

# Effect of Exposure to Cement Dust of Residents in Vicinity of Kirkuk Cement Factory on Kidney Parameters

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## Article Information:

### History:

Received: 03 September 2022.

Accepted: 28 September 2022.

Published: 31 December 2022.

### Keywords:

Cement Factory; Laylan; Urea; Creatinine.

DOI:<http://dx.doi.org/10.32894/kujss.2022.135869.1071>

## Abstract

The aim of the current study is to determine the effect of Kirkuk cement factory dust on renal function tests among the residents of villages and farms surrounding the factory and those who are constantly exposed to cement dust, which include: urea, uric acid, creatinine and total serum protein for the period from January 2021 to April 2021. The samples were randomly collected (60) samples from different distances as the study group, which were divided according to the distance from the factory into six categories D1, D2, D3, D4, D5, D6, while the control group was (30) samples for the last category, Laylan D7 area, and their average age ranged from (10-70) years, venous blood was drawn (5) ml of blood, serum was separated by common methods of separation, and renal function tests were performed on it. The results showed that the studied groups recorded a significant increase in the concentration of urea, uric acid, creatinine when compared to the control group, While the total serum protein decreased at the level  $P \leq 0.01$  compared to the control group.

## 1. Introduction:

Air is one of the basics of life, its interruption for a few minutes is enough to kill a person. Therefore, the issue of air pollution has become at the forefront of topics that raise sharp controversy and continuous debate, not only among specialized scientists, but in all circles and institutions and even among ordinary citizens. The danger of air when polluted is that it may not be seen, but the person takes it through the respiratory system and enters directly into the alveolar of the lungs, which are delicate and soft tissues, prepared for the gas exchange process. Thus, the presence of any vapors, gases or liquid droplets capable of penetrating the lining membranes of the pulmonary alveoli, and this means the possibility of reaching the blood and then to the sensitive centers of the body within a few seconds and creating a biological effect on it without the person realizing it [1].

Air pollution is now, according to the World Health Organization (WHO), the largest [2] threat to human health and the

environment in the world. There were about 7 million deaths in 2014 as a result of exposure to air pollution from both outdoor and indoor emission sources [2],[3]. The harmful effects of air pollution can be observed not only in the respiratory, circulatory systems but also in the renal functions [4].

The level of economic development, technological progress and industrialization is negatively correlated with industrial pollution, while population density and industrial production capacity are positively correlated with it [5], [6]. Pollution is the most important problems facing the human being at the present time. Air pollution is the most serious problem because of its direct relation to human health and other organisms [7]. Pollution from cement factories is a typical source of pollution and uncontrolled emission of aerosols and toxic aerosols into the atmosphere. A cement plant has the proper machinery, equipment, technology, materials, manpower and management for the production of cement and other related products. The processes that take place during the manufacture of cement result in the release of wastes harmful to the environment such as carbon dioxide and concrete dust [8].

Environmental pollutants, including metals and air pollutants, can increase the risk of developing chronic kidney

disease (CKD) or accelerate its progression, which can affect the level of uric acid in the blood. Heavy metal pollution is caused by Usually to human pollution, which greatly affects human health, and the harmful effects of air pollution can be observed not only in the respiratory and circulatory systems, but also in the renal functions [9],[4]. Additionally, it has been noted that chromium has a highly harmful effect on important organs such the lung, kidney, and liver [10], the study of [11] found that cement's components (such as chromium and silica) stimulate inflammatory responses from workplace exposures and lead to specific target organs derangement such as the lungs, skin, liver, and immune system. Many previous studies on mega cement factory workers have reported the toxic effect of cement dust exposure and focused on its effects on the prevalence of chest infections and liver function tests [12].

The Study [13] indicates that industrial workers are at risk of imminent death Because of the high concentrations of heavy metals, which are considered industrial pollutants They are exposed to it, and this requires a quick and urgent intervention from all health and environmental aspects to protect them. As a study [14] showed The five chimneys in the Kirkuk Cement Factory contribute to the high rates of air pollution in very high quantities, causing damage to housing, agricultural lands and personnel working inside and outside the plant, due to the amount of plankton and dust that the chimneys emit in the nearby areas, Which is arable land that works to destroy and kill the plantations and reduce the life of the trees in the area, and causes great damage to human health in general.

The objective of the current investigation was to ascertain the impact of cement exposure of cement factory on the of kidneys parameters residents in the vicinity of Kirkuk cement factory at cement field.

## 2. Materials and Methods:

### 2.1 Research Period and Location:

This study was conducted in the areas surrounding the Kirkuk Cement Factory and at great distances for the period from 2020 to 2021, and the study included (90) people living in the vicinity of Kirkuk Cement Factory, their ages ranged between (10-70) years from the areas of Haj Miteb 1, Haj Miteb 2, Tarjeel 1, Tarjeel 2, Yahyawa, Turkishkan and Laylan. A questionnaire was prepared that included several information related to the subject of the research, such as age, gender, chronic diseases, an approximate distance of the place of residence from the factory, occupation, and the date of sampling, and the study included knowing the effect of distance or distance from the factory in the concentrations of some biochemical parameters that related to kidney functions.

### 2.2 Sample Collection:

A total of 90 (60 study group with 30 control group) blood samples were collected from the people living in the vicinity of Kirkuk Cement Factory. The Blood samples were obtained from the brachial vein with a volume of (5) milliliters from each person, using a medical wine disposable syringe. The blood sample was placed in wine test tubes free of anticoagulant. EDTA Ethylene Diamine Tetra acetic Acid A coated clot activator with gel for biochemical tests. The blood was left at room temperature for 20 minutes, then the serum was separated using a centrifuge at 3000 cycles/ A minute and for 15 minutes, then the serum was withdrawn by means of a micropipette, and it was distributed to eppendorf tubes and then kept at (-20) until the required tests were performed Table 1 and 2.

**Table 1.** Analysis kit used in the study.

NO.	Subject	The manufacture company	Origin	Testing technique
1-	Urea	Biomerienx	France	Spectrophotometers
2-	Uric acid	Biomerienx	France	Spectrophotometers
3-	Creatinine	Biomerienx	France	Spectrophotometers
4-	Total protein	Biolabo	France	Spectrophotometers

**Table 2.** Equipment and tools used in the study.

NO.	Equipment and Instruments	The manufacture company	Origin
1-	Spectrophotometer	Cecil Ce 1011	France
2-	Centrifuge	Hettachi	Japan
3-	Incubator	Fisher scientific	Japan
4-	Refrigerator	Ishtar	Japan
5-	(20-) C° Freeze	Ishtar	Japan
6-	Micro Pipettes	Esplf	Germany
7-	Eppendorff tube	Esplf	Germany
8-	Plastic test tubes EDTA	Esplf	Germany

### 2.3 Statistical analysis:

The data for the study samples were collected and statistically analyzed using statistical package for social the (SPSS), and the arithmetic averages were estimated, mean  $\pm$ SE or SD. T-test and Duncan's test to compare between arithmetic means and to find moral significance [15], and the results of the tests were considered significant at the level of probability ( $p < 0.01$ ), [16].

## 3. Result and Discussion:

### 3.1 Urea Concentration in Blood Serum :

The results in the Fig.1 showed the studied groups recorded a significant increase at the level of p 0.01, where the concentration of the urea reached ( $47.32 \pm 2.57$ ) mg/dl compared to the control group in which the concentration reached ( $34.07 \pm 2.82$ ) mg/dl as in the Table 3. According to the distance

from the cement dust Fig.2 reported a significant increase in all distances with the lowest level in D3 which is ( $44.800 \pm 2.394$ ) mg/dl /L when compared with control group D7 ( $34.067 \pm 2.815$ ) mg/dl as in the Table 4.

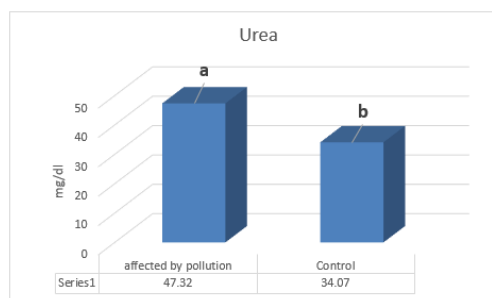
Study current findings are in line with those of a study [17] that on 55 employees of the Hammam Al-Alil (2019) cement industry in Iraq. The workers were divided into groups based on the department they worked in. Blood urea, creatinine, sodium, and potassium were the study's parameters. The findings revealed a considerable rise in the amounts of sodium, potassium and urea in the employees' serum, which increase as exposure time increased. The study [4] indicated the contribution of air pollution to the premature death of about 428,000 citizens in Europe each year, the association between kidney function and a group of air pollutants, namely NO<sub>2</sub>, SO<sub>2</sub>, and PMs, was evaluated in, 3,554 patients with an average age of 66 were included, 53.2 of whom were men. Chronic kidney disease (CKD) was diagnosed in 21.5%.and, exposure of air pollution affected on kidney function by short and long term.

**Table 3.** Concentrations of renal function variables in blood serum.

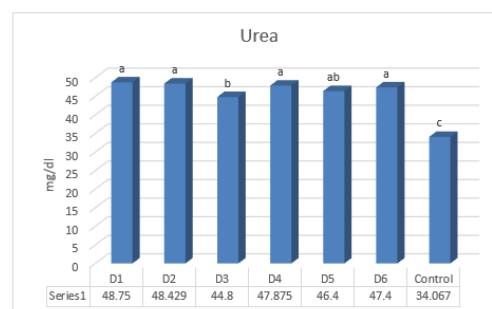
No.	Adjectives	Mean $\pm$ Standard dev.	
		Study group (60)	control group (30)
1-	UREA** mg/dl	$47.32 \pm 2.57$	$34.07 \pm 2.82$
2-	Uric acid** mg/dl	$6.405 \pm 0.478$	$4.973 \pm 0.493$
3-	Creatinine** umol/L	$1.205 \pm 0.152$	$0.773 \pm 0.108$
4-	Total Protein** g/dl	$6.315 \pm 0.222$	$6.787 \pm 0.354$

### 3.2 Uric Acid Concentration in Serum :

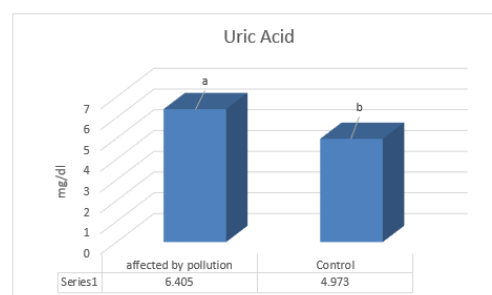
The results in Fig.3 indicate a significant increase for the studied groups whose concentration reached ( $6.405 \pm 0.478$ ) mg/dl compared to the control group in which the concentration reached ( $4.973 \pm 0.493$ ) mg/dl as in the Table 3. according to the distance from the cement factory Fig.4 reported that all groups in the studied groups showed a significant increase compared to the D7 group that represented the control group, Its concentration is ( $4.973 \pm 0.4934$ ) mg/dl, as in the Table 4. The results of our study differ with the findings of the researcher [18] that the low level of uric acid behaves as an oxidant in chemical reactions through a series of reactions of different active oxygen classes, while its function in body fluids is as an antioxidant. In a study in [4], it was shown that environmental pollutants, including metals and air pollutants, can increase the risk or accelerate the progression of chronic kidney disease (CKD), which can effect on the level of uric acid concentration in the blood serum.



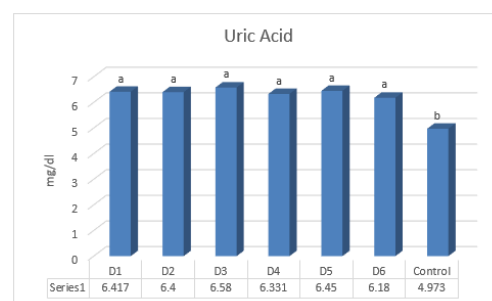
**Figure 1.** Concentration of urea in the blood serum of the studied groups.



**Figure 2.** Concentration of urea in the blood serum of the studied groups according to the distance from the factory.



**Figure 3.** Concentration of uric acid in the blood serum of the studied group.



**Figure 4.** Concentration of uric acid in the blood serum of the studied groups according to the distance from the factory.

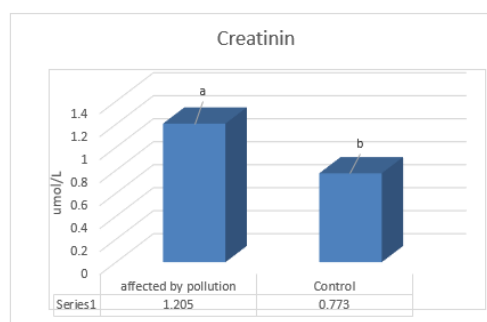
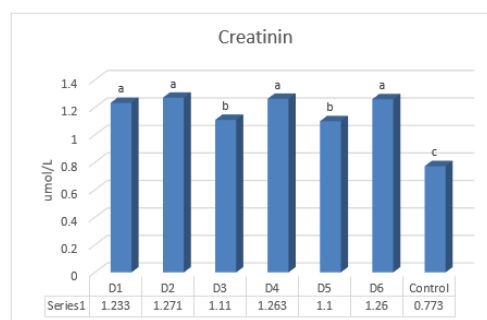
**Table 4.** Concentrations of renal function variables in blood serum by distance from the laboratory.

Adjectives	Mean $\pm$ Standard dev.						
	Distances						
	D1	D2	D3	D4	D5	D6	D7
UREA** mg/dl	48.750 $\pm$ 1.658 a	48.429 $\pm$ 1.988 a	44.800 $\pm$ 2.394 b	47.875 $\pm$ 2.918 a	46.400 $\pm$ 2.119 ab	47.400 $\pm$ 1.140 a	34.067 $\pm$ 2.815 c
URIC ACID** mg/dl	6.417 $\pm$ 0.522 a	6.400 $\pm$ 0.2582 a	6.580 $\pm$ 0.516 a	6.331 $\pm$ 0.484 a	6.450 $\pm$ 0.619 a	6.180 $\pm$ 0.1483 a	4.973 $\pm$ 0.4934 b
CREATININ** umol/L	1.2333 $\pm$ 0.1303 a	1.2714 $\pm$ 0.0488 a	1.1100 $\pm$ 0.2025 b	1.2625 $\pm$ 0.0806 a	1.1000 $\pm$ 0.2055 b	1.2600 $\pm$ 0.0548 a	0.7733 $\pm$ 0.1081 c
T.P.** g/dl	4667 $\pm$ 0.2425 b	6.2714 $\pm$ 0.1604 b	6.2000 $\pm$ 0.1826 b	6.2875 $\pm$ 0.1996 b	6.3600 $\pm$ 0.2413 b	6.400 $\pm$ 0.2300 b	6.7867 $\pm$ 0.3540 a

### 3.3 Creatinine Concentration in Blood Serum:

The results in Fig.5 a significant increase for the studied groups whose creatinine concentration was ( $1.205 \pm 0.152$ )  $\mu\text{mol/L}$  compared to the control group in which the concentration reached ( $0.773 \pm 0.108$ )  $\mu\text{mol/L}$  as in the Table 3. The concentration of creatinine in the blood serum according to the distance of factory Fig.6 indicated that the groups D1, D2, D4, D6 showed a significant increase at the level of  $P \leq 0.01$ , where their concentrations respectively reach ( $1.2333 \pm 0.1303$ ) ( $1.2714 \pm 0.0488$ ), ( $1.2625 \pm 0.0806$ ), ( $1.2600 \pm 0.0548$ )  $\mu\text{mol/L}$ , and compared to the groups D3, D5, D7, where their concentrations are respectively ( $1.1100 \pm 0.2025$ ), ( $1.1000 \pm 0.2055$ ), ( $0.7733 \pm 0.1081$ )  $\mu\text{mol/L}$ , and the D3, D5 groups showed a significant increase compared to the D7 group, which represented the control group. as in the Table 4 The results of our study in agreement with the study [17] which investigated the effects of pollution in Hammam Al-Alil Cement Factory, In all departments of the factory. While creatinine did not show a significant decrease with increasing exposure time.

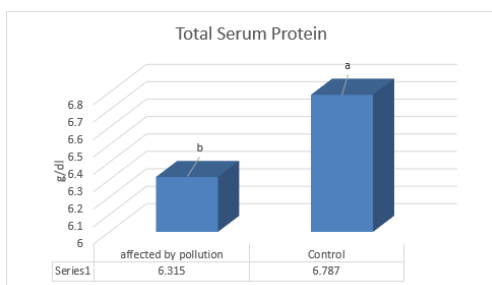
In the study [19] chronic kidney disease (CKD) is a global public health problem associated with high rates of morbidity and mortality due to end-stage chronic kidney disease and cardiovascular disease. Patients with CKD lack safe and effective medications to reverse or stabilize renal function, and thus it is important to identify modifiable risk factors associated with worsening renal function. Environmental pollutants, including metals, air pollutants, phthalates and melamine, can increase the risk or speed up the progression of chronic kidney disease. In this review, the epidemiological evidence for the association between environmental pollution and kidney disease, including heavy metals, air pollution, and other environmental nephron toxins in the general population is discussed. The silica exposure was described as being associated with renal insufficiency [20]. Increase in creatinine and urea levels in this study suggests that the nephrotoxic effect of cement dust in the test group. These results consist with [21], [22], [23] they are all reported the nephrotoxic effects of silica exposure in separate studies. Our results are not consistent with the study of [24] they are reported that there is no effect of cement dust on urea and creatinine. Exposure to environmental con-

**Figure 5.** Concentration of creatinine in the blood serum of the studied groups.**Figure 6.** Concentration of creatinine in the blood serum of the studied groups according to the distance from the factory.

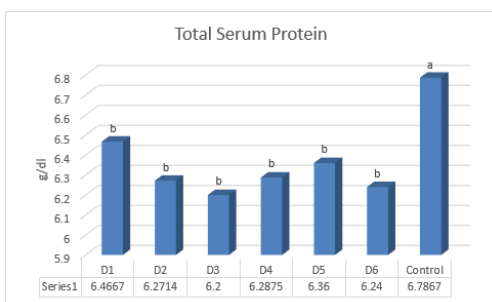
taminants, such as heavy metals, industrial and agricultural chemicals, and biogenic toxins, is a significant risk factor for renal disorders [25]. Our study has advantages in terms of the exposure period as well as the follow-up investigation that was conducted for eight years, which allowed for the evaluation of long-term exposures to the air pollutants. However, the relationship between air pollution and CKD has not yet been fully elucidated [26].

### 3.4 Total Protein Concentration in Blood Serum:

The results in the 7 showed a significant decrease in concentration of control group that reached ( $6.787 \pm 0.354$ ) g/dl



**Figure 7.** Concentration of total serum protein in the blood serum of the studied).



**Figure 8.** Concentration of total serum protein in the blood serum of the studied groups according to the distance from the factor.

compared to the studied group whose concentration reached  $(6.315 \pm 0.222)$  g/dl as in the Table 3. As for the concentration of total protein in the blood serum, according to the distance from the factory in 8, a significant increase at the level of  $P \leq 0.01$  for the D7 group, whose concentration is  $(6.7867 \pm 0.3540)$  g/dl in comparison with all other groups as in the Table 4. The results of present study indicate a decrease in the concentration of total protein in the blood serum among people who live in the areas near the cement factory which agree with the study of [27]. which notes that difficulties to the kidneys caused by oxidative stress from pollution exposure or as a result of heart disease or diabetes, which leads to what is known as nephropathy, which is characterized by protein loss, may be responsible for the decrease in the level of total protein. Ammonia (reduced nitrogen), according to a study on ammonia in Europe, is the main reason for nitrogen deposition in natural environments. However, in the eastern half of North America, nitrogen oxides are common, and the source is nitrogen deposition. This is true even in places with large densities of traffic and nitrogen emissions. The study [28] also indicated that exposure to pollutants pm10 and NO2 was significantly associated with lower levels of glomerular filtration rate GFR, but not with chronic kidney disease (CKD) in Korean adults.

## 4. Conclusions:

Industrial pollutants negatively affect human health in general and kidney function variables in particular. The concentrations of urea, uric acid and creatinine compounds in kidney function increased among the people living near the cement factory, while their total protein concentration decreased.

**Funding:** None.

**Data Availability Statement:** All of the data supporting the findings of the presented study are available from corresponding author on request.

## Declarations:

**Conflict of interest:** The authors declare that they have no conflict of interest.

**Ethical approval:** The manuscript has not been published or submitted to another journal, nor is it under review.

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تأثير التعرض لغبار السمنت على مؤشرات وظائف الكلى لدى بعض الساكنين في محيط معمل سمنت كركوك

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### الخلاصة

هدفت الدراسة الحالية الى تحديد عن تأثير غبار الاسمنت على مؤشرات وظائف الكلى لدى سكان القرى والمزارع المحيطة بالمعمل الذين يتعرضون باستمرار لغبار السمنت والتي تشمل: اليوريا وحامض البوليك والكرياتينين و البروتين الكلي، للفترة من كانون الثاني 2020 إلى نيسان 2021. جُمعت العينات عشوائياً (60) عينة كمجموعة دراسة، والتي تم تقسيمها حسب المسافة عن المعمل إلى ست فئات D1 ، D2 ، D3 ، D4 ، D5 ، D6 ، بينما كانت مجموعة السيطرة (30) عينة للفئة الأخيرة المتمثلة بمنطقة ليلان D7 ، وقد تراوحت اعمارهم من (10-70) سنة، وجرى سحب الدم الوريدي (5) مل من الدم، وقد تم فصل المصل بالطرق الشائعة، وأجريت عليه فحوصات وظائف الكلى. أظهرت النتائج أنَّ المجموعات المدروسة سجلت زيادة معنوية في تركيز اليوريا وحامض البوليك والكرياتينين عند مستوى  $P \leq 0.01$  مقارنة مع مجموعة السيطرة، في حين انخفض إجمالي بروتين المصل عند مستوى  $P \leq 0.01$  بالمقارنة مع مجموعة السيطرة.

الكلمات الدالة: معمل السمنت، ليلان، يوريا كرياتينين.

التمويل: لا يوجد.

بيان توفر البيانات: جميع البيانات الداعمة لنتائج الدراسة المقدمة يمكن طلبها من المؤلف المسؤول.

اقرارات:

تضارب المصالح: يقر المؤلفون أنه ليس لديهم تضارب في المصالح.

الموافقة الأخلاقية: لم يتم نشر المخطوطة أو تقديمها لمجلة أخرى، كما أنها ليست قيد المراجعة.