Magna Scientia Advanced Research and Reviews

eISSN: 2582-9394

Cross Ref DOI: 10.30574/msarr

Journal homepage: https://magnascientiapub.com/journals/msarr/

(Research Article)

Evaluation of cement chemicals effect on the serum Urea and Creatinine levels of Artisans working with cement in Enugu metropolis, Nigeria

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Magna Scientia Advanced Research and Reviews, 2026, 16(02), 119-126

Publication history: Received on 12 February 2026; revised on 22 March 2026; accepted on 24 March 2026

Article DOI: https://doi.org/10.30574/msarr.2026.16.2.0038

Abstract

Objective: Cement is a fine powdery substance that serves as a key binding agent in construction materials. Artisans such as masons, bricklayers, plasterers, and other construction workers, handle cement daily to mix mortar for bricklaying, render walls, pour concrete foundations, or create blocks. In informal settings common in Nigeria, cement mixture is done manually on-site without advanced machinery, increasing direct exposure. This exposure affects the kidneys of these artisans. This study assessed the serum urea and creatinine which are the main renal biomarkers in artisans who use cement in Enugu metropolis.

Methods: A total of sixty participants of ages 20-50 years (30 cement chemical-exposed subjects as test group and 30 non-cement chemical exposed subjects as controls) were recruited for this cross-sectional study. Anthropometric parameters (Blood pressure, height and weight) of the participants were measured and body mass index (BMI) calculated. 2ml of venous blood collected from each participants was used for the assessment of urea and creatinine levels using Urease-Berthelot method and Jaffe-Slot method respectively. The data generated were analyzed using statistical package for social sciences (SPSS) version 25 and results expressed as mean and standard deviation.

Results: The result shows significant ($p<0.05$) differences in the mean ± SD of systolic blood pressure (132.57 ± 15.82, 120.58 ± 11.25), body mass index (17.72 ± 4.27, 22.50 ± 3.68), urea (5.52 ± 5.19, 2.41 ± 1.02), creatinine (83.53 ± 31.23, 65.56 ± 17.50) in test subjects compared to control subjects respectively. There exists a positive significant ($p<0.05$) correlation in BMI vs Urea, BMI vs DBP, BMI vs Creatinine, SBP vs DBP, DBP vs Creatinine, Urea vs Creatinine.

Conclusion: This study demonstrated higher levels of systolic blood pressure, urea and creatinine among cement chemical-exposed subjects. Therefore, regular assessment of urea and creatinine levels is vital in those artisans to avoid kidney dysfunctions and other renal complications.

Keywords: Cement-chemicals; Artisans; Urea; Creatinine; Kidney; Enugu

1. Introduction

Cement production and its use on construction sites generate a range of gases and particulate matter that pose health risks to artisans (workers such as masons, labourers and tilers) who inhale these pollutants [1]. The main chemicals in cement that artisans inhale during handling, mixing, or application primarily arise from cement dust, which contains a mix of compounds from raw materials and production processes [1-2]. Cement is a finely ground hydraulic binder that

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hardens when mixed with water, forming a solid matrix for construction. It is primarily composed of calcium silicates, aluminates, and aluminoferrites that hydrate to produce strength [2]. Cement plants are significant sources of air pollutants. Emissions from cement manufacturing have drawn considerable interest due to their role in environmental contamination [1]. The industry generates substantial atmospheric pollution and contributes to air quality deterioration by releasing hazardous air pollutants such as particulate matter (PM), nitrogen oxides (NO_x), Sulphur dioxide (SO_2), and carbon monoxide (CO), while also being an intensive energy consumer and a major greenhouse gas emitter [3]. Among the atmospheric contaminants released during cement production are various heavy metals (HMs), which can disperse over large distances and eventually deposit in surrounding ecosystems. These heavy metals (HMs) originate from raw materials, fuel, and waste combustion during the clinkering process [4]. Heavy metals in the environment exist in multiple forms-particles, oxides, salts, or gases- and their toxicity varies based on chemical speciation [5]. Moreover, investigations have assessed heavy metal concentrations in soils and their implications for air quality [6].

Cement use affect an array of systems and organs in the body namely; respiratory system, skin, liver function, kidney function, metabolism. Particulate matter (PM) causes chronic airway inflammation, cough, asthma-like symptoms, lung infections etc [7].When wet cement get in contacts with the skin, chemicals react to water molecules in the skin. This reaction produces alkaline molecules that can break down the skin tissue. The longer cement stays in contact with the skin, the worse the burn becomes [8]. Workers who are regularly exposed to cement dust- such as masons, construction workers, cement plant staff and tilers tend to have higher levels of kidney function markers (urea and creatinine) than people who are not exposed [9].

Urea and Creatinine are nitrogenous end products of metabolism. Urea is the primary metabolite derived from dietary protein and tissue protein turnover, while creatinine is the product of muscle creatine catabolism. Both are relatively small molecules (60 and 113daltons, respectively) that distribute throughout total body water [10]. Monitoring urea and creatinine levels is crucial for assessing renal function and metabolic health, with high levels indicating potential risks for kidney dysfunction [11]. Urea is a naturally occurring metabolite in the human body, it is a key nitrogenous waste product in the body, is primarily produced in the liver through the urea cycle, involving the conversion of ammonia and carbon dioxide into urea [12]. This process is crucial for eliminating nitrogenous waste and maintaining acid-base balance.

Creatinine is a waste product formed in the body through the dehydration of creatine, a compound crucial for energy production in muscles [13]. Creatine is synthesized in the kidneys, liver, and pancreas from amino acids like arginine, glycine, and methionine, and is then transported in the blood to various organs, including muscles [14]. Approximately 2% of the body's creatine is naturally converted to creatinine daily, which is then filtered by the kidneys and excreted in urine [15]. The levels of creatinine in the blood are relatively stable and reflect muscle mass, making it a valuable indicator of kidney function. When kidney function declines, the filtration and excretion of urea are impaired, leading to its accumulation in the blood. Therefore, an elevated blood urea nitrogen (BUN) level is a key indicator of renal dysfunction [16]. Like urea, creatinine is freely filtered by the glomeruli and is not reabsorbed by the tubules to any significant extent, meaning the amount filtered is almost entirely excreted [17].This steady production and reliable filtration makes serum creatinine a more specific and widely used biomarker for assessing kidney function than blood urea nitrogen (BUN) [18]. A rise in serum creatinine level directly indicates a reduced glomerular filtration rate (GFR), signifying that the kidneys are not affectively getting rid of waste [15].

High urea and creatinine levels can signify kidney impairment or failure, emphasizing the diagnostic importance of urea and creatinine in assessing renal health [11]. Determining the renal function status can predict kidney state and prevent any disease progression. A 2023 study by Ansari and colleagues compared sixty cement workers with sixty unexposed individuals and found that the exposed individuals had much higher average creatinine (2.00 mg/dl) and urea levels (72.5 mg/dl) compared to 1.10 mg/dl and 32.2 mg/dl respectively of their unexposed counterparts [9]. This underscores cement dust as an occupational hazard and highlights the need for workplace dust controls and routine monitoring of renal function (urea/creatinine) in exposed workers.

2. Materials and methods

2.1. Study Design/Selection

This cross sectional study involved a total number of sixty (60) men from Enugu metropolis. The study comprised of thirty (30) cement handlers and thirty non-cement handlers (aged 20-50 years) as test and control subjects respectively. Informed consent was obtained from each participant. Questionnaires were distributed and duly filled by the participants before commencement of the study.

2.2. Inclusion and Exclusion Criteria

2.2.1. Inclusion criteria for test group

Registered artisans working with cement at building sites in Enugu Metropolis for a period of one year and above between ages 20 to 50 years

2.2.2. Inclusion criteria for control group

Apparently healthy individuals, not exposed to cement dust with ages of 20 to 50 years.

Subjects willing to participate and provide informed consent.

2.2.3. Exclusion Criteria for both test and control groups

Individuals with known kidney disease or chronic illnesses, chronic kidney disease, diabetic neuropathy and alcohol-induced kidney disease.

Subjects taking drugs that affect kidney function, Subjects under ages twenty and above fifty years.

Individuals unwilling to participate in the study.

2.3. Ethical Considerations and Informed Consents

Ethical approval was duly obtained from the ethical committee of the College of Medicine University of Nigeria Ituku Ozalla Enugu (COMHRE/2026/01/014). Written consent of willingness to participate in the study as subject was obtained from all participants included in the study with absolute confidentiality maintained.

2.4. Anthropometric Measurements

2.4.1. Measurements of Body Mass Index (BMI)

The weight, height and BMI of the respondents were recorded. A digital weighing scale (Egole 1112) was used to measure the body weight (kg). A stadiometer was used to measure height (m); and the BMI was calculated by dividing the weight (kg) by the square of height (m^2).

2.4.2. Measurements of Blood Pressure (BP)

A standardized automatic BP monitor (ANDON MODEL KD-595) was used to take the blood pressure measurements in two readings after the participants have been sat undisturbed for a minimum of five minutes and the average record was used.

2.5. Sampling Techniques

Venous blood was collected into appropriately labelled two millilitres (2mls) plain tube. Sample was allowed to clot and retract, centrifuged at 5,000 rpm and the supernatant (serum) was separated into another labelled vial and stored at -20^{0}C until analysed, and the analyses were carried out within 48 hours of collection. All analysis of the samples was done by the researchers at the laboratory of University of Nigeria Teaching Hospital Ituku-Ozalla Enugu.

2.6. Biochemical Analysis

Urea and Creatinine were all estimated on each collected sample.

2.6.1. Serum Urea and Creatinine estimation

Estimation was done by Urease-Berthelot and Jaffe-Slot methods respectively using cobas c 111 system analyzer, with the manufacturer's instructions duly followed.

2.7. Data Analysis

Data obtained from this study were analysed using the statistical package for social sciences (SPSS) for Windows Inc. Chicago, IL, USA. Student's independent T-test was used to calculate the difference between means. Results were recorded as mean ± standard deviation. P-value < 0.05 was considered statistically significant.

3. Results

Table 1: Shows the anthropometric parameters of cement chemical exposed and non-cement chemical exposed subjects. The result shows significant differences (P<0.05) in the mean values of BMI (17.72 ± 4.27, 22.50 ± 3.68), SBP (132.57 ± 15.82, 120.58 ± 11.25) and a non-significant increase (P>0.05) in DBP (78.53 ± 16.05, 74.43 ± 10.68) among cement exposed (test) and non-cement chemical exposed (control) subjects respectively.

Table 1 Anthropometric parameters of cement chemical exposed and non-cement chemical exposed subjects.

Groups	Body Mass Index (Kg/m^2)	Systolic BP (mmHg)	Diastolic BP (mmHg)
Cement Chemical Exposed subjects N = 30	17.72 ± 4.27	132.57 ± 15.82	78.53 ± 16.05
Non-Cement Chemical Exposed Subjects N = 30	22.50 ± 3.68	120.58 ± 11.25	74.43 ± 10.68
t-Statistics	-5.020	3.709	1.286
P-values	0.000*	0.000*	0.203

Values are given as Mean ± Standard Deviation (SD) ; *……….. Significant value (P<0.05)

Table 2: shows the urea and creatinine values of cement chemical exposed and non-cement chemical exposed subjects. The result shows significant increase (P<0.05) in the mean values of Urea (5.52 ± 5.19, 2.41 ± 1.02) and Creatinine (83.53 ± 31.23, 65.56 ± 17.50) among cement exposed (test) and non-cement exposed (control) subjects respectively.

Table 2 The Serum Urea and Creatinine levels of cement exposed and non-cement exposed subjects.

Groups	Urea (mMol/L)	Creatinine (µMol/L)
Cement Chemical Exposed Subjects N = 30	5.52 ± 5.19	83.53 ± 31.23
Non-Cement Chemical Exposed Subjects N = 30	2.41 ± 1.02	65.56 ± 17.50
t-Statistics	3.701	3.060
P-value	0.000*	0.003*

Values are given as Mean ± Standard Deviation (SD); *................Significant value.

Table 3**:** Shows the relationship between the parameters of the cement chemical exposed individuals. The result shows positive significant correlation (P<0.05) between BMI vs DBP (r = 0.449), BMI vs Urea (r = 0.443), BMI vs Creatinine (r = 0.446), SBP vs DBP (r = 0.596), DBP vs Creatinine (r = 0.532), Urea vs Creatinine (r = 0.481). While other parameters show non-significant correlation.

Table 3 The relationship between parameters among the cement chemical exposed subjects.

Parameters (N = 30)	Pearson (r)	P-values
BMI vs SBP	0.312	0.094
BMI vs DBP	0.449	0.013*
BMI vs Urea	0.443	0.014*
BMI vs Creatinine	0.466	0.009**
SBP vs DBP	0.596	0.001**
SBP vs Urea	0.007	0.969

SBP vs Creatinine	0.209	0.269
DBP vs Urea	0.352	0.057
DBP vs Creatinine	0.532	0.002**
Urea vs Creatinine	0.481	0.007*

*= Correlation is significant at the 0.05 level (2-tailed); **= Correlation is significant at the 0.01 level (2-tailed).

4. Discussion

Urea and Creatinine are the major renal function parameters. They are used as biomarkers for kidney abnormalities. Significant increase of these renal parameters indicates kidney abnormalities. Individuals who are constantly exposed to cement dusts are prone to have renal abnormalities [19]. Table 1 of this study shows the anthropometric measurements of cement chemical exposed and non-cement chemical exposed subjects. Cement exposed subjects have significantly decreased body mass index (BMI) compared to their non-cement chemical exposed counterparts. This could be as a result of intense manual labour which increases energy expenditure that is not matched by adequate calorie intake, exacerbating undernutrition according to [20]. Fatigue from irregular schedules further reduce appetite and meal preparation. In developing countries like Nigeria, junk food consumption, skipping breakfast, time constraint from demanding tasks, environmental stressors(heat/noise) and poor food access at sites all contribute to undernutrition and weight loss according to [20]. Loss of body mass can also be directly associated with cement exposure rather than socioeconomic causes. Urea and Creatinine accumulation as a result of cement chemical exposure act as toxins, inducing nausea, altered gut motility and appetite suppression (via ghrelin/leptin dysregulation), leading to inadequate calorie/ protein intake and subsequent weight loss [21].

In a study [22] hyper catabolism in Chronic kidney disease raises urea production while muscle loss lowers creatinine generation, elevating Urea-Creatinine Ratio as a biomarker of rapid wasting; this reflects ubiquitin-proteasome activation and autophagy, degrading muscle proteins faster than synthesis. The table also indicates an increased systolic blood pressure among the cement chemical exposed subjects. This could be primarily due to stress and increase in the urea and creatinine levels which indicates impaired kidney function. Study by Shao *et al* [23] explains that elevated urea and creatinine impair endothelial cells, increasing reactive oxygen species (ROS) and inhibiting Nitric Oxide (NO) synthesis, leading to vasoconstriction and higher systolic blood pressure. Urea/creatinine disrupt metabolic pathways, indirectly raising SBP through cardiovascular strain [24].

Furthermore, table 2 shows the urea and creatinine values of cement chemical exposed and non-cement chemical exposed subjects. The urea and creatinine values of the cement exposed subjects were higher than those of the control group. This could be attributed to inhaled cement dust which triggers systemic inflammation and oxidative stress, damaging the delicate filtration units of the kidney (nephron) [19]. This finding is in line with the previous research by Morshed *et al.,* [25] who demonstrated that increased cement dust exposure was associated with elevated white blood cells and other markers of inflammation.

The relationship between different parameters was assessed among cement chemical exposed subjects in Table 3. There exists a positive correlation between BMI vs DBP, BMI vs Urea, BMI vs Creatinine, SBP vs DBP, DBP vs Creatinine, and Urea vs Creatinine. This result indicates that as body mass index is increasing, the diastolic blood pressure, Urea and Creatinine also increases. This finding agrees with a previous study by [26]. An increase in serum creatinine leads to an increased diastolic blood pressure. A creatinine increase means a decline in kidney function. The kidneys retain more salt and water, increasing blood volume, which directly raises blood pressure. This creates a feedback loop where elevated blood pressure causes further kidney damage, which then pushes blood pressure even higher [27]. The table also shows that as urea is increasing, creatinine is also increasing in these cement chemical exposed individuals. This is because both urea and creatinine depend on glomerular filtration for removal. Therefore, when Glomerular filtration rate (GFR) decreases, renal inflation and oxidative injury occur causing a simultaneous increase urea and creatinine. This is in agreement with previous studies [28-29].

5. Conclusion

The study observed a decrease in BMI and an increase in Systolic blood pressure among the cement dust exposed individuals compared to their counterparts.

The study also shows an increase in both the Urea and Creatinine levels of cement dust exposed subjects when compared to non-cement dust exposed subjects.

This study suggests that exposure to cement dust increases Urea and Creatinine levels of individuals which could lead to kidney dysfunction and other metabolic disorders.

This highlights the need for regular evaluation of kidney function among the professions who use cement regularly to avert renal dysfunctions like acute kidney injury (AKI) and other renal complications.

Compliance with ethical standards

Acknowledgements

The authors wish to appreciate all the participants and everyone who contributed in any way to the success of this research work.

Disclosure of conflict of interests

The authors declare no conflict of interest, financial or otherwise.

Statement of ethical approval

Ethical approval was duly obtained from the ethical committee of the College of Medicine University of Nigeria Ituku Ozalla Enugu (COMHRE/2026/01/014).

Statement of informed consent

Informed consent was obtained from all participants in this study before commencement.

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