Original Article

JCMCTA 2026 ; 37 (1) : 55-60
DOI: https://doi.org/10.3329/jcmcta.v37i1.91572

Comparative Analysis of Liver Enzymes in Population with and without Occupational Cement Dust Exposure

Aindrila Das Gupta[1*] Momtaz Begum[2] Shahin Akhter[3] Md. Mujahidul Islam[4] Uschash Karan[5]

Abstract

Background: Prolong and repeated exposure to cement dust may cause serious occupational health hazards, affecting multiple organs including liver. Workers in cement factories are at high risk of such exposure. Chronic exposure to cement dust may impair liver function. This study is aimed to assess the effects of cement dust exposure on liver enzymes in cement factory workers.

Materials and methods: This cross sectionalstudy was conducted from July 2022-June 2023 in Confidence Cement Factory Ltd. and in the Department of Physiology, Chittagong Medical College, Chattogram. Apparently healthy total 96 male subjects, aged between 20-50 years with BMI 18.5-27.5 kg/m^2 were includedby simple random sampling method according to inclusion and exclusion criteria. A questionnaire along with general information, about previous diseases, medical and family history were filled up by the researchers. Physiological parameters-pulse, systolic and diastolic blood pressurewere recorded. Serum Alanine Aminotransferase (ALT) Aspartate Aminotransferase (AST) and Alkaline Phosphatase (ALP) were measured.

Results: Result was compiled and compared after data collection by using SPSS-27. Chi-square and unpaired 't'-test were done as test of significance. $p<0.05$ was considered as statistically significant. Mean values of serum ALT and AST were significantly higher in cement dust exposed group.($p<0.05$) Serum ALP showed non-significant changes between groups. ($p>0.05$)

Conclusion: Occupational exposure to cement dust is associated with alterations in liver function biomarkers, suggesting potential hepatocellular damage. Regular medical surveillance and preventive occupational health measures are recommended for at-risk populations.

Key words: Cement dust; Hepatocellular damage; Occupational health hazard.

Introduction

Environmental and occupational pollution is regarded as one of the significant cause of morbidity and mortality worldwide.[1] Considering the rising trend of urbanization and population bloom, cement is the most used material inconstruction industry.[2,3] Cement industry is a fast growing sector in Bangladesh and worldwide.[4] In cement industry,combustion of fuel at high temperatures leads to production of kiln dust which is rich in heavy metals.[5] Occupational exposure to it causes various health hazards to factory workers.[4,6]

Cement dust particles enter into the body through skin, or by inhalation or swallowing.[7] Then via systemic circulation and reaches to almost all organs of the body. These particulate affect micro structure of the organs, induce systemic inflammation and oxidative stress.[8] Ultimately alter physiological functions.[9] Previous studies reported that cement dust can infiltrate different tissues- lungs, liver and kidney, resulting in altered cellular structure and oxidative damage to membrane components.[10-12] This oxidative injury can result in the leakage of liver enzymes from damaged hepatic tissue.[13]

Long term exposure to cement dust may increasemorbidity and mortality with various complications, including liver damage.[1,7]

Liver acts as the body's primary detox center, playing a vital role in managing metabolism and elimination of exogenous and endogenous toxins.[14,15] Liver enzymes are crucial for assessing type, extent and severity of liver damage.[7] These enzymes are released from damaged hepatocytes. Elevation of these indicate hepatocellular damage.[13]

1. Lecturer of Physiology
Chittagong Medical College, Chattogram.
2. Professor of Physiology (Retired)
Chittagong Medical College,Chattogram.
3. Associate Professor of Physiology
Chittagong Medical College, Chattogram.
4. Assistant Professor of Physiology
Chattagram Maa-O-Shishu Hospital Medical College, Chattogram.
5. Medical Officer
Anowara Upazila Health Complex, Chattogram.

***Correspondence:** **Dr. Aindrila Das Gupta**
Cell : 01866 83 01 01
E-mail: draindrilaphysiology2019@gmail.com

Submitted on : 31.08.2025
Accepted on : 22.11.2025

JCMCTA 2026 ; 37 (1) : 55-60
DOI: https://doi.org/10.3329/jcmcta.v37i1.91572

Researchers found significant rise in ALT, AST and ALP in cement exposed groups. It might be due to hepatotoxicity and inflammation.[14-16] Previous researchers observed significant increase in plasma bilirubin in cement workers.It indicates hepatotoxicity and inflammation.[7,10,16,17] Reduced hepatic uptake and conjugation of bilirubin, or increased hemolysis and peri-portal necrosis might be the cause.[10,18]

Tirumalaraju et al, carried out a study on people living in and around the industrial areas in India.They found increased liver enzymes like ALT, AST and ALP among them.They supposed that presence of air pollutants in environment, affects liver function near industrial area.[14]

Researchers supposed that air pollutants may increase ROS and RNS production, which may cause oxidative stress.[19] It results in increased membrane lipid peroxidation and decreased anti-oxidant capacity.[20,21] Previous authors supposed that the constituents of cement (Such as silica, aluminium, chromium) can stimulate inflammatory responses and results in target organ derangement.[8,12,15]

A comparative study was conducted in Iraq to assess the haematological parameters, oxidant and antioxidant status and liver function of workers in three cement factories of Iraq. They observed significant increase in liver enzymes (ALT, AST and ALP) inworkers group comparing to control.[22]

A study conducted by Zawilla et al. found liver enzymes were significantly higher in cement exposed workers.It might be due to immunological cause.[9] Construction and cement workers with abnormal ALT, AST and ALP was predisposed to high risk of developing prehypertension and hypertension.[7]

Researchers found total protein was significantly decreased in cement factory workers as a result of oxidative stress on liver.[10,23-25]

Evidence suggests that chronic exposure to industrial pollutants can compromise hepatic health, but data specific to cement dust exposure remain limited.This study aims to exposed bridge this gap by comparing liver function biomarkers between cement dustexposed and un-exposed populations.

Materials and methods

A cross-sectional comparative study was carried out in the Department of Physiology, Chittagong Medical College and Confidence cement factory Ltd. during the period of July 2022 to June 2023 after approval of Ethical Review Committee of Chittagong Medical College (Date: 11.07.2023, number: 2023/975) and taking permission of respective authority. Total 96 subjects were included in this study by simple random sampling method as per fulfillment of inclusion criteria. 48 male cement factory workers exposed to cement dust for ≥5 years, at least 8 –10 hours a day, for six days per week were selected as exposed group. Age, gender and socioeconomic status matched un-exposed group was taken from office workersof the same factory with no known occupational pollutant exposure.

Inclusion criteria

- Apparently healthy, non smoker male worker.
- Age: 25–50 years.
- Voluntarily willing to participate.

Exclusion criteria

- Age : < 25 Years and > 50 Years.
- Subjects exposed to cement dust < 5 years and <8 hours/day
- History of previous exposure or concurrent exposure to other occupational toxicants.
- History of any systemic diseases like liver disease, asthma, diabetes, hypertension, anemia, cancer, infections, thyroid and Cardiac disease.
- Subjects with recent history of blood transfusion.
- History of drug addiction, alcohol addiction, exposure to deadly substances, therapy with antioxidants, or drugs or radiation.
- Workers using more than 3 safety gadgets.

At first an employee list was made containing information regarding their age (20-50 years) and job duration (≥5 years). These information were collected from administration office of the factory. Apparently healthy 48 subjects exposed to cement dust, matching all selection criteria were grouped as cement dust exposed group. Age and BMI

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matched 48 male office workers not directly exposed to cement dust matching the selection criteria were selected as cement dust un-exposed group. Unmatched subjects were excluded.

Total 96 subjects were recruited in the study. They were gathered at a specific room provided by authority. After proper counselling aims, objectives, and detail procedure of the study were explained to them. Voluntary participation were encouraged. They were ensured that all the data would be confidential and used for research purpose only.

Their contact number were collected. They were informed about the specific date and time of data collection over telephone. Data were collected 3 days per week from 10 am to 1pm. Each day data were collected from 16 subjects.Personal information, clinical and anthropometric datawere collected through interviewing and examination by researcher herself. They were coded by an ID number. Then general examination was done and recorded on data collection sheet

Subjects failed to fulfil the inclusion and exclusion criteria, were dropped out and new set of subjects was chosen by same technique. They were informed on previous day over telephone to be present on next day.Blood sample was collected on another 4 days from 96 subjects for estimation of liver enzymes (ALT, AST and ALP). Each day blood sample was collected from 24 subjects. Theywere informed previously over telephone to present on specific day of sample collection. Samples were collected between 10.30 am to 12.00 pa.

Venous blood (4mL) samples were collected by venipuncture for the evaluation of Serumalanine aminotransferase, aspartate aminotransferase and alkaline phosphatase.Sample was kept in room temperature for 1 hour for clot formation. Then it was transported to the laboratory within 1-2 hours in a sample transport box maintaining temperature 2ºC-8ºC with minimum vibration. After reaching laboratory, parameters were measured immediately on the same day.

Data generated from the study were analyzed by SPSS-27. Quantitative or continuous data was expressed as mean ± Standard Deviation (SD). Qualitative data was expressed as frequency (%). Unpaired Student's t-test and Chi-square test were used as test of significance. Significance was set at $p<0.05$ at 95% confidence interval.

Results

Table I showing Sociodemographic characteristics of the study subjects. No significant difference was observed in terms of religion, educational status, residencyand monthly income between both groups. ($p > 0.05$) Figure 1 showing frequency distribution of the cement dust exposed workers according to their duration of exposure to cement dust.

Table I Sociodemographic characteristics of the study subjects in cement dust exposed and un-exposed group) (n = 96)

Chracteristics	Cement dust exposed (n = 48) Frequency (%)	Cement Dust un-exposed (n = 48) Frequency (%)	p-value
Age (Years)			
21 - 30	9 (18.8)	15 (31.3)	
31 - 40	25 (54.2)	20 (41.7)	0.351^{ns}
41 - 50	14 (29.2)	13 (27.1)	
Educational status			
Iliterate	1 (2.1)	0 (0)	
Primary	30 (62.5)	26 (54.1)	
Secondary	15 (31.2)	17 (35.4)	0.441^{ns}
Undergraduate	2 (4.2)	5 (10.4)	
Residency			
Urban	1 (2.1)	2 (4.2)	0.56^{ns}
Rural	47 (97.9)	46 (95.8)	
Monthly income			
≤ 15000	25 (52.1)	29 (60.4)	0.411^{ns}
>15000	23 (47.9)	19 (39.6)	

Chi-square test was done. Values are expressed as frequency. n: number of subjects, ns: not significant ($p > 0.05$) values in parenthesis indicate percentage.

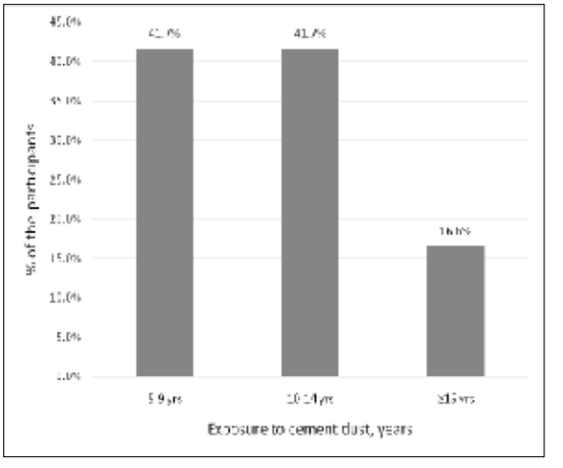

Figure 1 Bar chart showing frequency distribution of the cement dust exposed workers according totheir duration of exposure to cement dust

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Table II Comparison of serum ALT, AST and ALPof cement dust exposed and cement dust un-exposed group (n=96)

Parameters	Cement Dust exposed (n = 48) (Mean ± SD) (Range)	Cement Dust un-exposed (n = 48) (Mean ± SD) (Range)	p - value (t - value)
Serum ALT (U/L)	51.3 ± 22.7 (21.0 - 140.0)	41.1 ± 19.9 (19.0 -125.0)	0.022** (2.335)
Serum AST (U/L)	27.9 ± 10.5 (10.0 - 59.0)	22.5 ± 6.9 (13.0 - 48.0)	0.004** (2.98)
Serum ALP (U/L)	78.9 ± 18.8 (50.0 -127.0)	81.7 ± 15.2 (47.0 - 114.0)	0.412^{ns} (-0.824)

Unpaired Student's t- test was done. Values are expressed as Mean ± SD (Standard Deviation), n = number of subjects, ns = not significant ($p > 0.05$) ** = statistically significant, values in parenthesis indicate range, ALT = Alanine Aminotransferase, AST = Aspartate Aminotransferase, ALP= Alkaline Phosphatase.

Table II shows significantly higher serum ALT and AST levels in cement dust exposed group($p <0.05$), but no significant difference was observed in case of serum ALP ($p>0.05$).

Discussion

In the present study, most of the participants belong to 31-40 years age group and had educational level upto primary or secondary. There was significantly higher mean serum ALT and AST in cementdust

exposedgroup.Similar findings were observed by some researchers.[10,13,20,22,26]Non-significant alteration in ALT and AST in cement dust exposed group were alsofound in some studies.[27,8]

Constituents of cement (Such as silica, aluminium, chromium) act as pro-oxidantandstimulate inflammatory responses. They may cause oxidative damage and increase lipid peroxidation. It may result in vital organ damage.[4,12,15]

A study quoted that survival in chemically hostile environment is facilitated by induction of enzymes to detoxify different toxins and chemicals.[13] It is another possible mechanism of elevation of liver enzymes.

Liver is involved in bio-transformation and metabolism of different toxins and chemicals. Occupational exposure to cement dust causes liver injury.[7] According to researchers, liver is vulnerable to damage from toxic substances.[8]

Liver functions can be evaluated by enzyme studies. Among them ALT is more specificenzyme for hepatic damage. AST was found raised in liver diseases and also in heart, kidney, skeletal muscle pathology.Increase serum ALT and ASTindicate oxidative stress on liver.[18]

Balance between free radical and antioxidant activities is necessary for proper functioning of hepatocytes.[7] Hepatic malfunction might be associatedwith generation of Reactive Oxygen Species (ROS) generated during metabolism of cementdust component.These are highly reactivemolecules generated in small amounts through metabolism. They can damagecellular molecules such as lipids, proteins or DNA.[14,15]

Silica itself may act as antigens or adjuvants. It can produce autoantibody. It causes release of reactive oxygen species along with lytic enzymes, cytokines, chemotactic factors and eicosanoids.[16]

Exposure to harmful noise during cement processing can increase metabolic activity via oxidative phosphorylation. It also generates Reactive Oxygen Species (ROS) and causes antioxidant elimination.[25]

A study was carried out by Tirumalaraju et al. on the inhabitants of industrial areas in India. It was observed that liver enzymes like ALT, AST and ALP were significantly raised among them. It was supposed thatenvironmental air pollutants may impair their liver function.[14]

Several mechanisms are considered as possible mechanism of liver diseases. It was supposed that cement dust induced plasma lipid peroxidation, decreased anti-oxidant capacity, immunological disturbances and persistent inflammation might contribute to these.[9,21]

In present study, mean serum ALP in exposed group was insignificantly less comparing to un-exposed group. It waswithin normal range. Present finding is consistent with some researchers.[8,26] According to Sadek et al. aluminium, a component of cement dust, could inhibit ALP enzyme.[28] Possible mechanism of thisneeds to be evaluated by further study.

Limitation

Due to financial constraint we have conducted this study in a selected area within limited time, so the sample size was small. The study population might not be representative of the whole country.

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Conclusion

It may be concluded that exposure to cement dust may cause deleterious changes in liver functions. The study revealed serum ALT and AST were significantly higher in cement dust exposed workers ($p<0.05$) but serum ALP showed non-significant changes between groups ($p>0.05$).

Recommendation

Further longitudinal study with larger sample size can be conducted. Long duration study and multi-centric approach will strengthen the outcome of study result.Training about proper use of personal protective equipment should be provided to the workers. It is also suggested that workers must undergo pre-employment and periodic health check up including liver function test.

Acknowledgement

The authors gratefully acknowledge the support of study subjects and authority of Confidence Cement Factory Ltd. Chattogram.

Contribution of authors

ADG-Conception, acquisition of data, data analysis, interpretation of data, drafting drafting & final approval.

MB- Conception, design, critical revision & final approval.

SA-Conception, design, interpretation of data, critical revision & final approval.

MMI- Acquisition of data, data analysis, drafting, critical revision & final approval.

UK-Acquisition of data, data analysis, interpretation of data & final approval.

Disclosure

All the authors declared no competing interest.

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