubin, Alkaline phosphatase (ALP) and creatinine levels.

2. Materials and Methods

2.1 Blood sampling Localities

Blood samples were collected from workers exposed to stone dust in stone crush plants. For this purpose stone crush plants located at Khwazakhela and Matta of District Swat and Chakdara of Distric Dir (Lower) were visited. Blood samples were collected from a total of 66 workers and 66 unexposed persons considered as control.

2.2 Blood sampling and Isolation of Serum

A 5ml blood was collected from the radial vein of each of the stone crush workers and controls in falcon tubes labeled accordingly. The falcon tubes containing blood were transferred to ice box brought to nearby laboratories for immediate isolation of serum. Serum samples were obtained by centrifuging the clotted blood samples at 4500 rpm for 5 minutes, using Eppendorf Centrifuge 5702R.

2.3 Biochemical Assays

The serum samples of stone crush plant workers and controls were analyzed for the assessment of Serum levels of Glutamate Pyruvate Transaminase (SGPT), Alkaline Phosphatase (ALP), bilirubin and creatinine. For the estimation of all these serum parameters, Ultraviolet–visible (Uv) spectrophotometer (1700 Shimadzu Japan) was used.

2.4 Kits/Reagents Used

SGPT kit of FAR srl (Italy), ALP kit of Dia sys International Germany, Bilirubin liquicolor of Human Germany and Creatinine kit of Chromatest Spain.

2.5 Statistical Analysis

For comparing the means of parameters between workers and control (unexposed persons), Paired Student's T test was used. For this analysis computer software SPSS 16 was used.

3. Results

In the present study the effects of stone dust exposure on liver and kidney related serum parameters were studied in workers of stone crush plants in various localities of Swat and Dir (L) districts of Khyber Pakhtunkhwa, Pakistan. These included serum Glutamate Pyruvate Transaminase (GPT), Alkaline Phosphatase (ALP), bilirubin and creatinine.

The effects of stone dust exposure on serum levels of GPT, ALP, bilirubin and creatinine of stone crush plant workers have been shown in table 1. The mean value of serum SGPT in stone crush workers was 59 .452 + 5.5 U/L and that of control was 5.837 + 2.237 U/L. The mean value of serum GPT of workers was compared with mean value of serum GPT of persons (control) outside the vicinity of stone crush plants. The serum GPT level of workers was significantly higher as compared to serum SGPT level of control (P<0.05). The mean value of serum ALP in stone crush workers was 102.65 +73.471U/L and that of control was 52.7576 + 24.467 U/L. The mean value of serum ALP of workers was compared with the mean value of serum ALP of control. The serum ALP level of workers was significantly higher as compared to serum ALP level of control (P<0.05).

The mean value of serum bilirubin in stone crush workers was 1.7573 +0. 46121 mg/dl and that of control was 0.666 + 0.444 mg/dl. The mean value of serum bilirubin of workers was compared with mean value of serum bilirubin of control. The serum bilirubin level of workers was significantly higher from control (P>0.05).

The mean value of serum Creatinine in stone crush workers was 2.4076 + 1.737 mg/dl and that of control was 0.7856 + 0.476 mg/dl. The mean value of serum Creatinine of workers was compared with mean value of serum Creatinine of control. The serum Creatinine level of workers was significantly higher as compared to serum Creatinine level of control (P<0.05).

Table 1. The effects of stone dust exposure on the liver and kidney related serum parameters of stone crush workers.

Serum parameters	Control	Workers	T-value	Significance (2-tailed)
GPT (U/L)	5.83+ 2.23	56.452 + 5.52	4.62	P < 0.05
ALP (U/L)	15.75+ 24.46	69.65 + 73.47	7.85	P < 0.05
Bilirubin (mg/dl)	0.66+ 0.44	1.7573 + 0. 46	1.22	P < 0.05
Creatinine (mg/dl)	0.78+ 0.47	2.4076 + 1.73	7.45	P < 0.05

Values are means and standard deviation of means of 66 observations.

4. Discussion

The levels of serum SGPT of stone crush workers was significantly higher as compared to persons not exposed to stone dust (P<0.05). Glutamate pyruvate transaminase is produced and localized in the hepatic cells. The level of GPT is increased in the circulation when the hepatic cells are damaged (Rej, 1978). Serum GPT is a more specific enzyme for liver damage and therefore elevated level of this enzyme indicates stress on the liver (Himmerichet al., 2001).

The serum ALP level of stone crush workers was significantly higher as compared to persons not exposed to stone dust (P<0.05). Alkaline phosphatases comprise a group of enzymes that catalyze the hydrolysis of a number of phosphate esters in an alkaline environment, generating an organic radical and inorganic phosphate (Reichling, 1988). In healthy adults this enzyme is mainly derived from the liver (Friedman, 1996) and its increased serum level is seen in liver disease associated with extra or intra-hepatic obstruction, obstructive jaundice, infectious mononucleosis, biliary cirrhosis and cholestasis (Kechrid and Kenouz, 2003; Khanna and Kumar, 2003).

The serum level of bilirubin of stone crush workers was significantly higher than the control persons (P<0.05). The elevated level of bilirubin together with the higher concentrations of serum GPT and ALP clearly indicate stress on the liver of workers exposed to stone dust.

Stone dust contains silica, lead, asbestos and airborne solids etc(Levin, 1994).The toxic elements and their compounds contained in stone dust are deposited in lungs. There are reports about the transposition of these toxic ingredients from the lungs to other tissues and organs including liver (Osorioet al., 1987). Kanta et al. (1986) studied the effect of silica on the liver of rats by injecting silica into veins and results shows large liver of the rats. There are some reports on the liver functions of workers; working in other major and minor industries. Jong-Daret al. (1991) reported increased serum GPT level in workers of paint industry. Saber et al. (2010) reported the increased serum level of ALP and ALT in workers exposed to organic solvents in auto manufacturing industry. Khan et al. (2010) reported increased serum bilirubin in the workers employed in automobile workshops.

During the present study the serum level of creatinine was also studied which was significantly higher in stone crush workers as compared to the persons not exposed to stone dust. The significantly higher level of serum creatinine represents adverse effect of stone dust exposure on the kidneys of stone crushes workers. Creatinine, urea and uric acid are waste products of protein metabolism that need to be excreted by the kidney(Panda, 1999).There are some reports on the creatinine level of workers, working in other major and minor industries. Yaqoob et al. (1993) studied renal functions in different departments of car factory; paint sprayers, petroleum based mineral oils and automated press operators. They reported high level of serum creatinine in workers.

From the results of the present study it was concluded that continuous exposure to stone dust in stone crushing plants results in the increased levels of serum GPT, ALP, bilirubin and creatinine.

References

Ampian, S.G. & Virta, R.L. (1992).Crystalline silica overview: Occurrence and analysis. Washington, DC: U.S. Department of the Interior, Bureau of Mines, Information Circular IC 9317.

ATS (American Thoracic Society). (1997). Adverse effects of crystalline silica exposure. *American Journal Respiratory Care Medicine*, *155*, 761–768.

Brunekreef, B. & Forsberg, B. (2005). Epidemiological evidence of effects of coarse airborne particles on health. *European Respiratory Journal, 26*, 309–18.

CDC. (1995)**.** Proportionate mortality from pulmonary tuberculosis associated with occupations 28 states, 1979– 1990. *Morbidity and Mortality Weekly Report, 44*(1), 14–19.

Chattopadhyay, B.P., Gangopadhyay, P.K., Bandopadhyay, T.S. & Alam, J. (2006). Comparison of Pulmonary Function Test Abnormalities between Stone Crushing Dust Exposed and Non exposed Agricultural Workers. *Environmental Health and Preventive Medicine, 11*, 191-198.

Chekan, G.J. & Colinet, J.F. (2002). Silica dust sources in underground limestone mines. In: Proceedings of the 33rd Annual Institute on Mining Health, Safety and Research. (pp. 11-13). Roanoke, Virginia.

Fatusi, A. & Erbabor, G. (1996). Occupational health status of sawmill workers in Nigeria. *Journal of the Royal Society of Health, 116*, 232–6.

Friedman, LS., Martin, P. & Munoz, SJ. (1996). Liver function tests and the objective evaluation of the patients with liver disease. In: Hepatology: a Textbook of Liver Diseases (Edited by Zakim D, TD Boyer TD). (pp.791-833). Philadelphia, WB Saunders.

Himmerich, H., Anghelescu, I., Klawe, C. & Szegedi, A. (2001). Vitamin B 12 and Hepatic enzyme levels correlate in male alcohol dependent patients. *Alcohol & Alcoholism, 36*(1), 26-28.

Jarup, L., Berglund, M., Elinder, C.G., Nordberg, G. & Vahter, M. (1998). Health effect of cadmium exposure – a review of the literature and a risk estimate. *Scandinavian Journal of Work, Environment and Health,24*, 1–51.

Jin, T., Nordberg, Y.T., Bo, M., et al. (2004). Osteoporosis and renal dysfunction in a general population exposed to cadmium in China. *Environmental Research, 98*, 215–23.

Jong-Dar, C., Wang, J.D., Jang, J. & Chen, Y. Y. (1991). Exposure to mixtures of solvents among paint workers and biochemical alterations of live function. *Britian Journal of Industrial Medicine, 48*, 696-701.

Kanta, J., Horsky, J., Kova, H., Tilšer, I., Korolenko, T.A. & Barto, F. (1986). Formation of granulomas in liver of silica- treated rats. *Britian Journal of Experimental Pathology, 67*(6), 889–899.

Kechrid, Z. & Kenouz, R. (2003). Determination of alkaline phosphatase activity in patients with different zinc metabolic disorders. *Turkish Journal of Medicinal Science, 33*, 387-391.

Kechrid, Z. & Kenouz, R. (2003). Determination of alkaline phosphatase activity in patients with different zinc metabolic disorders. *Turkish Journal of Medical Sciences*, 33, 387-391.

Khan, A., Safeena, A. I., Idrees, M., Dad, A., Gul, K. & Akbar, H. (2010). Effect of automobile workshop on the health status of automechanics in N. W. F. P., Pakistan. *African Journal of Environmental Science and Technology, 4*(4), 192-200.

Khanna, S. & Kumar, A. (2003). Infectious mononucleosis presenting as acute hepatitis with marked leukocytosis and renal impairment. *Indian Journal of Gastroenterology, 22*, 6.

Kilburn, K. H. (2000). Indoor air effects after building renovation and in manufactured homes. *The American Journal of the Medical Sciences, 320*(4), 249-54.

Levin, SM. (1994). Asbestos related Abnormalities among De-molition workers. Electronic library of construction and occupational safety and health. Georgia: Center for Construction Research and Training.

Mathur, M. L. & Choudhary, R. C. (1996). Mortality experience of sand stone quarry workers of Jodhpur district. *Lung India, 14*(2), 66–68.

Mossman, B. T., Bignon, J. & Corn, M. (1990). Asbestos: scientific developments and implications for public policy. *Science*, *247*, 294-301.

Mossman, B. T., Kamp, D. W. & Weitzman, S. A. (1996). Mechanisms of carcinogenesis and clinical features of asbestos-associated cancers. *Cancer Investigation*, *14*, 464-478.

Nnorom, I. C. & Osibanjo, O. (2002). Determination of lead and cadmium content of dry cell batteries available in Nigeria. *Journal of Applied Science and Environmental Management, 10*, 37–41.

Olsson, I. M., Ericksson, J., Oborn, I., Skerfving, S. & Oskarsson, A. (2005). Cadmium in food production systems: A health risk for sensitive populations. *Ambio: A Journal of the Human Environment, 34*, 344–51.

Onianwa, P. C. & Fakayode, S. O. (2000). Lead accumulation of top soil and vegetation in the vicinity of a battery factory in Nigeria. *Environmental Geochemistry and Health, 22*, 211–18.

Osorio, A. M., Thun, M. J., Novak, R. F., Cura, J. V. & Avner, E. D. (1987). Silica and glomerulonephritis: Case report and review of the literature. *American Journal of Kidney Diseases, 9*(3), 224–230.

Oxman, A. D., Muir, DCF., Shannon, HS., Stock, SR., Ninzdo, E. & Lange, HJ. (1993). Occupational dust exposure and chronic obstructive pulmonary disease: A systemic overview of the evidence. *American Review of Respiratory Diseases*, *148*, 38–48.

Panda, N. C (1999). Kidney. In: Textbook of Biochemistry and Human biology. 2nd Edition.(pp.290-296). Prentise hall India.

Peto, J. H., Seidman, I. & Selikoff, J. (1982). Mesothelioma mortality in asbestos workers: implications for models of carcinogenesis and risk assessment. *British Journal of Cancer*, *45*, 124-135.

Reichling, J. J. & Kaplan, M. M. (1988). Clinical use of serum enzymes in liver diseases. *Digestive Diseases and Science, 33*, 1601-1614.

Rej, R. (1978). Aspartate aminotransferase activity and isoenzymes proportions in human liver tissues. *American Journal of Clinical Pathology, 28*, 56.

Saber, M., Mehrparvar, A., Yasser, L. & Attarchi, M. S. (2010). The effect of exposure to a mixture of organic solvents on liver enzymes in an auto manufacturing plant. *Journal of Public Health*, *18*, 553–557.

Sandstrom, T., Nowak, D. & VanBree, L. (2005). Health effects of coarse particles in ambient air: messages for research and decisionmaking. *European Respiratory Journal, 26*, 187–8.

Smith, D. R. & Flegal, AR. (1995). Lead in the Biosphere, recent trends. *Ambio: A Journal of the Human Environment, 24*, 21–3.

Smith, R., Corvalan, C. & Kjellstrom, T. (1999). How Much Global Ill Health Is Attributable to Environmental Factors. *Epidemiology, 10*, 573–84.

Ugbogu, O. C., Ohakwe, J. & Foltescu. (2009). Occurrence of respiratory and skin problems among manual stone-quarrying workers. *African Journal of Respiratory Medicine*, 23-26.

WHO. (1999). Prevention and control exchange: Hazard prevention and control in the work environment. (pp.219). Geneva, WHO.

Yaqoob, M., Bell, GM., Stevenson, A., Mason, H. & Percy, DF. (1993). Renal impairment with chronic hydrocarbon exposure. *Britain Journal of Medicine, 86*, 165-174.

Ziskind, M., Jones, R. N. & Weill, H. (1976). Silicosis. *American Review of Respiratory Diseases, 13*, 643–665.

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