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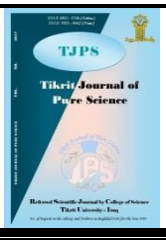

An Analytical Study Using Biochemical Markers to Assess the Effect of Emissions on Workers' Health in Nineveh at Badoush Cement Factory

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ABSTRACT

This study investigated the impact of working conditions in a cement factory on the health of 64 employees. Biochemical parameters (IgE, GPT, creatinine, CBC) were compared between workers and a control group of 10 individuals not exposed to factory emissions. A significant correlation between years of employment and elevated GPT levels was revealed by the findings, suggesting potential liver stress from prolonged exposure. Smoking was associated with higher creatinine levels, IgE levels, WBC counts, platelet counts, and neutrophil counts, indicating an increased risk of kidney impairment, allergic response, and inflammation. Age-related variations were also observed, with younger workers showing higher lymphocyte counts and older workers exhibiting higher creatinine levels, particularly those with pre-existing hypertension. Our results show the obvious effect of smoking and long-term exposure on the health of cement factory workers.

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دراسة تحليلية لتقييم تأثير انبعاثات مصنع أسمنت بادوش على صحة العمال باستخدام الواصمات الحيوية

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الملخص

هدفت هذه الدراسة إلى بحث تأثير ظروف العمل في مصنع للأسمنت على صحة 64 عاملاً. تمت مقارنة المؤشرات الكيميائية الحيوية (IgE، GPT، كرياتينين، صورة الدم الكاملة) بين العمال ومجموعة ضابطة من 10 أفراد غير معرضين لانبعاثات المصنع. كشفت النتائج عن وجود علاقة قوية بين سنوات العمل وارتفاع مستويات GPT، مما يشير إلى احتمالية وجود إجهاد كبدي بسبب التعرض الطويل الأمد للملوثات. ارتبط التدخين بارتفاع مستويات الكرياتينين، ومستويات IgE، وعدد خلايا الدم البيضاء، وعدد الصفائح الدموية، وعدد الخلايا الحبيبية المتعادلة، مما يشير إلى زيادة خطر الإصابة بقصور كلوي، ورد فعل تحسسي، والتهابات. كما لوحظت اختلافات متعلقة بالعمر، حيث أظهر العمال الأصغر سناً ارتفاعًا في عدد الخلايا الليمفاوية، بينما أظهر العمال الأكبر سناً ارتفاعًا في مستويات الكرياتينين، وخاصة أولئك الذين يعانون سابقاً من ارتفاع ضغط الدم. تسلط هذه النتائج الضوء على الآثار الضارة للتدخين والتعرض المهني طويل الأمد للملوثات على صحة عمال مصانع الأسمنت.

1. Introduction

Carnivorous Asthma and allergies have been common diseases for a long time; however, the definitive causes behind them remain unclear. From the observation of many individuals and families, there is clear evidence that asthma and allergies often occur together [1]. This observation raises many questions about the nature of the co-occurrence of both conditions. One of the theories suggests that both conditions share the same underlying pathway that leads to the development of these diseases, despite being clinically different [1]. This means that both conditions share the same driving factors in terms of environmental causes, genetic predisposition, and when the immune system is not responding in the usual way. Another theory suggests that both conditions result from a single unified disease process but show different symptoms. This suggests that the cause of these conditions is a problem with the immune system, along with other environmental and genetic factors [2]. These different theories underline the importance of further research into the root causes of asthma, particularly when it occurs alongside allergies [2].

The National Institutes of Health (NIH) emphasize the chronic inflammatory nature of asthma in their guidelines from 1991, 1997, and 2007 [3]. The NIH guidelines explain that asthma is a long-term condition where the

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airways get inflamed and many types of cells in the body are involved, but it is complicated how they all work together [4]. All these different cells work together in a complex way, sending out messages that make the airways sensitive, tighten up, and produce more mucus, leading to coughing, wheezing, and breathing problems for people with asthma [5].

One of the common allergic conditions is allergic rhinitis (AR) which happen when the inside of the nose gets inflamed affected from the allergens in the air, where the immunoglobulin E (IgE) have and important role in this case [6]. This will lead to symptoms like sneezing, stuffy nose, itchy nose, and runny nose. If there are eye symptoms like watery eyes and itchy in the eyes, then it is called allergic rhino conjunctivitis (ARC) [7]. Usually, AR and asthma have the same main causes and often happen together [6]. Further research to understand the reasons behind the occurrence of these diseases is needed.

Many possible reasons could be behind the occurrence of asthma and allergies. Climate change is considered one of the causes, and some research works consider it as a main factor, mostly for people who have the genes that make them susceptible [8]. Pollutants are one of the factors that may increase the possibility of allergic problems [9], particularly in regions with more industrial factories [10]. There is a growing need to find ways to control climate change, which will help reduce air pollution and enhance the environment that has a direct impact on human health [8].

As we mentioned earlier, industrial factories are considered one of the reasons that can negatively affect air quality by increasing pollution, which can lead to health problems. Cement factories are an important part of city development nowadays and are located in most countries. These types of factories negatively affect the environment and air quality by emitting pollutants during the production process. The emissions that happen by those factories effect the balance of the atmosphere, leading to poor quality of the air [11]. Pollution from cement factories increases the likelihood of many different diseases, including asthma and allergic conditions. It especially affects the factories workers and people who live near the factories[12]. More environmental regulation is needed for factories to enhance air quality and protect the health of the workers. This study aims to have a better understanding of the association between the negative effects of industrial factories and the health of workers by:

1. Measure the impact of cement factory emissions on the main biochemical parameters of the workers.
2. Investigate the relationship between duration of employment and its impact on the health of the workers.
3. Evaluate the effects of the emissions that come from the various manufacturing processes to the liver and kidney function.

2. Materials and methods

2.1. Study Design and Setting:

This study used a case-control design to explore the relationship between factory emissions and worker health. A total of 64 participants were

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recruited from employees at the Badoush Cement Factory. A control group of 10 individuals residing outside the immediate vicinity of the factory was also included. This design allowed for comparison between exposed (cases) and less-exposed (controls) groups.

2.2. Data Collection

A standardized case report form (CRF) was used to collect participant data. The CRF included demographic information (name, age, and gender), occupational history (years of employment and specific department), blood type, and a detailed medical history. The medical history section specifically inquired about pre-existing chronic conditions and hereditary conditions, and smoking status.

2.3. Biochemical Analysis

Blood samples were collected from all participants. Blood collection utilized two types of evacuated tubes: one containing EDTA to prevent clotting and another facilitating serum separation for biochemical analyses using Cobas 6000 and Horiba ABX Micros ES 60.

- **Immunoglobulin E (IgE) Assay:** Serum IgE levels were quantified to evaluate potential sensitization or allergic responses in workers [1].
- **Complete Blood Count (CBC) with Differential Leukocyte Count:** A comprehensive CBC analysis was performed, including white blood cell (WBC) count and differential (percentage of lymphocytes, monocytes, and neutrophils), red blood cell indices (mean corpuscular hemoglobin (MCH), hemoglobin (HB), hematocrit (HCT), mean corpuscular volume (MCV)), and platelet count (PLT).
- **Liver Function Tests:** Serum alanine aminotransferase (ALT) was measured to assess potential liver injury.
- **Renal Function Test:** Serum creatinine concentration was measured to evaluate glomerular filtration rate (GFR) and kidney function.

2.4. Statistical Analysis

A statistical analysis was conducted to indicate the presence or absence of a relationship linking biochemical variables with years of work, age, and other information collected and recorded in the form. Statistical analysis was performed using SPSS software [13] to assess the association between biochemical parameters (IgE levels, CBC parameters, ALT, creatinine) and years of employment, age, and other relevant factors.

3. Results and Discussion

This study investigated the health status of 64 cement factory workers, focusing on the potential impact of their work environment on various blood parameters. Four main blood tests were conducted to analyze the results: Complete Blood Picture, IgE, creatinine, and GPT. Additionally, examine potential associations with the work environment, smoking status, years of employment, and age group. The summary of statistics is shown in table 1.

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Table 1: Summary Statistics

Characteristic	Value
Total Participants	64
Age Range (years)	20-64
Mean Age (years)	40.78
Gender	Male (89.1%), Female (10.9%)
Smoking Status	Smoker (53.1%), Non-Smoker (46.9%)
Mean Years of Employment	16.28
Common Diseases	High blood pressure (14.1%), Diabetes (7.8%), Blood lipids (1.6%), Heart diseases (1.6%), Diabetes & High blood pressure (1.6%)

3.1. Biochemical Results

The findings suggest a significant correlation between the duration of employment and GPT levels. Specifically, individuals who had been employed for longer periods exhibited higher GPT levels. This trend indicates that prolonged exposure to the cement factory environment might contribute to liver stress or damage, as reflected in elevated GPT levels. On the other hand, smoking status did not consistently influence GPT levels. Both smokers and non-smokers showed varying GPT levels, suggesting that factors other than smoking might play a more critical role in affecting GPT levels among these workers. Also, the results show that GPT levels increased among workers compared to the control group.

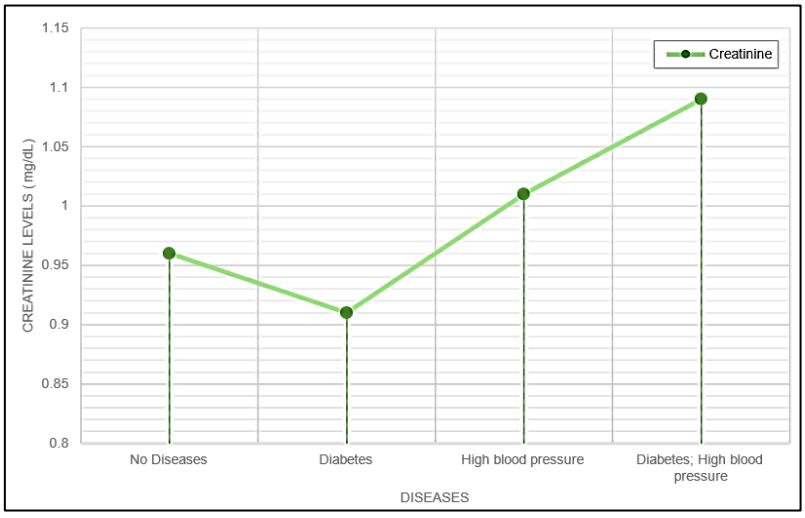

Fig. 1: Average creatinine levels by diseases

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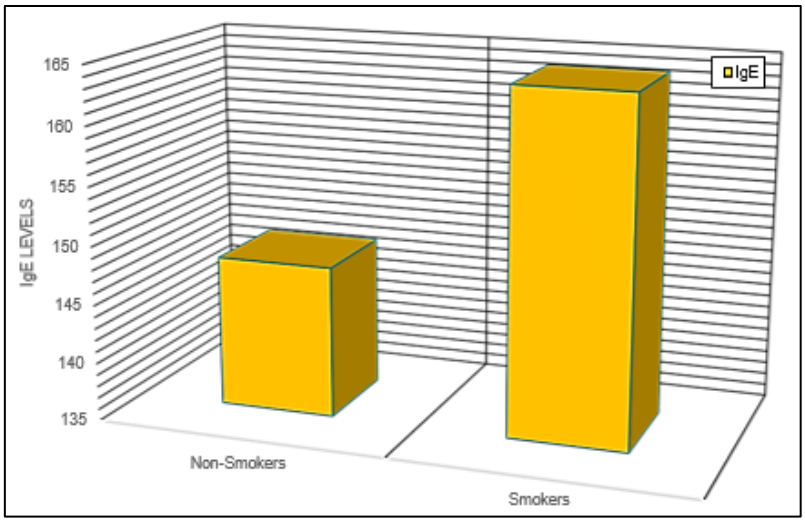

Fig. 2: Average IgE levels for non-smokers vs. smokers.

The study found that people with diabetes or high blood pressure tend to have higher levels of creatinine, which is crucial for assessing kidney health, as shown in Figure 1. This suggests potential kidney function issues in these individuals. Smokers also showed higher creatinine levels compared to non-smokers, which means that smoking could have a bad effect on kidney function over time. It is important to have a regular health check as it could help to diagnose health issues. Additionally, the creatinine levels of the workers were higher than those of the control group when compared.

The IgE levels were found to be higher among workers compared to the control group. Among those workers, the levels were much higher in smokers compared to those who do not smoke, as shown in Figure 2, which indicates that smoking might be linked to increased allergic reactions and the immune system issues. Workers with high blood pressure also had higher IgE levels, indicating possible changes in their immune systems. Yet, the results indicate that the number of years of employment does not have a direct relationship to the IgE levels, leading to the conclusion that the cement factory does not negatively affect the IgE levels of its workers.

3.2. Complete Blood Picture (CBP) Results

The CBP test is one of the important blood tests that analyzes many components of the blood. This kind of test is crucial for understanding human health, making it essential to conduct it in this study. The components analyzed by the CBP test include packed cell volume (PCV), hemoglobin (HB), platelets (PLE), white blood cells (WBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), lymphocytes, monocytes, and neutrophils.

The analysis of the results showed that HB levels are not different between smokers and non-smokers and also indicated that age does not affect the HB results. On the other hand, the counts of WBC were noticeably higher among workers compared to the control group, with even higher levels observed in smokers and workers with high blood pressure. Packed cell

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volume levels were regular across different groups, showing that exposure in the working place in addition to smoking does not affect PCV significantly. Higher platelet counts were observed in workers with high blood pressure and in smokers. This leads to a higher risk of cardiovascular issues in these workers.

MCH levels did not vary significantly based on smoking status or years of employment. On the other hand, MCV levels were higher in individuals with longer employing years and some smokers, indicating possible changes in red blood cell size due to smoking or prolonged exposure. Neutrophil counts were higher among smokers and individuals with high blood pressure, which means that there is a possible inflammatory response. Monocyte counts did not vary significantly with smoking status, years of employment, or age, which shows that these factors do not greatly influence monocyte levels. Lymphocyte counts were higher in younger age groups and smokers, suggesting potential immune system activation in these populations.

The study shows the significant impact of smoking on different health parameters. Smokers generally had higher levels of creatinine, white blood cells, platelets, neutrophils, and lymphocytes compared to non-smokers. This led to the fact that smoking may increase inflammation and immune responses, leading to negative health effects. Elevated IgE levels were especially notable among smokers, indicating a heightened allergic response or immune system activity. These findings highlight the harmful effects of smoking on multiple aspects of health.

3.3. Employment Duration and Age Group

The study shows that the employers of the cement factory with longer years of work were linked to higher GPT and MCV levels, which means that prolonged occupational exposure may cause liver stress and changes in red blood cell size. However, other health parameters did not show a consistent pattern based on years of employment, indicating that the impact of occupational exposure might be specific to certain health conditions.

An analysis by age group shows significant variations in health parameters. In the 20-34 age group, higher lymphocyte counts were noted, suggesting potential immune system activity or response. While among individuals aged 35-49, elevated levels of white blood cells (WBC), platelets (PLE), and neutrophils were observed, particularly among smokers. These findings indicate an increased inflammatory or immune response in this age group. In the 50-64 age group, higher creatinine levels were observed, especially in individuals with high blood pressure, which suggests potential kidney function impairment in older workers.

4. Conclusion

The study shows that smoking has a significant impact on various health parameters such as creatinine, IgE, white blood cells, platelets, neutrophils, and lymphocytes. Prolonged years of employment are associated with raised levels of GPT and MCV, suggesting that occupational exposure affects liver and red blood cell health. Different age groups also show distinct variations, with younger workers having higher lymphocyte counts and older workers showing

signs of kidney function decline. The findings of the study emphasize the need to monitor the health of cement factory workers, especially those with higher exposure levels and smokers, as well as considering the impact of age on their health. Further research is necessary to better understand the reasons behind the health outcomes observed in workers across similar fields.

5. Conflict of interests: The authors declared no conflicting interests.

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7. Author contribution: Authors contributed equally in the study.

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