Effects of Cement Dust on Electrolytes and Osmolality in Serum and Urine of Kufa Cement Factory workers

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Abstract

Cement industry is considered one of the serious pollutants in the environment inducing different kinds of health problems among workers. However, there have been few studies examining the adverse effects of cement dust on the levels of electrolytes and osmolality among workers. In the current study, we investigated the potential impacts of the cement dust on the levels of electrolytes and osmolality in both serum and urine among workers of Kufa Cement Factory. The workers were grouped into three groups according to their departments. The workers, who were aged between 38-48 years, were grouped into oven workers (N=20), mills workers (N=16) and control workers (N=22). While workers who were aged between 49-59 years, were also grouped into oven workers (N=14), mills workers (N=13) and control workers (N=9). Serum and urine samples were collected from all studied subjects. Regardless of age groups, the results showed that the levels of serum sodium and potassium were significantly increased among workers at the oven and mills departments compared to the control. While the levels of blood serum calcium and osmolality were significantly reduced among workers at the oven and mills departments compared to control group. In the urine samples, the levels of sodium were significantly higher among oven workers compared to the findings in both mills and control. While the levels of calcium and osmolality were significantly higher in both oven and mills workers compared to the control.

Keywords: *Cement dust, electrolyte, osmolality, blood serum, urine*

Introduction

The demand for cement are increasing with the increasing population; resultant in a rapid growth of cement industry. Like all 0ther industrial processes cement manufacturing involves the generation of waste materials that are of concern from both health point and environmental of view[1]. Based on the massive amount of gases being used and emitted; cement industry can be measured as one of the serious pollutants in the environment[2]. It has been suggested that the effects of cement dust and its gasses on the subject's health can be varied according to different factors[3]. Duration time of the exposure which is shown to be positively correlated with the negative effects[4,5]. Work place of the subjects as workers at the oven or packing departments are more influenced than others[3,6,7]. In addition , residency of the people as people that live near the cement factory are more targeted than others[8,1]. The cement dust and its gasses can invade human's body through different routes such as inhalation, ingestion, and absorption through the skin[9]. There are considerable evidences showing the adverse effects of the cement dust and its gasses on the human health. Previous research indicated that cement dust had induced several bad impacts on the different internal organs such as liver , lung and kidney among workers at the cement factory. To date, there have been few studies performed investigating the potential effects of cement dusts and its gasses on the levels of electrotypes and osmolality in both serum and urine among workers in different work places at the Cement Factory[3,6,7]. Therefore, in the current study we

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investigated the potential effects of cement dust on the levels on several electrolytes (sodium, potassium and calcium) and the osmolality in both serum and urine among workers at the different sections of Kufa cement factory.

Material and Method

Criteria of participants

A sample of 325 workers aged between 38 and 59 years was selected among workers of kufa cement factory. About 120 of blood serum sample aged between 38-48 years were divided to: A1: worker in ovens department N=(20), A2: worker in mills department N=(16), A3: control department N=(22) ,while the rest sample of blood serum aged between 49-59 years were divided to: B1: worker in ovens department N=(14),B2: worker in mills department N=(13),B3: control department N=(9).

in addition to workers aged between 49 and59years was selected among workers of kufa cement factory. About 120 of urine sample aged between 38-48 years were divided to: C1:worker in ovens department=20, C2:worker in mills department=16, C3: control department=22, aged between 49-59 years were divided to: D1:worker in ovens department=14, D2:worker in mills department=13, D3: control department=9,

Collection of Data

The data were collected using a self-administered questionnaire and it is built on several axes: (name - age - work section - height and weight -duration of exposure- smoking case- the family history and diabetes). The Criteria for selecting workers were that no one should suffer any medical complication such as heart disease, stroke or any other disorder. Blood samples were collected from all studied workers by venipuncture approach. Five milliliters were drawn of each worker and collected in a gel tube. The collected bloods were then centrifuged at 3000/rpm for 15 minutes, then serum was kept at -20 for later analysis of serum electrolytes and osmolality. Urine samples were also collected from every worker at 10.a.m. The collected urine was split into two tubes. The first tube was directly used for the electrolytes measurements, while the other one was centrifuge at 3000 /rpm for 15 minutes. The supernatant was then for osmolality measurement .

Methods of measuring electrolytes and osmolality

Serum micro-minerals (mg/L) were determined from all samples in serum and urine. Sodium was measurement by ELZA. While measurement potassium and calcium was measured by test kits and spectrophotometer device. Randox and spectrum laboratories .Osmolality (mosm/Kg) was determined by using standardized procedures of single-sample Micro-Osmometer device.

.Statistical Analysis

All data were checked for normality using Shapiro-Wilk test. One way ANOVA was used for normal distributed data, while Kruskal-Wallis test was performed for not-normal distributed data. In these models, the group was fitted as a fixed factor, while the dependent variables like the values of electrolytes and osmolality were included as a response. The statistical outcomes were expressed as a Mean ± Standard deviation. A post hoc test was also used for detecting the significant differences among groups, $P<0.05$ was considered as statistically significant. Minitab version 18 (USA) was used to analyze the data in the current study.

Results and Discussion

Electrolytes and osmolality in serum:

In the current study, we examined the potential effects of cement dust on the health of workers by measuring their electrolytes in both serum and urine. The results indicated that the levels of serum sodium among workers with age group 1 in both oven and mills department were significantly higher ($p<0.05$) compared to the values observed in the control group (table1). While in the age group 2, the significant difference was disappeared between workers in mills department and control group (table 2). These results are consistent with previous studies[6,7,8]. High levels of serum sodium observed among workers in both oven and mils departments may indicate that the cement dust could cause this elevation. It has been suggested that the concentration of serum sodium that exceeds 145 mg/dL can be physiologically considered higher[10] . The results of the current study indicated the effects of cement dust were almost the same in both age groups. However, The picture was an opposite direction in terms of the levels of serum calcium and osmolality. The workers in both oven and mills department had significantly

($p<0.05$) decreased the serum calcium and osmolality compared to the values found in the control group (see table 1,2). Although the exact reason for the lowering serum osmolality is unknown, reduction of other factors (not measured in our study) that may drive the serum osmolality could explain why the serum osmolality was significantly decreased among workers. It has been suggested that the serum osmolality is influenced by several factors[11,12]. Another possible explanation for such reduction observed in serum osmolality could be indirect effect of cement dust on the lung function especially forced expiratory volume and then this effect could be behind the reduction of serum osmolality[13]. The changes in serum osmolality have been observed among workers exposed to different kinds of pollutants. Levels of serum potassium was significantly increased ($p<0.05$) among workers with age group 1 in oven department compared to what have been seen among workers in both mills and control departments (table1). However, levels of serum potassium was only significantly different ($p<0.05$) to that observed among workers in control group with age group 2 (table 2).

Table 1: the levels of electrolytes and osmolality measured in serum among workers aged between 38-48 years in Kufa Cement Factory.

Markers	Mean±SD	Mean±SD	Mean±SD	LSD
	Ovens	Mills	Control	
Serum Sodium	146.42a±1.86	145.73a±2.23	137.12b±1.90	3.95
Serum Potassium	6.74a±1.46	4.87b±1.07	4.08b±0.64	1.23
Serum Calcium	6.51a±0.63	6.93a±1.53	8.44b±1.30	1.42
Serum Osmolality	121.95a±9.5	114.68a±6.18	292.22b±12.02	97.24

The various letters refer *significance at $P<0.05$

Table 2: the levels of electrolytes and osmolality measured in serum among workers aged between 49-59 years in Kufa Cement Factory.

Markers	Mean±SD	Mean±SD	Mean±SD	LSD
	Ovens	Mills	Control	
Serum Sodium	145.12^{a}±3.08	145.24^{a}±4.69	137.35^{b}±1.49	4.50
Serum Potassium	4.94^{a}±1.11	5.21^{ab}±1.13	4.07^{b}±0.71	1.07
Serum Calcium	6.64^{a}±0.58	6.61^{a}±1.31	9.51^{b}±1.36	1.20
Serum Osmolality	118.14^{a}±6.82	118.84^{a}±9.62	297.55^{b}±11.38	83.44

The various letters refer *significance at $P<0.05$

Electrolytes and osmolality in urine:

The results indicated that the levels of urine sodium among workers with age group 1 in the oven department were significantly higher ($p<0.05$) compared to the values observed in both mills and control departments (table3). The changes observed in the findings measured with age group 2 were also followed the same path. Levels of urine sodium among workers in the oven department were significantly higher ($p<0.05$) compared to the values observed in both mills and control departments (table 4). This elevation was in the same direction to what we have seen in the levels of sodium measured in the serum of the same subjects, suggesting that the pollutants derived from the cement dust could cause this elevation in both serum and urine. To our knowledge, this is the first study examining the potential effects of cement dust on the levels of electrolytes in the urine. Our results also indicated the subjects with high levels of sodium in their serum had increased the levels of osmolality measured in their urine. One possible explanation for such link is that the hypernatremia found in the serum of the workers in both oven and mills department could induce the body to secret more sodium and other electrolytes like calcium in the urine and hence increase the ratio of these solutes in the secreted urine which ultimately leading to increase the osmolality[14]. Levels of urine potassium was significantly different ($p<0.05$) among the two groups within both age groups in which the lowest levels were observed in the control, while the highest levels were found among workers in the mills department (table3,4). Levels of urine calcium among workers with in both age groups in the oven and mills department were significantly higher ($p<0.001$) compared to the values observed in the control group (table 3,4). This picture was also correct for the findings of urine osmolality. The levels of urine osmolality within both age groups were significantly ($p<0.001$) lower in both oven and mills workers compared to the findings in the control group (table 3,4). The current study had highlighted the role of cement dusts on the levels of the electrolytes and osmolality among workers at the cement factory. This study also expanded our awareness towards the serious effects of the pollutants a rounded us.

Table 3: the levels of electrolytes and osmolality measured in urine among workers aged between 38-48 years in Kufa Cement Factory.

Markers	**G1, Mean±SD**	**G2, Mean±SD**	**G3, Mean±SD**	**LSD**
	Ovens	Mills	Control	
Urine Sodium	146.18a±3.72	135.44b±8.98	139.81b±3.89	5.30
Urine Potassium	6.58a±1.73	11.57b±1.63	3.96c±0.67	1.94
Urine Calcium	7.70a±1.72	6.81a±1.89	4.76b±1.38	2.01
Urine Osmolality	352.5a±50.76	384.5a±85.66	293.5b±20.88	56.01

Table 4: the levels of electrolytes and osmolality measured in urine among workers aged between 49-59 years in Kufa Cement Factory.

Markers	**G1, Mean ±SD**	**G2, Mean ±SD**	**G3, Mean ±SD**	**LSD**
	Ovens	Mills	Control	
Urine Sodium	145.60^{a}±4.13	138.97^{a}±5.70	126.59^{b}±26.41	7.01
Urine Potassium	6.69^{a}±1.89	11.41^{b}±1.55	3.99^{c}±1.03	2.56
Urine Calcium	7.25^{a}±2.42	7.36^{a}±2.26	3.66^{b}±1.33	3.01
Urine Osmolality	420.57^{a}±100	489.15^{a}±82.31	295.88^{b}±11.92	114.05

Conclusions

Levels of the electrolytes and osmolality measured in both serum and urine were significantly influenced by cement dust among workers came from different departments. These results should encourage the workers to protect themselves by following the safety instructions which ultimately constrain the possible adverse effects caused by cement dust. In addition, workers at cement factories should be a ware of using some of antioxidant supplementations which could mitigate the potential oxidative damage by cement derived molecules**.**

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Environmental Sciences and all experiments were carried out in accordance with approved guidelines.

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