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Article

The Effect of Environmental Pollution on Blood Components of Individuals in Different Environmental Areas (Rural and Urban)

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ABSTRACT

Many chemicals and their harmful effects and diseases have been linked as causative agents of diseases. The research included knowledge of the effect of continuous exposure to environmental pollutants on the blood components of individuals living in Mosul (an urban area) and Al-Sheikhan district (a rural area). Eighty blood samples were collected from males only, non-smokers, alcohol abusers and those free of chronic diseases. Their ages ranged Between (21-55) years old; the samples were divided into two groups. The first group included (40) blood samples from Mosul, while the second group included (40) samples from individuals from the Al-Sheikhan district in the same age groups. The results showed a significant increase in Red Blood cell count (RBCS), Hemoglobin concentration (Hb) and Packed Blood Cell Volume (PCV) in the group of males living in the city of Mosul compared with the group of males living in the Al-Sheikhan district. In contrast, the results showed a significant increase in White Blood cell count (WBCS), Erythrocyte Sedimentation Rate (ESR) and Platelet Count (PLT) in a group of males living in Al-Sheikhan district compared with a group of males living in Mosul city.

Keywords: Environmental Areas, Environmental Pollution, Blood Components, Rural, Urban.

INTRODUCTION

The environment is one of the most important fields that preoccupies a person because it is the environment in which he lives and obtains essential resources for his livelihood, survival, and continuation of life. Environmental pollution is the most dangerous thing that threatens life and prevents its ability to renew and continue to provide human requirements and needs[1]. Ecosystems were in equilibrium until before the second half of the twentieth century, when there was a balance between the living and non-living components and between the systems' inputs and outputs, such as energy, water, gases, salts and wastes. However, at the end of the twentieth century, humans reached a state where their impact on the environment is alarming, as it sometimes exceeds the ability of natural ecosystems to tolerate these changes and creates environmental imbalances that threaten our life and survival on the surface of Earth. The significant population increase and the scientific and technological revolution caused a considerable increase in environmental pollutants[2]. This, in turn, led to a significant imbalance in the balance of environmental systems, which led to severe damage to human health and other living organisms, as scientific progress led to the emergence of many chemical compounds that harm the environment, such as the expanded use of fuel (oil, natural gas, coal) in various fields, which led to the spread of pollutants in the environment, such as gases resulting from the combustion of fuel and industrial activities, such as carbon, nitrogen, and sulfur oxides, as these gases are formed as a result of incomplete combustion of fuel[3]. The relationship between the environment and health appeared long ago when humans linked the environment to spreading diseases. The discovery of infectious disease-causing bacteria in the seventeenth century led to the activation of the role of environmental health to limit and reduce

the spread of diseases. The widespread chemicals used today have become dependent on the development of civilization, and their number now exceeds two million substances. Such Chemicals are dangerous sources of environmental pollution, especially since we do not have complete and accurate knowledge about the extent of their harm to the environment and health[4]. Many chemicals and their harmful effects and diseases resulting from them have been linked as causative agents of diseases, such as lung diseases resulting from air pollution, heart disease and its relationship to carbon monoxide, mercury and its relationship to nerve damage, cancer diseases, and many other chemicals that are related to cancer diseases, such as the relationship Between asbestos dust and lung cancer [5,6]. This study aims to determine the extent of the impact of environmental pollution on the blood components of people within the studied areas using vital indicators (RBC count, WBC count, Hb, ESR, PCV, PLT) and adopting them as vital indicators to detect pollution upon exposure to it in the future.

MATERIALS AND METHODS

Sample collection

The current study dealt with (80) samples of males, non-smokers, non-abusers of alcohol, and free of chronic diseases. Their ages ranged between (21-55) years. The samples were divided into two groups: the first group included (40) blood samples from individuals from Mosul, and the second group included (40) blood samples from individuals from the Sheikhan district.

Estimation of total RBC count

The total number of (RBCs) was calculated using a hematology analyzer device manufactured by the Japanese company Sysmex and according to the method[7].

Estimation of total WBC count

The total number of (WBC) was calculated using a hematology analyzer device manufactured by the Japanese company Sysmex and according to the method[7].

Estimation of hemoglobin concentration in blood

Hemoglobin concentration was measured using a Hematology Analyzer device from the Japanese company Sysmex and based on the Cyanide-Free Sodium Lauryl Sulfate (SLS) method[8].

Estimating the erythrocyte sedimentation rate (ESR):

The sedimentation rate of red blood cells was measured using a Hematology Analyzer device from the Japanese company Sysmex, based on the method[9].

The blood sample was placed in a unique tube containing an anticoagulant (sodium citrate). Therefore, the sample must be mixed well with the anticoagulant. The pipette was inserted into the opening of the tube containing the blood sample, the pipette was pressed until the blood level reached zero, and the pipette was placed vertically using a unique holder; the sedimentation rate was recorded one hour after placing the pipette in the tube. The result was written in units (mm/hour). For example, when the sedimentation rate of red blood cells in the pipette was 5, the result was ESR=5mm/h.

Measurement of compressed cell volume (PCV)

The volume of compressed cells was measured using a Hematology Analyzer device from the Japanese company Sysmex and according to the method[7].

Platelet count (PLT) measurement

The platelet count (PLT) was measured using the Hematology Analyzer (from the Japanese company Sysmex) and according to the method[9].

Statistical analysis

The data were analyzed according to the simple experiment system, and comparisons between sites were made according to the t-test at the probability level ($P \leq 0.001$), which was considered a significant difference (Significant), using (the SPSS) program that was used to analyze the experiment data and to find the mean ± standard error[10].

RESULTS AND DISCUSSION

Table 1 shows the effect of environmental pollution on some blood components (total number of red blood cells, total number of white blood cells, hemoglobin concentration, red blood cell sedimentation rate, size of packed blood cells, and total number of platelets).

Group	Mosul city	Al-Sheikhan district
RBC count	4.25 ± 0.29 b	5.26± 0.72 a
WBC count	13.01 ± 1.01 a	7.00 ± 1.13 b
Hb	11.77 ± 1.16 b	17.07 ± 1.16 a
ESR	26.42 ± 5.23 a	9.90 ± 3.71 b
PCV	35.30 ± 6.61 b	50.77 ± 5.01 a
PLT	372.70 ± 36.81 a	236.68 ± 35.26 b

Values are expressed as arithmetic mean ± standard deviation.

Horizontally different letters mean a significant difference at the probability level ($P \leq 0.01$).

The number of replicates for each group is (40) replicates.

Table 1. The effect of environmental pollution on some blood components

Total number of (RBCs) and (PLT)

The results in Table (1) and Figure (1) show a significant increase in the total number of (RBC count) at the probability level ($P \leq 0.01$) in the group of males living in Al-Sheikhan district compared to the group of males living in the city of Mosul, as the arithmetic mean of the total number of blood cells was (RBC count) in the group of males living in Sheikhan was (5.26 ± 0.72) * 910 / liter, while the arithmetic mean of the total number of (RBCs) in the group of males living in the city of Mosul was (4.25 ± 0.29) X 10^9 / liter.

The results shown in Table (1) also showed that there was a significant increase in the (PLT) at the probability level ($P \leq 0.01$) in the group of males living in the city of Mosul compared with the group of males living in the Al-Sheikhan district, as the arithmetic mean of the (PLT) in the male group for those living in the city of Mosul was (372.70 ± 36.81) X 10^9/ liter. The arithmetic mean of the (PLT) in the group of males living in the Al-Sheikhan district was (236.68 ± 35.26) X 10^9/ liter.

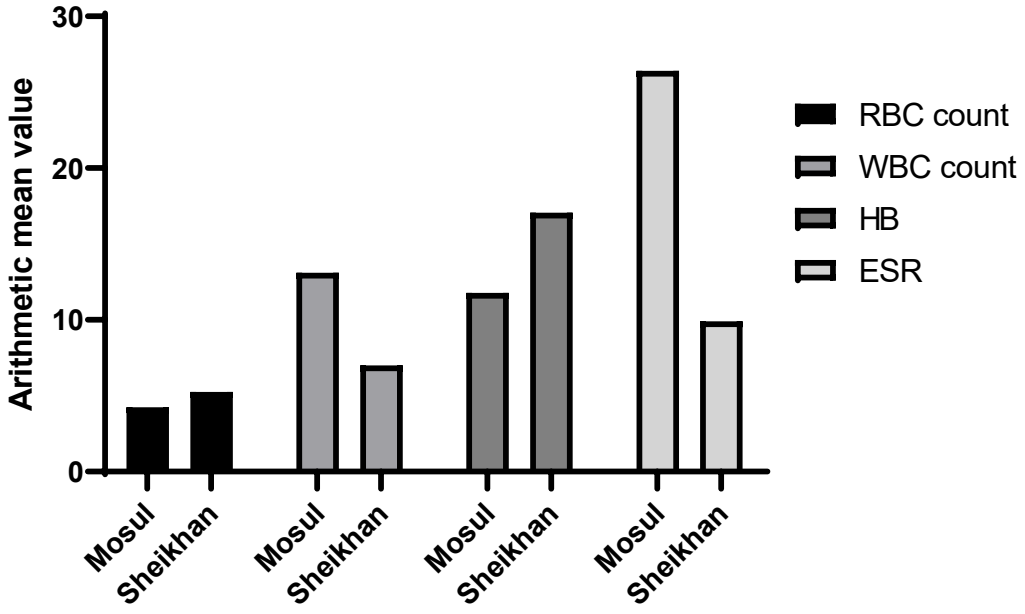

Figure 1. Arithmetic mean values of RBC, WBC, Hb, and ESR from Mosul and Sheikhan patients

The results of the current study are consistent with the findings of [11] in that children who live in urban areas are more susceptible to developing anemia than their peers who live in rural areas, because the percentage of pollution in urban areas is higher than in urban areas. Likewise, in rural areas, the results were consistent with the findings 12 that exposure to air pollutants reduces the number of red blood cells as air pollutants enter the bloodstream through the mouth, nose, skin, and gastrointestinal tract. Air pollutants, such as lead, also interfere with forming red blood cells by inhibiting the work of essential enzymes. Lead inhibits the production of hemoglobin, a compound necessary to carry oxygen in red blood cells. It interferes with the enzymes that produce it. It inhibits the activity of the enzymes Delta-aminolevulinate dehydratase (ALAD) and Ferrochelatase (FECH). In addition, lead destroys the membranes of red blood cells. It interferes with the cell metabolism process, as this leads to a reduction in the lifespan of each red blood cell, which leads to anemia, as the results of the study were consistent with the findings of both researchers[13,14] that the high platelet count and low red blood cell count were the result of exposure to polluted air.[15] also indicated that the increase in the number of platelets results from the body being exposed to oxidative stress. This may also result from the immune system and bone marrow responding to air pollutants associated with the hemolysis of red blood cells. One of these pollutants is benzene, which is toxic to humans. At any concentration, it may cause blood poisoning and inhibit bone marrow function when inhaled for a long time. Also, naphthalene, another

compound inhaled in large quantities, destroys the red blood cell membrane, leading to erythrocyte hemolysis [16]. The current study is also consistent with what was indicated by [17], who found that there is a decrease in the total number of red blood cells in geese in Canada due to poisoning with heavy metals, especially lead and cadmium, which lead to the decomposition and destruction of red blood cells. The increase in anemia among residents of urban areas is due to differences in food hygiene between residents of urban and rural areas, as residents in urban areas consume food rich in energy sources such as rice and corn flour. In contrast, rural residents consume larger quantities of fruits and vegetables, such as green leaves rich in iron, vitamin C, and provitamin A in rural areas compared to urban areas [18].

Hemoglobin concentration (Hb) and packed blood cell volume (PCV)

The results in Table (1) and Figure (1) showed that there was a significant increase in the concentration of (Hb) at the probability level ($P \leq 0.01$) in the group of males living in the Al-Sheikhan district compared to the group of males living in the city of Mosul, where the arithmetic mean of the concentration of (Hb) was In the group of males living in Al-Sheikhan district, there was (17.07 ± 1.16) g/100 ml. In contrast, the arithmetic mean of (Hb) concentration in the group of males living in Mosul was (11.77 ± 1.16) g/100 ml.

The results in Table (1) and Figure (2) also showed that there was a significant increase in the (PCV) at the probability level ($P \leq 0.01$) in the group of males living in the Al-Sheikhan district compared to the group of males living in the city of Mosul, where the arithmetic mean of the volume of packed blood cells was (50.77 ± 5.01)% in the group of males residing in Al-Sheikhan district was while the arithmetic mean of the (PCV) in the group of males residing in the city of Mosul was (35.30 ± 6.61)%.

The current study agrees with the findings of [13,19], who indicated that pollutants have a significant impact on blood components, as they led to a decrease in (Hb) and (PCV), and this is due to direct exposure to pollutants. Toxic compounds present in the air affect the concentration of (Hb) and (PCV), the process of producing red blood cells, the size and shape of these blood cells, and this, in turn, leads to anemia.

The results of the current study also agree with the findings of [20,21] that exposure to various pollutants such as CO and CO_2 gases and other pollutants such as benzene also lead to changes in the components of blood, and these changes can be detected, as they are used to evaluate the health status of individuals exposed to these pollutants.

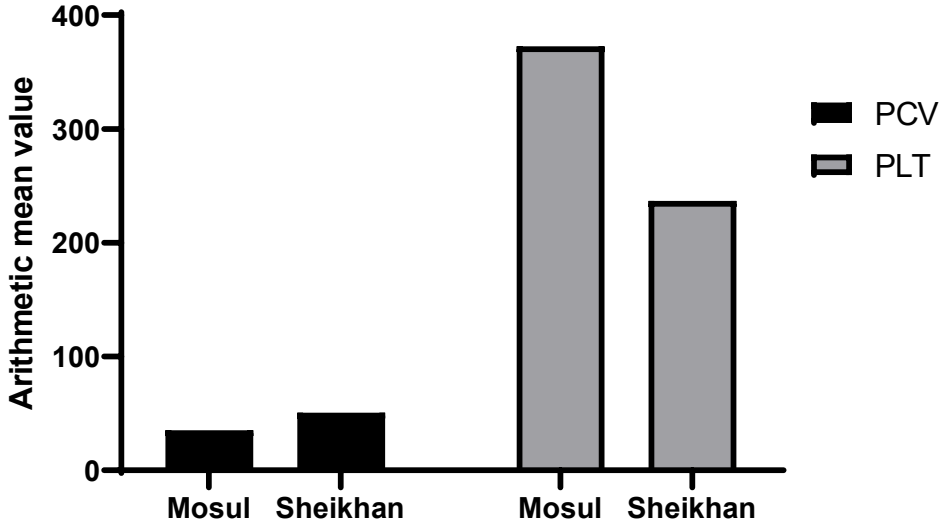

Figure 2. Arithmetic mean values of PCV and PLT from Mosul and Sheikhan patients

The decrease in the concentration of (Hb) and (PCV) was a result of the decrease in the concentration of red blood cells as a result of inflammation, as inflammatory processes lead to the release of (Cytokine), which leads to the inhibition of red blood cell formation in the bone marrow [22]. Studies have also indicated that exposure to air polluted with dust for 3 days decreases the concentration of hemoglobin and agglutinated blood cells [23,24]. Another study [11] also showed that the presence of pollutants In the body, such as heavy metals, for an extended period and at high concentrations, its effect is toxic by preventing the absorption of iron and copper in the body, which leads to a defect in the properties of cell membranes and red blood cell membranes, leading to anemia. Studies have indicated that the concentration of (Hb), (PCV), and (RBC) decreased in the blood samples of those who engage in various activities in areas with high levels of air pollution compared to less polluted areas [25].

The results also agreed with the findings of [26] in that the concentration of heavy metals in the cattle egret (Bubulcus ibis), which were taken from industrial areas, was higher than their concentration in the blood samples taken. In rural areas, the concentration of (PCV) and (RBC) was lower in samples taken from industrial areas compared to rural areas.

Total number of white blood cells (WBCs) and erythrocyte sedimentation rate (ESR)

The results of Table (1) and Figure (1) showed a significant increase in the total number of (WBC counts) at the probability level ($P \leq 0.01$) in the group of males living in the city of Mosul compared with the group of males living in Al-Sheikhan district, where the arithmetic mean of the total number of blood cells was The (WBC count) in the group of males living in the city of Mosul were $(13.01 \pm 1.01) \times 10^9$ / liter, while the arithmetic average of the total number of (WBC count) in the group of males living in the Sheikhan district was $(7.00 \pm 1.13) \times 10^9$ / Liter.

The results of the current study were consistent with the findings of [27] that the total number of white blood cells increases in individuals exposed to different types of pollutants, as continuous exposure to these pollutants leads to different effects on the numbers of white blood cells and then change in the immune response, as the increase in the concentrations of SO_2, NO_2, and $PM_{2.5}$ in the air leads to an increase in the total number of white blood cells, as the increase in the total number of white blood cells is attributed to an increase in the production of antibodies. As a result of tissue damage when exposed to pollutants, the increased production of antibodies strengthens the body's immune system to reduce the harmful effects of inhaling polluted air [28].

The results of the current study also agreed with the findings of [26] in that the total number of white blood cells in the blood samples of cattle egret (Bubulcus ibis) taken from industrial areas was higher than in blood samples taken from rural areas, and this is consistent with what was indicated by [29], who found that lead and copper contamination led to an increase in the number of white blood cells.

The results in Table (1) also showed a significant increase in the (ESR) at the probability level ($P \leq 0.01$) in the group of males living in the city of Mosul compared to the group of males living in Al-Sheikhan district, where the arithmetic mean of the erythrocyte sedimentation rate (ESR) in the group of males living in the city of Mosul was (26.42 ± 5.23) mm/hour. The arithmetic mean of the (ESR) in the group of males in the Sheikhan district was (9.90 ± 3.71) mm/hour.

The reason for the increase in the erythrocyte sedimentation rate is due to anemia resulting from pollution or infections, and the erythrocyte sedimentation rate increases with the increase in air pollutants and the incidence of diseases and infections[30]. The current study is consistent with what [31] indicated, which is that the erythrocyte sedimentation rate is higher in children with pneumonia with hardening or swelling of the alveoli. The results of the current study also agreed with the findings of [32] that pollutants in air generated from traffic in cities cause an increase in the rate of erythrocyte sedimentation and increase the possibility of infections and blood clotting.

CONCLUSIONS

Gaseous pollutants hurt the components of the blood of residents in the city of Mosul, as there was a significant decrease in RBC count, Hb, and PCV, and an increase in WBC count, ESR, and PLT in the blood of residents in the city of Mosul compared to those residing in Al-Sheikhan district. The reason for this may be due to an increase in the concentrations of gaseous pollutants in the city of Mosul are higher than in the district of Sheikhan, and the reason for this is due to the higher population density in the city of Mosul compared to the district of Sheikhan, as well as the presence of a more significant number of cars, electric generators, and factories that release significant quantities of toxic gases into the atmosphere.

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Conflicts of Interest: There is no conflict of interest in this work.

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