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Research Article

Evaluation of Serum Aminotransferase AST and ALT among Subjects Exposed to Cement Dust at Berber Locality, Sudan

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Abstract

Background: Cement is a dark grey colored powdery substance made with calcined lime and clay as major ingredients. Cement is an essential component of the construction industry. Cement dust is the major pollution problem in cement factories. Cement dust can cause ill health through skin contact, eye contact or inhalation.

Objective: The aim is to estimate serum aminotransferase levels (ALT and AST) among subjects exposed to cement dust.

Methodology: This is a case-control study conducted in Berber city during the period from December to February 2024, at Almkaylab health center in Berber locality. A total of seventy blood samples were collected for the study, forty of them were exposed to cement dust as the case group and thirty healthy individuals were not exposed to cement dust as the control group, 25 from the exposed group were factory workers and 15 of them were subjects in areas adjacent to factory. To measure AST and ALT by using a spectrophotometer.

Result: The result showed that the mean of ALT in case group was 19.08U/L and in control group was 15.13U/L and the mean of AST in case group was 24.45U/L and in control group was 18.93U/L with P-value (0.036) and (0.006) respectively that means statistically significant increase of ALT and AST in the exposed group when compared to control group. The result also showed that mean of ALT in highly exposure group was 18.92U/L and in low exposure group was 19.33U/L and the mean of AST in highly exposure group was 25.40U/L and in low exposure group was 22.87U/L with P-value (0.873) and (0.414) respectively that means statistically insignificant variation in ALT and AST in highly exposure group when compared with low exposure group.

Conclusion: According to the results of this study, we can conclude that the serum levels of AST and ALT were increased in subjects exposed to cement dust in comparison with the control group. While long-term exposure reduces peak expiratory flow rate, inhaling cement dust may be linked to changes in serum element levels as well as changes in lung and liver functioning.

Keywords: Cement dust; LFT; AST; ALT; Hazard; Workers; Exposure; Berber; Pollution; Evaluation

Introduction

Cement production is a rapidly growing industry in developing countries like Sudan. Cement is an essential component of the construction industry. Cement dust is a major pollution problem in cement factories [1,2]. Cement dust can cause health issues through skin contact, eye contact or inhalation. The risk of injury depends on the duration and level of exposure, as well as individual sensitivity [1-3]. Most studies on the effects of cement dust exposure in humans have focused on the respiratory system. However, it appears that cement

dust exposure may also affect other systems; cement dust impacts the skin and eyes and it can cause hematologic and cytogenetic damage [4]. Cement is a product made from limestone, laterites, clay and gypsum [5]. The molecules of primary importance in cement dust, in terms of content and potential health effects, typically include 60-67% Calcium Oxide, 17-25% Silicon Oxide (SiO_2) and 3-5% Aluminum (Al) oxide, along with some amount of Iron Oxide, Chromium (Cr), Potassium, Sodium, Sulfur and Magnesium Oxide [2-6]. The liver is a large and complex organ weighing approximately 1.2-1.5kg in a healthy adult. It is located beneath and attached to the diaphragm. The liver performs four major functions: excretion/secretion, synthesis, detoxification and storage [7].

Although many enzymes have been identified as useful in assessing liver function, the most clinically useful include the aminotransferases (Alanine Amino Transferase [ALT] and Aspartate Amino Transferase [AST]), the phosphatases (Alkaline Phosphatase [ALP] and 5-Nucleotidase), Gamma-Glutamyl Transferase (GGT) and lactate dehydrogenase [7]. The aminotransferases (ALT and AST) are enzymes involved in transferring an amino group from a 2-Amino Acid to a 2-Oxoacid; they require the cofactor pyridoxal phosphate for optimal activity [8]. Cement dust also contains several key components required for regular physiological processes. Only when exposure exceeds the range that homeostatic mechanisms can handle does toxicity from these vital trace elements manifest [9]. There have been studies on how exposure to cement dust affects lung and liver functions in Nigerian workers [10]. However, it is still unknown how much of certain essential and non-essential elements are present in workers exposed to cement dust, as well as how much of each contributes to lung and liver toxicities. In order to ascertain their potential role in the deterioration of liver functions in these individuals, this study analyses the levels of Liver Enzymes (ALT and AST) in cement industrial locations.

Materials and Methods

This case-control study was conducted in the Berber locality, River Nile state, northern Sudan, to estimate serum aminotransferase levels among subjects exposed to cement dust. The study area was Berber city, located approximately 50 kilometers north of Atbara, near the junction of the Atbara River and the Nile. The study was performed from December 2023 to February 2024. The study population consisted of individuals exposed to cement dust (cases), categorized into high and low exposure groups and a control group of healthy individuals not exposed to cement dust. Inclusion criteria encompassed individuals exposed to cement dust. Exclusion criteria excluded individuals with pre-existing liver diseases, those who consume alcohol and individuals with any pathological condition known to affect liver function. A total sample size of seventy participants was utilized: forty individuals exposed to cement dust comprised the case group and thirty unexposed healthy individuals served as the control group.

Study sample

Seventy venous blood samples were collected using a sterile disposable plastic syringe after cleaning the vein puncture area with 70% ethanol. The samples were then centrifuged to obtain serum.

Study variables

Data to determine age, gender, years of exposure, whether the individual is highly exposed (workers) or has low exposure (in the areas adjacent to the factory), ALT and AST levels, was obtained.

Sample collection

Five milliliters of blood were collected by venipuncture under aseptic conditions into a dry, clean, plain sample container. The blood was allowed to clot and was centrifuged at 3,500 revolutions per minute for 5 minutes. After centrifugation, the serum was separated with the aid of a Pasteur pipette and was dispensed into a dry, clean serum container. After that, the samples were analyzed immediately.

Spectrophotometer

AST and ALT are examined by using Mindray BA88A, the principle of this instrument, the concentration of that solution, has been described by Beer and others. Beer's law states that the concentration of a substance is directly proportional to the amount of light absorbed or inversely proportional to the logarithm of the transmitted light [7].

Ethical consideration

The study was approved by the Department of Clinical Chemistry in Medical Laboratory Sciences at Shendi University. The study was submitted to the ethical review committee board. The data collection was conducted with volunteers' permission, and all participants were informed about the study.

Data analysis and presentation

Data was entered, checked and analyzed using SPSS version 28.0 (Statistical Package for the Social Sciences).

Result

Table 1-8.

Table 1: Comparison between the mean concentration of AST and ALT (U/L) among cases and controls.

Study Group		Frequency	Mean(U/L)	P. Value
AST	Case	40	24.45	0.006
	Control	30	18.93	
ALT	Case	40	19.08	0.036
	Control	30	15.13	

Table 2: Comparison of mean serum AST and ALT concentrations (U/L) in highly exposed cement factory workers versus low exposure adjacent residents.

Sub Group		Frequency	Mean(U/L)	P. Value
AST	Highly exposure	25	25.40	0.414
	Low exposure	15	22.87	
ALT	Highly exposure	25	18.92	0.873
	Low exposure	15	19.33	

Table 3: Comparison of mean concentration of ALT(U/L) among cement factory workers (high exposure groups) according to duration of exposure.

Duration	Frequency	Mean of ALT (U/L)	P. Value
Less than 5 years	7	23.00	0.249
5--10 years	7	18.57	
More than 10 years	11	16.55	

Table 4: Comparison of mean concentration of AST (U/L) among cement factory workers (high exposure groups) according to duration of exposure.

Duration	Frequency	Mean of AST (U/L)	P. Value
Less than 5 years	7	29.86	0.328
5-10 years	7	25.57	
More than 10 years	11	22.45	

Table 5: Correlation of AST and ALT with the age of the subject in the cement factory (highly exposed groups).

Enzymes	R. Value	P. Value
AST	-0.520	0.008
ALT	-0.298	0.148

Table 6: Comparison of mean concentration of ALT(U/L) among subjects in areas adjacent to the factory (low exposure groups) according to duration of exposure.

Duration	Frequency	Mean of ALT (U/L)	P. Value
Less than 10 years	3	13.00	0.118
More than 10 years	12	20.92	

Table 7: Comparison of mean concentration of AST (U/L) among subjects in areas adjacent to the factory (low exposure groups) according to duration of exposure.

Duration	Frequency	Mean of AST (U/L)	P. Value
Less than 10 years	3	22.33	0.904
more than 10 years	12	23.00	

Table 8: Correlation of AST and ALT with the age of the subject in areas adjacent to the factory (low exposure groups).

Enzymes	R. Value	P. Value
AST	-0.068	0.810
ALT	-0.124	0.661

Discussion

Cement is an essential component of the construction industry; cement dust poses a major pollution problem in cement factories. Cement dust can cause health issues through skin contact, eye contact or inhalation [1]. This study was conducted in Berber City to estimate serum aminotransferase levels among subjects exposed to cement dust. The study included seventy subjects: forty of them were exposed to cement dust as the case group, while thirty were healthy individuals serving as the control group. Our results showed a statistically significant increase in the mean concentration of ALT among those exposed to cement dust (19.08U/L) compared to the control group (15.13U/L), with a P-value of 0.036, as revealed in Table 1. Additionally, our results indicated a statistically significant increase in the mean concentration of AST among those exposed to cement dust (24.45U/L) compared to the control group (18.93U/L), with a P-value of 0.006, as revealed in Table 1. Our findings align with those of Ashwini S et al. [2,6,11-13]. However, they disagree with the findings of FBO Mojiminiyi et al. [4]; this discrepancy may be due to their study involving 23 workers occupationally exposed to cement dust and 46 matched unexposed controls. We also disagree with the findings of Shahin Akhte et al. [1], which may stem from their study comparing exposed workers with non-exposed workers in the same factory. Additionally, our research does not align with that of O Festus et al. [14], which may be due to their descriptive study involving 114 volunteers.

This study included forty subjects, 25 of whom were cement factory workers and 15 were individuals from areas adjacent to the factory. Our results showed no statistically significant difference in the mean concentration of ALT among cement factory workers (18.92U/L) compared to subjects from adjacent areas (19.33U/L) with a P-value of 0.873. Furthermore, our results showed no significant difference in the mean concentration of AST among cement factory workers (25.40U/L) compared to subjects in adjacent areas (22.87U/L) with a P-value of 0.414, as revealed in Table 2. This finding is inconsistent with the findings of Richard EE et al. [6], possibly due to their study involving 50 workers and 60 residents. Our study also showed no statistically significant variation in the mean ALT and AST levels for those highly exposed to cement dust for less than 5 years (mean ALT=23.00U/L, mean AST=29.86U/L) compared with those exposed for 5-10 years (mean ALT=18.57U/L, mean AST=25.57U/L) and those exposed for more than 10 years (mean ALT=16.55U/L, mean AST=22.45U/L), with P-values of 0.249 and 0.328 respectively, as revealed in Table 3 & 4. Our results indicate a weak negative correlation in ALT levels with the age of highly exposed subjects (R-value=0.298, P-value=0.148) and also a weak negative correlation in AST levels with age among highly exposed subjects (R-value=0.520, P-value=0.008), as revealed in Table 5. Additionally, our study showed no statistically significant variation in mean ALT and AST levels among those with low exposure to cement dust for less than 10 years (mean ALT=13.00U/L, mean AST=22.33U/L) compared with those exposed for less than 10 years (mean ALT=0.118, mean AST=23.00U/L) with P-values=0.118 and respectively, as revealed in Table 6 & 7. Our results show a weak negative correlation in ALT levels with the age of low-exposed subjects (R-value=−0.124, P-value=0.661), but a strong negative correlation in AST levels with the age of low-exposed subjects (R-value=0.068, P-value=0.810), as revealed in Table 8. Reduced peak expiratory flow was linked to longer exposure times to cement dust. Other research has reported similar findings.

Conclusion

According to the results of this study, we can conclude that the serum levels of AST and ALT were higher in subjects exposed to cement dust compared to the control group, indicating that liver function is affected by exposure to cement dust.

Recommendation

a. It is essential for workers to wear safety equipment during work, such as masks, to ensure their well-being.

b. Cement factories should be constructed away from residential areas to minimize environmental and health impacts on local communities.

c. Implementing automated mechanisms in factories to reduce airborne dust is crucial for maintaining a healthy work environment and minimizing pollution.

d. Further studies in this field should involve larger sample sizes to ensure comprehensive and robust results.

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Consent

The patient's written consent has been collected.

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