RESEARCH ARTICLE

# Association of normal levels of both haemoglobin and white blood cells count with normality of complete blood count

Maysem Mouayad Alwash[1], Shaymaa Wahbi Salman[2], Taymaa Moayad Ahmed[3]

## Abstract

**Objective:** To assess the use of haemoglobin and white blood cell count together in predicting the normality of other complete blood count parameters and blood film.

**Method:** The prospective study was conducted from August to November 2021 at Al-Yarmouk Teaching Hospital, Baghdad, Iraq, and comprised adult individuals of either gender who were advised blood test by physicians in the outpatient department. Patients with normal haemoglobin and white blood cell counts were placed in group A, while those with abnormal counts of the two parameters were placed in group B. Examination of blood smears morphology was done in both groups. Data was analysed using SPSS 26.

**Results:** Of the 200 subjects, 100(50%) were in group A; 58(58%) males and 42(42%) females with mean age 51.09±18.8 years. There were 100(50%) subjects in group B; 52(52%) males and 48(48%) females with mean age 47.58±15.5 years ($p>0.05$). In group A, 70(70%) cases showed normal complete blood count parameters and abnormal morphology of 1+ grading in 13(13%). The results were significantly different than group B ($p<0.05$).

**Conclusion:** Normal haemoglobin and white blood cell count was found to a good marker for the normality of other complete blood count parameters.

**Key Words:** Leukocyte, Haemoglobins, Haematological

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## Introduction

The complete blood count (CBC) is one of the widely and frequently ordered haematological tests by physicians, and it usually includes 13-19 parameters in addition to continuous introduction of other parameters.[1] CBC assessment is critical not only for diagnosing and managing haematological diseases, but also for assessing overall health.[2]

CBC measures different parameters, most importantly the white blood cell (WBC) count and haemoglobin (Hb) level. WBC count could indicate bone marrow pathology by either increased (leucocytosis) or decreased (leukopenia) count.[3] Physicians could use WBC count changes as a prognosticator to identify patients with severe disease who need urgent management and follow-up.[4]

Hb levels that are lower than the normal range are indicative of anaemia, depending on the values of red blood cell (RBC) indices, while high Hb is associated with polycythaemia[5]. Some researchers used Hb level changes as a prognostic factor for disease severity and clinical outcomes, such as in acute lymphoblastic leukaemia in children and adolescents[6].

[1,3]Department of Pathology and Forensic Medicine, Mustansiriyah University, Baghdad, Iraq.[2]Laboratory, Al-Yarmuk Teaching Hospital, Baghdad, Iraq.

**Correspondence:** Maysem Mouayad Alwash

**Email:** maysemalwash@uomustansiriyah.edu.iq

The platelet (PLT) count and size are used for monitoring thrombopoiesis, and give an idea about the efficacy of primary haemostasis. A reduced PLT count has been confirmed to be a bleeding risk factor.[7]

The utility of automated CBC parameters has been hampered by two points. First, misinterpretation of CBC or information overload. Some studies mentioned that majority of clinicians most frequently used only 2-3 parameters out of the whole CBC range. These parameters were WBC count, Hb level and PLT count.[8] Other parameters, such as mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), RBC count and others, are usually neglected.

Due to medical advancements and use of automated technology in medicine, it is important to use automated CBC effectively to reduce the pressure on pathologists, especially in poorly resourced medical laboratories. It is essential, however, not to miss key diagnostic information by relying solely on findings provided by automated analysers.[9]

The two problems could be reduced by finding a reliable automated CBC parameter that can be used to effectively screen and predict the results of automated analyser and microscopic findings of blood smear.

The current study was planned to assess the use of Hb and WBC count together in predicting the normality of other

CBC parameters and blood film.

## Materials and Methods

The cross-sectional, prospective study was conducted from August to November 2021 at Al-Yarmouk Teaching Hospital, Baghdad, Iraq. After approval from the ethics review committee of the College of Medicine, Mustansiriyah University, Baghdad, the sample size was calculated by using G*Power[10]. The sample was raised using stratified random sampling technique. Those included were adult individuals of either gender who were advised blood test by physicians in the outpatient department (OPD). Patients with normal Hb level and WBC count were placed in group A, while those with abnormal counts of the two parameters were placed in group B. After verbal consent from all the participants, CBC was done using an automated haematology analyser. WBC count included differential count of neutrophil, lymphocytes, monocytes, eosinophils and basophils, and reference range used for CBC profile was in line with literature.[11]

A microscopic examination of well-prepared blood film from each sample was done by a haematologist. The blood picture was assessed for morphological features and cell counts to verify CBC findings and any red flag identified by the automated analyser. The morphological abnormality of blood picture was analysed using the 'plus' grading scale, and the grading system included 3 grades: 1+ = slight, 2+ = moderate, and 3+ = significant.[12]

Data was analysed using SPSS 26. Data was presented as mean ± standard deviation as well as frequencies and percentages, as appropriate. Two-tailed independent t-test was used to compare the continuous variables. Chi-square test was used to assess statistical association of the groups with CBC parameters. Fisher exact test was used when the expected frequency was <5. P<0.05 was considered significant.

## Results

Of the 200 subjects, 100(50%) were in group A; 58(58%) males and 42(42%) females with mean age 51.09±18.8 years. There were 100(50%) subjects in group B; 52(52%) males and 48(48%) females with mean age 47.58±15.5 years (p>0.05) (Table 1).

In group A, 70(70%) cases showed normal CBC parameters, and the difference between the groups across all the CBC parameters analysed was significant (Table 2).

Abnormal morphology of 1+ grading was seen in 13(13%)

**Table-1:** Age and gender distribution.

| Clinical Characteristics | Study Groups: Normal (Normal Hb and /or WBC) (%) n= 100 | Abnormal(Abnormal Hb and WBC) (%) n= 100 | Total (%) | p - Value |
|---|---|---|---|---|
| **Gender** | | | | |
| Male | 58 | 52 | 110 | |
| Female | 42 | 48 | 90 | |
| | Mean ± SD | Mean ± SD | | |
| Age (Year) | 51.09 ± 18.8 | 47.58 ± 15.5 | | 0.15 |

HB: Haemoglobin, WBC: White blood cell.

**Table-2:** Intergroup differences in haematological parameters.

| Parameters | Study Groups: Abnormal (%) n= 100 | Normal (%) n= 100 | Total (%) | p- Value |
|---|---|---|---|---|
| **RBC Level** | | | | |
| Abnormal | 70 (69.3) | 31 (30.7) | 101 (50.5) | 0.001 |
| Normal | 30 (30.3) | 69 (69.7) | 99 (49.5) | |
| **HCT Level** | | | | |
| Abnormal | 72 (100.0) | 0 (0) | 72 (36.0) | 0.001 |
| Normal | 28 (21.9) | 100 (78.1) | 128 (64.0) | |
| **MCV Level** | | | | |
| Abnormal | 57 (96.6) | 2 (3.4) | 59 (29.5) | 0.001 |
| Normal | 43 (30.5) | 98 (69.5) | 141 (70.5) | |
| **MCH Level** | | | | |
| Abnormal | 58 (93.5) | 4 (6.5) | 62 (31.0) | 0.001 |
| Normal | 42 (30.4) | 96 (69.6) | 138 (69.0) | |
| **Neutrophil Level** | | | | |
| Abnormal | 26 (92.9) | 2 (7.1) | 28 (14.0) | 0.001 |
| Normal | 74 (43.0) | 98 (57.0) | 172 (86.0) | |
| **Lymphocyte Level** | | | | |
| Abnormal | 32 (80.0) | 8 (20.0) | 40 (20.0) | 0.001 |
| Normal | 68 (42.5) | 92 (57.5) | 160 (80.0) | |
| **Monocyte Level** | | | | |
| Abnormal | 29 (63.0) | 17 (37.0) | 46 (23.0) | 0.044 |
| Normal | 71 (46.1) | 83 (53.9) | 154 (77.0) | |
| **Eosinophil Level** | | | | |
| Abnormal | 19 (95.0) | 1 (5.0) | 20 (10.0) | 0.001 |
| Normal | 81 (45.0) | 99 (55.0) | 180 (90.0) | |
| **Platelet Level** | | | | |
| Abnormal | 61 (93.8) | 4 (6.2) | 65 (32.5) | 0.001 |
| Normal | 39 (28.9) | 96 (71.1) | 135 (67.5) | |

RBC: Red blood cell, HCT: Haematocrit, MCV: Mean corpuscular volume, MCH: Mean corpuscular haemoglobin.

**Table-3:** Intergroup comparison of blood film morphology grading.

| | Study Groups | | | | |
|---|---|---|---|---|---|
| **Study group** | **Normal (%) n= 87** | **Abnormal 1+ (%) n= 22** | **Abnormal 2+ (%) n= 25** | **Abnormal 3+ (%) n= 66** | **p-Value** |
| Abnormal screened Group | 0 (0) | 9 (9.0) | 25 (25.0) | 66 (66.0) | 0.001 |
| Normal screened Group | 87 (87.0) | 13 (13.0) | 0 (0) | 0 (0) | |

group A subjects, and the results were significantly different than group B (Table 3).

## Discussion

The current study showed significant association between abnormality of Hb and WBC in group B with abnormality of all WBC, RBC and PLT parameters, indicating that a higher percentage of CBC parameters tended to be away from the normal reference range when Hb and / or total WBC count were of abnormal value ($p<0.05$).

Regarding differential WBC count, highest prevalence of abnormal neutrophil, lymphocyte, monocyte and eosinophil count was seen significantly in group B compared to group A ($p<0.05$). These results were concordant with previous studies.[13]

Very few patients in group A had abnormal differential WBC count, but most of them were close to upper or lower borderlines of the normal reference range. In addition, their corresponding blood film showed either normal or non-significant morphological abnormality (grade 1+).

These abnormal values in group A could have been caused by factors that are physiological in origin and occur in association with certain conditions, like pregnancy, in which returning to normal count will occur soon after delivery.[14] Moreover, benign ethnic neutropenia, which is reported in Middle East population, could explain the abnormally low neutrophil counts in some cases.[15]

In the present study, RBC count, haematocrit (Hct), MCV and MCH were outside the normal reference range in most cases when Hb and / or WBC levels were abnormal. Talking about RBC count, 70% of group B revealed abnormal RBC count in comparison with 30% in group A. Similar differences marked other RBC indices ($p<0.05$). The examination of corresponding blood smears showed findings concordant with CBC count. This means that among samples out of the reference limits in group A, none of the morphological features had more than 1+ grading, while those in group B gave major morphological defects with grade 2+ or 3+. The marginally abnormal RBC indices may be due to inheritance of haemoglobinopathies in a heterozygous state, like alpha thalassemia minor, which in the majority of the cases was asymptomatic.[16]

The highest prevalence of abnormal PLT count was observed when either or both Hb and WBC were abnormal, whereas only 4% samples with a normal Hb and WBC showed PLT count beyond the normal reference limit.

Some studies found a significant relation of Hb and WBC abnormality with blood smear morphological abnormality, which is in line with the current findings.[13] The current study's morphological findings also agreed with another study.[9]

In the light of the current findings, Hb and WBC count could be an effective predictor for other CBC parameters and blood film morphology. which could be of benefit in many circumstances. First, this may be a more low-cost and time-efficient approach compared to CBC and routine blood smear revision for all patients, especially those in the developing world, or those visiting the primary health centres in rural areas or in war zones.

Secondly, the utility of Hb and WBC as screening tools will decrease the workload on laboratory technicians and pathologists even in well-equipped large hospitals.

## Conclusion

Normal Hb level and WBC count increased the chances of other CBC parameters and peripheral blood morphology to be normal.

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**Conflict of Interest:** None.

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