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The exposure effects of chemical materials on some hematological parameters for biology and chemistry students

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Abstract

Exposure to chemicals plays a major role in the occurrence of diseases through its side effects on various human body systems, such as the respiratory and circulatory systems; therefore, the current study aimed to determine the accumulative effects of handling chemicals on some hematological parameters for chemical students/fourth stage/College of Science/University of Babylon. Out of 40 blood samples (3 ml) were collected by sterile syringes from male students/fourth stage of chemistry and biology departments, 20 samples for each and placed in EDTA tubes in order to estimate the WBCs, platelet, and RBCs counts, as well as the level of hemoglobin. The study samples were collected from December (2023) to January (2024) and the mean age was 22 years. The results of the current study show a significant decrease ($p<0.05$) in the platelet count of chemistry students, compared with biology students, which reached 229.5±24.87 and 246.8±47.4 (cell $\times 10^9$ / L) respectively, while The results indicated non-significant variances ($p< 0.05$) in RBCs, WBCs count, and hemoglobin level between biology and chemistry students.

Key Words: Chemical materials, Side Effects , Hematological Parameters.

Introduction

The complete blood count (CBC) is a comprehensive panel that evaluates cellular components of blood, including red blood cells (RBCs), white blood cells (WBCs), and platelets (PLTs). The RBC components of the CBC consist of the RBCs count, hemoglobin (HB), hematocrit (HCT), mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC). Hematological indices serve as significant predictors for assessing numerical, structural, and functional alterations in blood cells across a range of physiological, inflammatory, and pathological conditions [2]. There are two significant types of white blood cells: neutrophils and lymphocytes. The former pertains to media innate immunity, whereas the latter refers to essential cells involved in adaptive immunity. Under typical physiological conditions, the neutrophil count exceeds that of lymphocytes in humans; however, these values may vary under different physiological conditions [3]. Complete blood count is the most commonly requested blood test globally. The main considerations in CBC include the assessment of anemia, evaluation of the white blood cell count for signs of infection, and the determination of platelet levels that may impact hemostasis [4]. Hematology laboratory analyses are fundamental for the diagnosis and conduction of clinical cases. The results of the hematology test were significant only in comparison with the normal range of values of a given population. Beside [5] Hematological and immunological parameters, these values are affected by race, diet, and social lifestyle [6], and are pivotal constituents of the health index in patients. The normal reference value ranges for these parameters in apparently normal individuals are used in helping to diagnose a number of different diseases The reference values that are presently used across Asia and Africa are based on studies conducted among populations in the developed world that are not necessarily applicable to local contexts. Thus, the determination of local reference values for immune hematological parameters is important for evidence-based medicine [7], which examined the complete blood count (CBC) in ostensibly healthy individuals, both male and female, and reported that a significant proportion of these prospective whole blood donors exhibited subnormal hematological parameter values. The internal dose is the amount of absorbed chemical that can react with biologically and temporally relevant receptors after exposure. Directly measuring chemical concentrations at specific target sites, such as the brain or testes, in exposed individuals poses significant challenges. A practical method involves measuring the internal dose in the blood [8]. During the use of products that contain chemical substances (alone or in mixtures) for the application of chemical substances, they are exposed to aerosols and vapor's that are released into the air. These operations, in terms of dust exposure, have the greatest potential for dust exposure [9]. These compounds may diffuse extensively into highly vascularized tissues, including hematopoietic organs, reproductive glands, and the central nervous system [10]. The use of cleaning products has been associated with a higher risk of respiratory problems, especially among professional cleaners, specifically with propylene glycol derivatives [11]. It was determined that there are severe health effects that can result from occupational exposure to aromatic solvents in the workplace and that these effects can be aggravated by increased exposure to the ambient environment during regular work tasks. Many aromatic organic solvents (expanded aromatic hydrocarbons), such as toluene, ethylbenzene, and xylene, are widely used in petroleum products, and they are also known to be potent carcinogens (e.g., benzene) [13]. The main

physiochemical properties of benzene suggest that its major source emissions are fuel vapors and gasoline (1.8–3.7%), as well as chemicals utilized for degreasing or as thinning agents in automotive settings are included [14]. This study aimed to identify the potential hazards associated with the handling and inhalation of chemical materials by students in the chemistry department, with a focus on specific hematological parameters.

Materials and Methods

Collection of blood samples:

Blood samples (3 ml) were drawn from 20 students (fourth stage) of the chemistry department, as well as from 20 students (fourth stage) of the biology department as a control group using a vacuum needle. These samples were then kept in sterile tubes containing anticoagulant (EDTA) AFMDispo in order to estimate some hematological parameters.

Laboratory Tests:

Hematological parameters were estimated according to the mechanical analysis of the automated blood analyzer apparatus (France).

Exclusion Criteria:

Patients with acute and chronic diseases such as cardiovascular diseases and diabetes mellitus renal failure were excluded from the current study.

Statistical Analysis:

Sociodemographic information was processed and displayed using SPSS version 23 and Microsoft Excel 2010. The results are summarized as means and standard deviations, with the t-test applied for the analysis. The degree of statistical significance was assessed using a p-value threshold of 0.05 [15].

Results and Discussion

The results of the current study (table.1) show a significant decline ($p<0.05$) in the platelets count for chemistry students compared with biology students, which reached 229.5±24.87 and 246.8±47.4 (cell $\times 10^9$ / L) respectively, as shown in figure(1), whereas the results revealed non-significant differences in RBCs and WBCs counts between chemistry (5.173±0.342 cell$\times 10^6$ /mm3 and 6.91±2.127 cell $\times 10^9$ /L respectively, as shown in figure 2), and biology students(5.282±0.49 cell$\times 10^6$ /mm3 and 6.727±1.16 cell $\times 10^9$ /L respectively, as shown in figure 3), and no notable variation in hemoglobin levels was observed among the students, as indicated in figure (4).

Table (1): Estimation of some hematological parameters for chemistry and biology students.

Parameters / Groups	RBCs cell$\times 10^6$ /mm3 Mean±SD	WBCs cell $\times 10^9$ /L Mean±SD	PLTs cell $\times 10^9$ / L Mean±SD	HGB gm/dl Mean±SD
Chemistry students	5.173±0.342	6.91±2.127	229.5±24.87*	15.84±1.27
Biology students	5.282±0.49	6.727±1.16	246.8±47.4	15.55±0.90

*: it was a significant at ($p<0.05$) .

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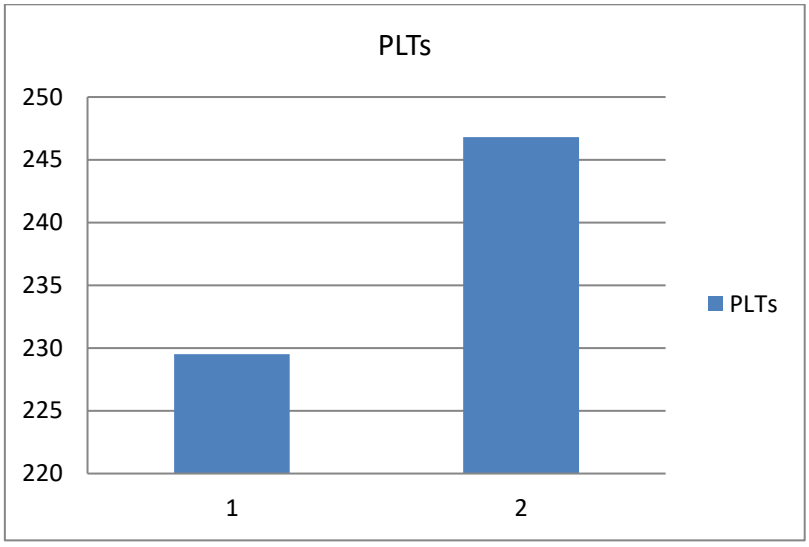

Figure (1): Estimation the PLTs count (cell $\times 10^9$ / L) for chemistry (1) and biology students(2).

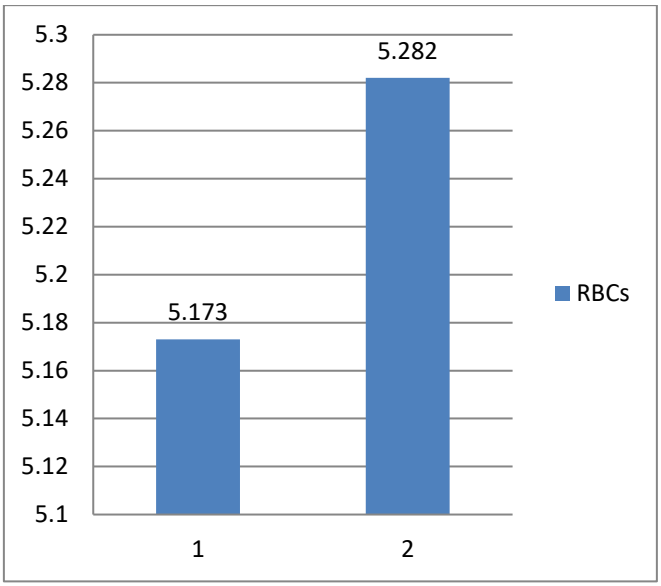

Figure (2): Estimation the RBCs count (cell$\times 10^6$ /mm^3) for chemistry (1)and biology students(2).

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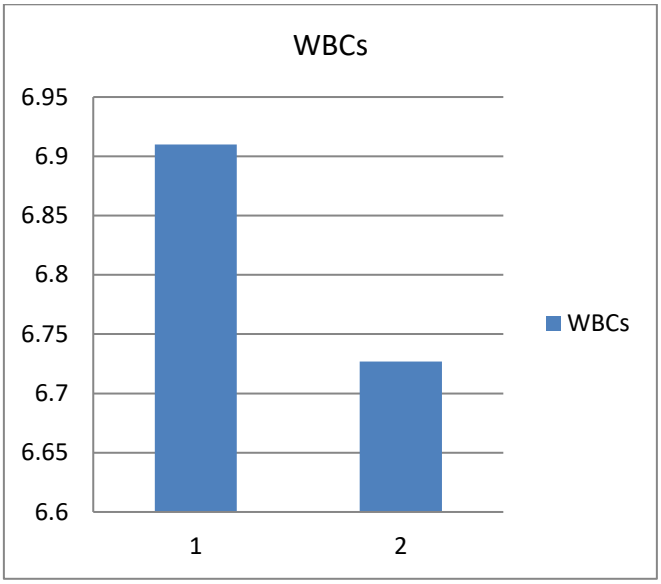

Figure (3): Estimation the WBCs count (cell $\times 10^9$ /L) for chemistry (1)and biology students(2).

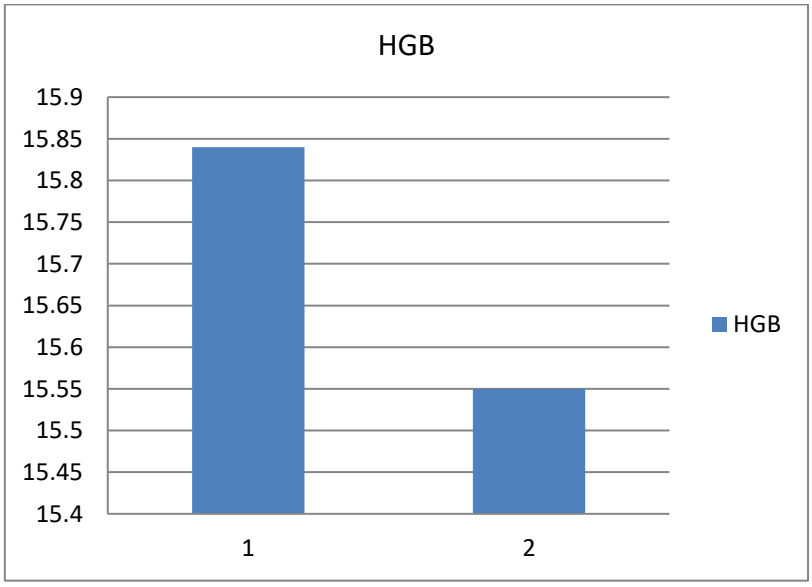

Figure (4): Estimation the levels of HGB (gm/dl) for chemistry (1)and biology students(2).

The findings from the current research indicate that chemistry students exhibit a notably reduced platelets count compared to their counterparts in biology. [16] revealed that platelets count was significantly decrease in farm workers exposed to pesticide than those of control group which reached to 155.7±35.7 and 271.3±96.2 (cell $\times 10^9$ / L) respectively, Moreover, exposure to formaldehyde has been found to negatively impact the platelets count and related indices among mortuary workers [17]. The other parameters disagreed with those of previous studies and the current results. A notable decline was observed in several hematological parameters among battery manufacturing workers compared to the control group. (Hb) levels dropped by 16.67% ($p<0.001$), (PCV) decreased by 20.31% ($p<0.001$), (MCV) reduced by 4.27% ($p<0.05$), (MCH) fell by 5.66% ($p<0.05$), (MCHC) declined by 7.16% ($p<0.001$), and RBCs count decreased by 10.39% ($p<0.001$). In contrast, the total WBCs count exhibited a significant rise of 20.47% ($p<0.001$)[18]. The enzymes that play an important role in the biosynthesis of heme are inhibited by lead, inhibiting the generation of erythrocytes through impaired globulin and heme synthesis and decreasing the level of serum erythropoietin [19]. In addition, exposure to different chemicals has been linked to changes in the hematological profile that combine to

produce pancytopenia, with specific reference to one of its forms, aplastic anemia, and increased oncological risk, notably acute myeloid leukemia. Low levels of RBCs, changes in RBCs and platelets counts, and long-term exposure to gasoline at gas stations. In addition, the time of exposure had a strong negative correlation with HGB, HCT, and platelet count [20]. Benzene, toluene, and xylenes (BTX) are commonly used single-ring aromatic compounds found in human habitats because of their high volatility and large emission sources [21]. Significant declines ($p<0.05$) were observed at the 4-year follow-up in various hematologic indices associated with BTX exposure. In addition, there was a positive association between cumulative BTX exposure and reductions in monocyte, lymphocyte, and hematocrit counts. Moreover, BTX has synergistic effects on the decrements in monocyte counts, RBCs counts, and HB levels [22].

Conclusion

1. The platelets count of chemistry students was decreased and this may be related to platelets entrapment in the spleen, decreased their production or increase their destruction.
2. The platelets may be a sensitive indicator for chemical exposure.
3. The other hematological parameters (RBCs count, WBCs count, and hemoglobin level) of the current study were not affected after the fourth year of exposure to chemicals for chemistry students, which may be related to strict safety conditions in chemistry department laboratories or the duration of exposure to chemicals in the laboratory.

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Conflicts of Interest

No conflict of interest.

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