Comparison of Complete Blood Counts between four Groups: a COVID-19 Patient, a Healthy and Healthy Vaccine Recipient, and Patient Vaccinated Recipients in Anbar Province

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Abstract
Corona virus is considered a scientific, social and economic crisis; Infections are an important factor leading to the emergence of multiple cases of pneumonia, including Covid-19 infection. White blood cells, lymphocytes, platelets and hemoglobin are signs of a regular inflammatory reaction and often predict the severity of the disease based on the complete blood count. This study aimed to compare the complete blood count between the studied groups and to know the effect of the vaccine on males and females. A study of 80 samples divided into 4 groups (the healthy, the Patient, the healthy and vaccinated recipients, the Patient and vaccinated recipient), 10 males and 10 females for each group, and the complete blood count was measured for them. The results indicated that there were significant differences between some variables of the complete blood count between males and females, as their values increased in males compared to females, and there were significant differences between those patients with Covid-19 compared to healthy people and other groups.
Keywords: covid-19, CBC, Vaccines, SARS-cov-2, Corona Virus.

1. Introduction

The severe acute syndrome coronavirus (SARS-Cov-2) appeared at the end of 2019 and spread at the beginning of 2020, which severely affected the progress of care worldwide, and clinical manifestations range from mild influenza-like illness to life-threatening forms (Chen et al ., 2020). The World Health Organization has confirmed 35,274,993 cases and 1,038,534 deaths across 216 countries (WHO, 2020), With more than millions of people infected worldwide, the SARS-Cov-2 outbreak has left its lasting mark on human history (Zhu et al., 2020), However, a large proportion of people have severe pneumonia, which is more prevalent and can progress to respiratory failure, hypoxia, shock, organ dysfunction and death. The incidence and death rate curve for COVID-19 is significantly higher in elderly patients, males, and some races and patients with certain chronic diseases (Xia et al., 2020). Although the disease affects both males and females, and its effects vary according to the body's immunity and resistance, male mortality rates are higher (10.4) compared to females (7.0) at all ages, according to the Global Health 50/50 statistic (Ahmed & Dumanski, 2020). Age and diseases affect Accompanying mortality rates in the elderly and in patients with cardiovascular diseases at a higher rate than others (Leung, 2020). The incubation period of the disease is estimated from 1 to 14 days. Several vaccines have been developed to prevent the spread of the virus and reduce the severity of symptoms among infected people. One of the most effective vaccines is (BioNTech, ChAdOx1-S, Sinopharm). Vaccines against COVID-19 are of great importance to the prevention of COVID-19 and control it (Wang et al., 2020). Blood is a vital body fluid that is made in the bone marrow and consists of four components (plasma, red blood cells, white blood cells, platelets) divide into 55% plasma and 45% into cells, the body of an adult person consists of approximately 5 liters of blood. One of the main functions of blood in the body is to transport oxygen and nutrients to various organs and tissues, and antibodies direct it to the work site to fight infection, transport waste from the liver and kidneys, and remove toxins from the body (Fathima & Khanum, 2017). The complete blood picture test is a routine test during the biological assessment of the patient to predict the disease and its severity (Sun et al., 2020). Therefore, the aim of this study is to find out the relationship between Complete Blood Count (CBC) and the extent of the effect of sex, Patient and vaccination, and compare it with the control group.

2. Materials and Methods

1-Sample Collection

Samples were collected from the Ramadi Teaching

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Hospital, the health center in Ramadi and Al tamayuz Laboratory for pathological analyzes. Their ages ranged between (17-75). 5ml was withdrawn for 80 samples divided into four groups, each group includes 20 samples divided into 10 males and 10 females, the first group the healthy and was used as a control group, the second the group with Covid-19 Patient, the third group healthy people and vaccine recipients, either the group the fourth represented the patient people and the recipients of the vaccine.

2- Pre-analytical sample handing

Venous blood was drawn with a sterile 5 cc syringe, a tube holder, containing Ethylene diamine tetra-acetic acid (EDTA) 3ml of blood , placed on a vortex device to mix blood with EDTA for 2-3 minutes, then placed With Mindary Company (Korea) Autologous Blood Analyzer,

3- Sample Analysis

CBC was measured by placing blood after turning on the device, then applying 3 levels of control (low, normal and high number) after rounding the tab with the sample probe and pressing the start key, the required amount of blood is suctioned out, then the LCD display screen analyzed the tube, and displayed the result On screen and printed

4-Statistical analysis

After collecting and tabulating the data related to the study, it was statistically analyzed using the statistical program SPSS (Spss, 2011) using the Analysis of Variance (ANOVA TABLE) table to calculate the variance, joint variance, correlation and test the averages using the least significant difference test L.S.D at the probability level of ($P \leq 0.01$, $P \leq 0.05$) (Judeh, 2009; Al-Rawi & Khalaf Abdullah, 2000).

3. Results

The result of (Fig.1) showed the comparison CBC between groups. In (Fig.1. A) There were significant differences in the mean values of some CBC variables for the healthy group at the level ($P \leq 0.05$) , and the value of lymphocytes showed significant differences at the level ($P \leq 0.05$) for the average values of females (28.24%) compared to males (33.26%), and the white granular blood cells showed no significant differences at the level of ($P \leq 0.05$) between females with an average of (63.90%) compared to males with an average of (61.03%). The RBC indicated that there were significant differences in females with an average of (4.17 mm3) compared to males where their average value was (5.16 mm3) at the level ($P \leq 0.05$), HGB showed significant differences in females with an average value of (12.44 g/dl) compared to males with a value of (15.05 g/dl) at the level ($P \leq 0.05$). There were no significant differences between the mean values of females (63.60%) and males (44.31%) at the level ($P \leq 0.05$), HCT while the value of platelets indicated that there was no significant differences between females (266.2%) and males (255.2%) at the level ($P \leq 0.05$).

(Fig .1.B) shows the results of the statistical analysis of the average values of CBC in the group of patients at the level of ($P \leq 0.05$) , we note that there are no significant differences in the value of the average (WBC) white blood cells among females, which reached (6.70mm3) compared to males, where their average values (6.17mm3) at the level ($P \leq 0.05$), and it showed that there were significant differences in the white Lymph in females , with an average of (27.51%) compared to males, where their average values (24.22%) at the level ($P \leq 0.05$) Cells showed Granular white blood There were no significant differences at the level ($P \leq 0.05$) between females with an average of (66.00%) compared to males , with an average of (60.95%) , RBC showed no significant differences in females with an average of (3.77mm 3) compared to males, where its average value reached (4.79 mm3) at the level ($P \leq 0.05$). HGB showed significant differences in females with an average value of (10.23 g/dl) compared to males with a value of (14.70 g/dl) at the level of ($P \leq 0.05$), HCT showed no significant differences between the mean values of females (33.22%) and males (43.10%) at the level ($P \leq 0.05$). As for the platelet value, it indicated that there were no significant differences in comparison between females (272.60%) and males (262.0%) at the level ($P \leq 0.05$).

Also, the results of (Fig.1.C) indicated the statistical analysis of the averages of some CBC variables for the healthy group and the vaccine recipients at the level ($P \leq 0.05$), which showed that there were no significant differences between females and males in the values of their averages due to the equal variance between them despite the appearance of a high value of the standard error for males which reached (33.07) , but equal variance values prevented the emergence of significant differences between the means.

While in (Fig .1.D) the results showed the statistical analysis of the averages of some CBC variables for the group of Patient and vaccine recipients at the level ($P \leq 0.05$) , where it indicated that there were significant differences in the average values of HGB for females (11.44 g/dl) compared to males, with an average of (14.26 g/dl) at the level ($P \leq 0.05$), and it was clear that there were no significant differences in

the means of other variables for females compared to males at the level (P≤0.05).

Fig A. CBC Healthy

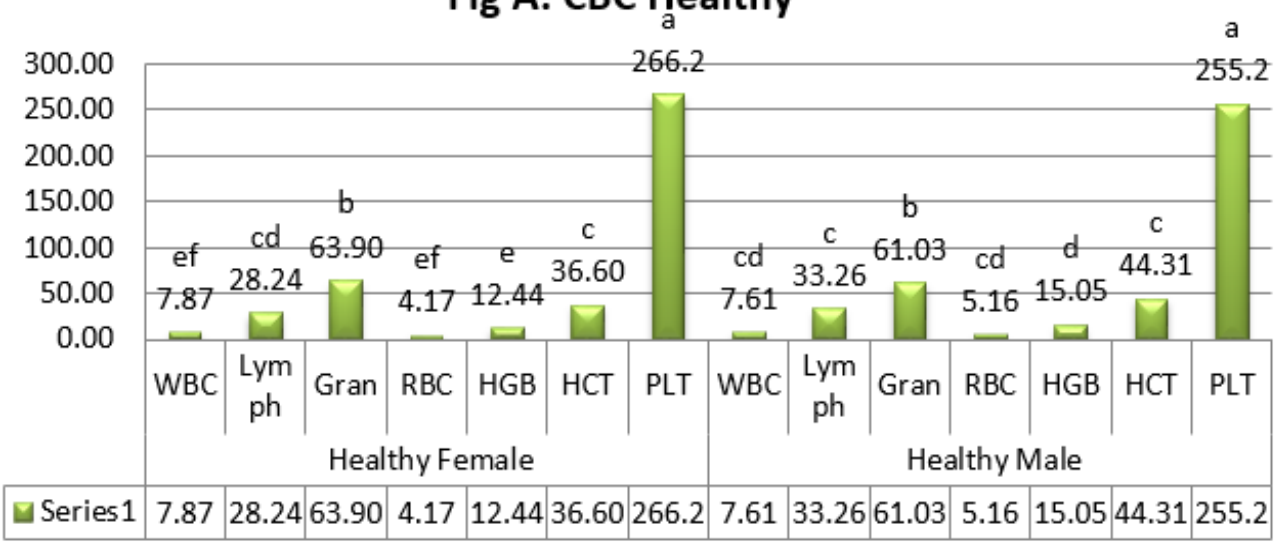


Fig B. CBC Patient

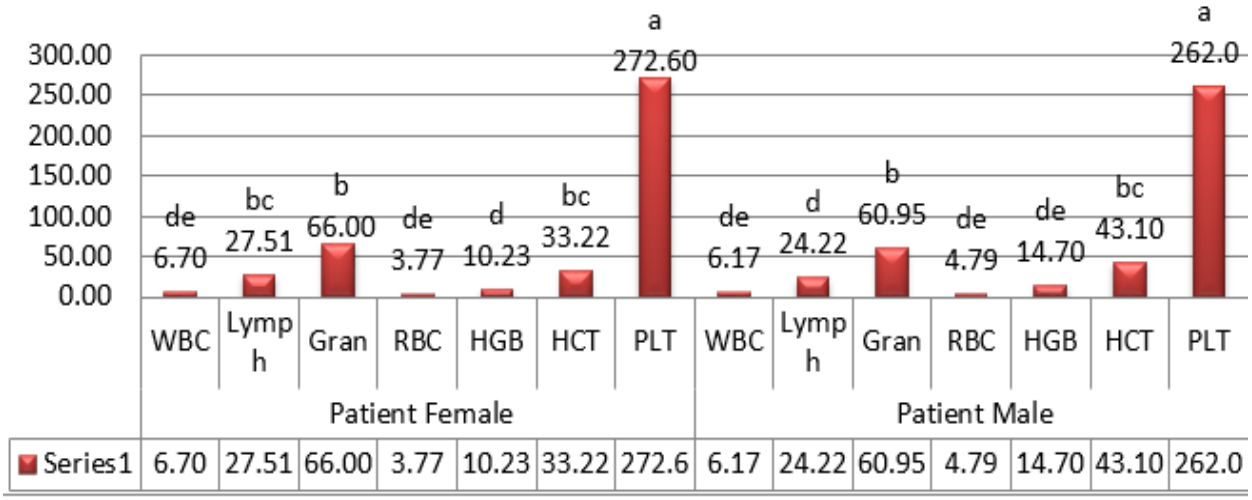
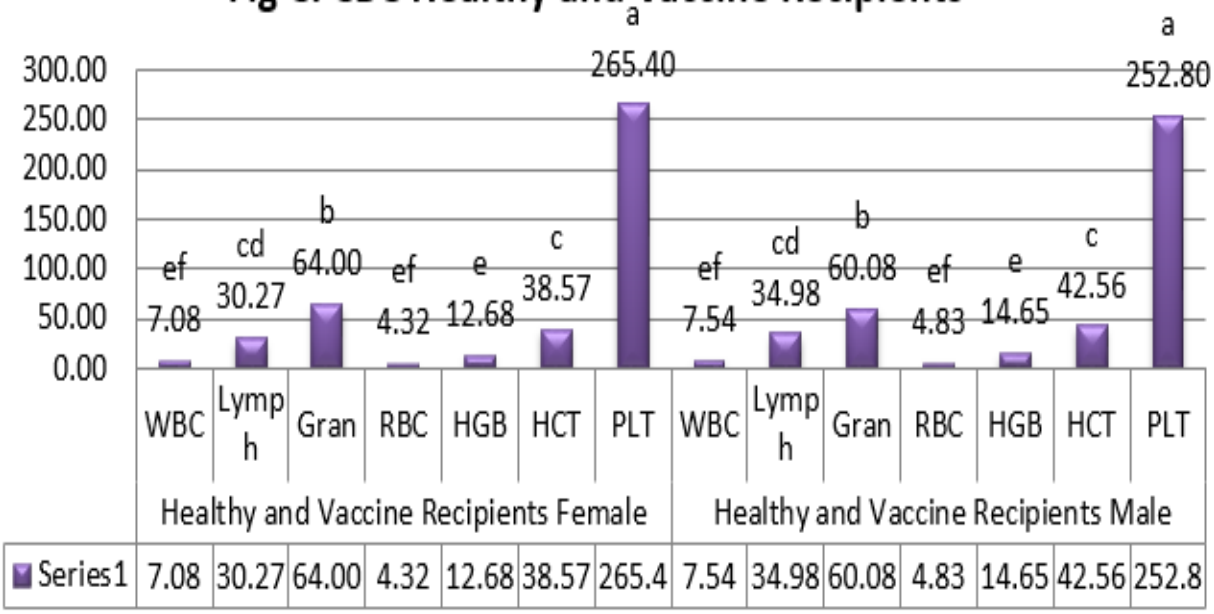
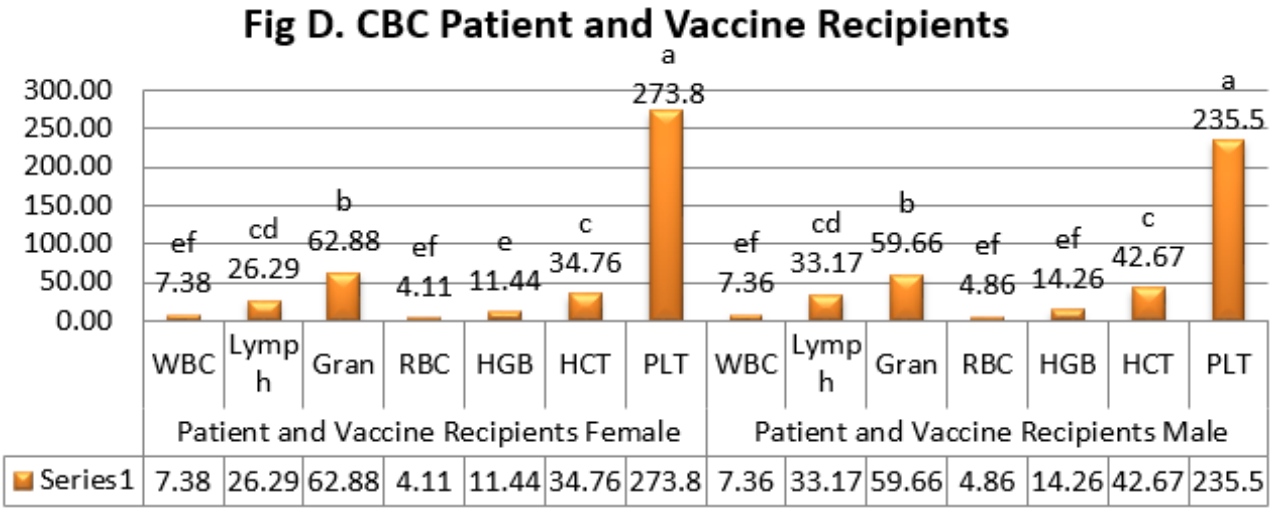


Fig C. CBC Healthy and Vaccine Recipients





(Fig 1.A, B, C, D) showed the mean values of CBC between males and females in the healthy, Patient, healthy and vaccine recipients, Patient and vaccine recipients' groups.

(Table 1), the statistical results indicated that the variance value of the affected females increased, which recorded 9,247,957 and a standard error of 36.34 compared to males, which recorded a lower variance value of 7,195.16 and a standard error of 34.62 for the same group. The affected women indicated that the values of the studied variables increased with a significant difference from the males of the same group. The results showed the value of the common standard error, which amounted to (24.11). The results of the table also indicate a high variance for females in the healthy group, which amounted to (8697.75) and a standard error of (35.24) compared to males, for which the value of variance reached (6691) and the value of the standard error amounted to (33.39), and the value of the common variance was recorded which amounted to (8233.55), as well as the common standard error, which amounted to (23.32).

The results indicate a clear difference in the values of the studied variables for males and females in healthy and vaccinated recipients, where we note the high value of the variance for males, which amounted to 6564.87 And a standard error of 33.07 compared to the variance of females, which amounted to 656.86 and a standard error of 9.687, and the value of the common variance was (1677.84) and the common standard error (17) It is noted from the results of the same table that there is an increase in the value of the variance of females for the group of patient and vaccine recipients, which amounted to 6672.44 and standard error of 30.876, and males recorded less variance of 5664.6 for the same group and standard error of 30.726, while the value of the common variance amounted to (6517.61) and common standard error Its value is (21.421) .

Table (1) shows the value of the variance, the common variance and the standard error of the studied groups in the CBC analysis.

Sex Groups	Variance	Common Variance		Standard error		Common Standard error
	Female	Male	female Male	Female	male	Female+ male
Patient	9247.957	7195.16	8799.05	36.34	34.62	24.11
Healthy	8697.75	6691	8233.55	35.24	33.39	23.32
Healthy with vaccine recipients	656.86	6564.87	1677.84	9.687	33.07	17
Patient with vaccine recipients	6672.44	5664.6	6517.61	30.874	30.726	21.421

4. Discussion

Our study shows the morphological changes of CBC associated with SARS-Cov-2 infection, and the severity of the changes varies according to the severity of infection and other comorbidities. Complete blood picture analysis is important to assess the general health of the body (Horton et al., 2018). Previous studies showed that there are many factors that affect CBC values, including age, race, gender, smoking and others (Sirdah et al., 2008). White blood cells are the resistance cells and the body's line of defense against any microorganisms or viruses and they fight external infection and the number of these cells increases in the infection period only (Liu et al ., 2020 ; Henry et al ., 2020) , High WBC has been associated with respiratory diseases, coronary artery disease, and it is an accurate measure of epidemiological studies (Kabat et al., 2017 ;), high WBC affects arterial disease by altering endothelial function (Walker et al., 2010), and mitigating vasodilatation. An increase in the association of WBC with the vascular endothelium stimulates capillary WBC production and thus increases vascular resistance (Lao et al., 2008), in a study conducted by Wang et al confirmed that High WBC is strongly associated with respiratory disease risk (Wang et al., 2018), as well as higher positivity for Covid-19 and worse and more severe clinical manifestations in male patients compared to females. PLT is one of the important indicators in

classification systems for disease severity and organ dysfunction, as in the case of Covid-19, PLT was associated with severity of infection (Polanco et al., 2014), Liu et al confirmed that low PLT was associated with higher mortality and severity Infection with Covid-19 (Liu et al., 2020), the mechanism of entry of SARS-Cov-2 into the blood was not known to know its effect on the decrease in PLT, as mechanisms were found that explained its decrease in the period of infection with Covid-19, while the virus enters cells Bone marrow suppresses PLT production (Seyoum et al., 2018), or SARS-Cov-2 suppresses hematopoiesis in bone marrow through receptors to preserve initial formation of PLTs and consequent thrombocytopenia (Ropa et al., 2021), causing capillary damage. The effect of infection with Covid-19 on lung tissue, causing damage to lung tissue, PLT clumping, micro-clot formation, and increased consumption of PLTs (Thachil, 2020). The severity of the association of PLT with hypoxemia is a predictive predictor of disease severity with an accuracy of 96% (Al-Samkari et al., 2020). Compared to other parameters, the WBC value increased with age, which is related to infection and diseases associated with the elderly, while the platelet value PLT did not show a significant increase in males and females (Wu et al., 2015).

Yang et al (2020) showed that lymphocytes were decreased in value in more than 80% of critically ill patients with COVID-19. The lack of lymphocytes is a distinctive feature of patients infected with the virus, as the virus works to break down and destroy the cytoplasm of lymphoid cells (Gu et al., 2005). The level of HGB, HCT, RBC during the period of infection with Covid-19 is low compared to the healthy ones due to the failure of the bone marrow to produce enough red blood cells that transport oxygen from the lungs to the tissues and the damage to the lungs caused by the virus, which makes gas exchange very difficult (Djakpo et al., 2020). As for the RBC value, hemoglobin HGB value, and hematocrit HCT, their values decreased significantly with age in males due to the gradual loss of androgens that stimulate the production of red blood cells. A decrease in this percentage in males causes malignant diseases, anemia and nutritional deficiencies, and their values increased with age. For postmenopausal women (Paul et al., 2012).

Studies have shown that at all ages, the value of HGB, HCT, and RBC was higher in males compared to females. The level of HCT increases due to fluid loss, dehydration, cardiovascular and renal disorders, and diuretic therapy in hypertensive patients, which is more frequent and severe in men (Ambrosino et al., 2020). Individuals aged 65 years or older are more likely to contract diseases, including diabetes patients and hypertensive patients, who are more likely to be infected with Covid-19 compared to healthy people, who have been given priority in vaccination (Mueller et al., 2020). The severity of infection and symptoms increase, and the risk of death with age (Arora & Das, 2020). Also, gender, immune history and obesity are among the most important influences on the effectiveness of the vaccine (Dhakal & Klein, 2019). In a previous study, it was clear that the person's immune history and his condition before the vaccine are considered the most important factors of response and vaccine effectiveness against diseases between the sexes, and body mass, especially in females, reduces the body Antibody in contrast to males (Kuo et al., 2022).

Other studies have shown the difference between the sexes in the response to vaccines, where women give a response to the vaccine and the formation of higher antibodies to vaccination against most vaccines diseases, such as the seasonal influenza vaccine, etc., than men (Voigt et al., 2019).

The results of our study agree with previous studies in terms of decreased lymphocyte values Lymph, Gran, RBC, HCT, RBC, in cases of Covid-19 infection compared to healthy subjects, as well as an increase in white blood cells and platelets. Also, by comparing the results between males and females, we note that WBC has no difference between the values of males and females. As for the values of RBC, HGB, and HCT, we note that their values are higher in males than females, while the value of Gran and PLT increases in females compared to males.

5. Conclusion

Our study emphasizes the importance of analyzing the complete blood picture if it is considered an important biological indicator for predicting infection with Covid-19, and the increase in some CBC variables in males indicates that males are more susceptible to infection than females that showed a higher immune response and effectiveness to vaccines than males.

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