International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

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Hematological profile of individuals suffering from Von Willebrand disease and hemophilia B in Southern Iraq: A comparative cross-sectional study

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International Journal of Science and Research Archive, 2026, 20(02), 206–215

Publication history: Received on 01 July 2026; revised on 09 August 2026; accepted on 11 August 2026

Article DOI: https://doi.org/10.30574/ijsra.2026.20.2.1612

Abstract

Background: Hemophilia B and von Willebrand disease are types of inheritied bleeding disorders. They affected the body' s ability to stop of bleeding properly, leading to repeated bleeding episodes. These conditions can also change certain blood- related measurements. Looking at all the numbers in a complete blood count (CBC) can give important clues about the blood health of patients who are sick.

Objective: The goal of this study was to check and compare the blood test results, specifically CBC parameters. In individuals suffering from Von Willebrand disease and hemophilia B. It also looked at how these patients' results differed from those of healthy individuals in AL-Muthanna province, Iraq.

Approaches: A cross – sectional analysis comparative A research was conducted. by reviewing laboratory records from the Hemophilia Center at the Women's and Children's Hospital in Samawah, Iraq. Twenty patients who had inherited bleeding disorders, including 11 with Hemophilia B and 9 with VWD, along with 20 healthy individuals, were included in the study. Hematological parameters such as Hematocrit, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, white blood cell count, red blood cell count, hemoglobin levels, and Platelet count were examined. Statistical analysis was done using t-tests for comparing two groups and one-way ANOVA for comparing more than two groups, and results were considered significant if a P - Value was below 0.05.

Results: Patients who have inherited bleeding disorders had much lower levels of hemoglobin compared to the control group. Their average hemoglobin was 10.70 ± 0.74 g/dL, while the control group had 12.55 ± 1.88 g/dL ($p = 0.0002$).Their hematocrit levels were also lower, at 33.94 ± 2.32%, compared to 37.58 ± 5.78% in the control group ($p = 0.0129$).Additionally, their mean corpuscular volume (MCV) was smaller, averaging 67.33 ± 7.75 fL, versus 82.36 ± 8.66 fL for the control group ($p < 0.001$).Their mean corpuscular hemoglobin (MCH) was also lower, at 19.79 ± 2.18 pg, compared to 27.88 ± 3.03 pg in the group under control ($P < 0.001$). No, major changes was seen in this Red blood cell count and White blood cell count, mean corpuscular standerd hemoglobin, or count of platelet In the group of patients studied, the platelet counts were notably higher in individuals with von Willebrand disease compared to those with Hemophilia B (306.56 ± 89.06 versus 227.09 ± 71.07 × 10^3/µL, P is equal to 0.0393).

Conclusion: Among individuals with Hemophilia B as well as VWD, there were marked changes in erythrocyte-related hematological indices, implying microcytic hypochromic hematological changes associated with recurrent bleeding episodes. Regular blood tests can help in better managing health and finding problems related to anemia earlier in those who are affected.

Keywords: Hemophilia B; Von Willebrand Disease; Complete Blood Count; Hemoglobin; Hematological Parameters; Anemia; Iraq.

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1. Introduction

Hereditary disorder of bleeding (HBDs) is a wide range of inherited circunstances that affect the body's ability to stop bleeding properly, either on its own or after an injury, leading to excessive or uncontrolled bleeding. These disorders happen when there are issues with the amount or function of coagulation factors, platelets, or von Willebrand factor, causing a wide range of symptoms from minor bleeding in the mouth or skin to serious and dangerous bleeding problems. Even though there have been improvements in diagnosing and treating inherited bleeding disorders, these conditions still cause a major strain on healthcare systems around the world.This is because they are long-term issues and people who have them are at risk of facing repeated bleeding problems (Seidizadeh et al., 2024; James et al., 2024).

Hemophilia and von Willebrand disease are the most Prevalent inherited bleeding disorders. Hemopilia B is caused by a deficiency or issue with a protein Known as coagulation factor IX, Which is inherited through recessive X Chromosome genes. The illness Primarily affects men and is characterized by recurrent bleeding episodes in the joints, muscles, and soft tissues. Frequent intra-articular bleeding events can cause joint tissues to deteriorate Over time, resulting in chronic discomfort, reduced mobility, and detrimental effect on patients quality of life. Managing bleeding complication is still a significant challenge, especially in developing nations that find it difficult to provide specialized heaithcare, despite notable advancements in modern treatment, particularly clotting factor replacement therapy, which has improved survival rates and health outcomes. (Mahlangu et al., 2023 ; Hassan et al., 2021

Von Willbrand disease is the most common inherited bleeding disorder worldwide. It resulte from a deficiencyor dysfunction of Von Willbrande factor (VWF), a complexprotein found in blood plasma, This protein plays a crucial role in platelet adhesion to the site of injury and the formation of the primary blood piug. it also contributes to the stability of coagulation factor VIII. Unlike hemophilia B, Von Willebrand disease affects males and females equally. Clinical presentation and laboratory test results vary among patients, with symptoms ranging from mild to severe bleeding, including nosebleeds, bleeding gums, heavy menstrual bleeding, easy bruising, and persistent bleeding after injury or surgery. According to the latest international guidelines, standardization of diagnostic procedures and laboratory tests is essential to improve the accuracy of Von Willebrand disease diagnosis and patient care.(James et al.,2024; Platton et al.,2024).

Blood test results in individuals with inherited bleeding disorder can be significantly impacted by recurrent bleeding episodes, according to multiple studies. Reduced hemoglobin levels and altered red blood cell shape can result from ongoing blood loss, particularly from mucosal membranes, the digestive tract, and recurrent joint bleeding. Long – term blood loss Patients frequently have lower mean corpuscular volum and mean corpuscular hemoglobin levels, demonstrating how ongoing bleeding impairs the bodys capacity to produce red blood cells and deliver oxygen. Because long – term anemia can affect a patients growth and development, it is crucial to repecially true for children and teenagers. (Connell et al., 2021; Jammes et al., 2024 ; Srivastava et al., 2020).

Besides issues with red blood cells, problems related to platelets can also give important clues about bleeding disorders. In Hemophilia B, platelet counts are usually normal since the main issue is with coagulation factor IX.However, changes in how platelets work are key to understanding von Willebrand disease. Some earlier research has indicated that repeated bleeding and the body's attempt to make up for it by producing more blood cells might lead to differences in platelet levels among people who are affected. As a result, comparing different blood test results can offer more understanding about how a disease is affecting the body and help doctors track a patient's condition more effectively (Seidizadeh et al., 2024; Platton et al., 2024).

Patients chances of survival and general quality of life have significantly risen as a result of recent advancements in the understanding and treatment of inherited bleeding diseases Despite this, disease is still a major issue, particularly in developing nation where there may not be enough facilies for medical diagnosis, availability to coagulation factor concentrates, or skilled hematologist care. In order to enhance long – term outcomes and reduce the risk of health concerns from recurrent bleeding events, the World Federation of Hemophilia (WFH) has emphasized the necessity of routin lab testing and early problem diagnosis.(Srivastava et al., 2020).

This research was carried out in Al – Muthanna Province, Iraq, to evaluate and contrast the total blood count characteristics between individuals with Von Willbrand disease and hemophilia B and healthy individuals. Additionally, the study sought to determine how specific demographic factors impact blood – related metrics and provide basic laboratory data that could aid in the better understanding and monitoring of inherited bleeding problems within the local community.

2. Equipment and Procedures

2.1. Participants and Study Design

Laboratory records from the Hemophilia Center at the Womens and Childrens Hospital in the Al- Muthanna Province of Iraq were used in a descriptive cross – sectional study. Twenty Patients with inherited bleeding disorders, including nine with Von Willebrand illness (VWI) and eleven with hemophilia B, were included in the study. Additionally, a control group of twenty people who appeared to be in good health was enrolled. the controls had no know bleeding disorders, hematological disorders, or long – term systemic illnesses, and they were chosen to reflect the local community.

2.2. Data Collection and Hematological Analysis

Laboratory results and demographic date were collected retrospectively from patients medical records, and complete blood count (CBC) parameters were obtained from routine blood testes.

The hematological indicators that were assessed included the following :

- White blood cell count (WBC; $\times 10^3/\mu L$)
- Red blood cell count (RBC; $\times 10^6/\mu L$)
- Hemoglobin concentration (Hb; g/dL)
- Hematocrit (HCT; %)
- Mean corpuscular volume (MCV; fL)
- MCH, or mean corpuscular hemoglobin (Pg)
- The concentration of mean corpuscular hemoglobin (MCHC ; g \dL)
- Count of Platelets (PLT ; $\times 10^3/\mu L$)

These measures were examined to compare results between individuals with, hemophilia B and VWD, as well as to assess hematological differences between patients with hereditary bleeding disorders and health controls.

2.3. Analysis of Statistical

Version 26.0 of module for Statistical for the Social Science (SPSS) program (IBM Crop., Armonk, NY, USA) was used to conduct the statistical analysis. The mean ± standard deviation (SD) was used to express continuous variables.

The independent – samples t – test was used to evaluate difference between patients and healthy controls. The independent – samples t – test was also used to compare the subgroups with hemophilia B and VWD. The impact of age groups on hematological parameters in the patients population was assessed using one – way analysis of variance (ANOVA).

Statistical significance was defend as P – Value of below 0.05.

3. Results

3.1. Demographic Characteristics of the Study Population

Table 1 Cohort Demographic Distributions

Variable	Sub-category	Patients (N=20)	Controls (N=20)	Total (N=40)
Gender	Male	11	10	21
	Female	9	10	19
Diagnosis	Hemophilia B	11	—	11
	Von Willebrand Disease	9	—	9
Age Structure	Mean Age ± SD (Years)	12.85 ± 6.13	18.90 ± 3.42	15.88 ± 5.76

Twenty patients with hereditary bleeding problems and twenty health controls made up the studys total of forty participants. Eleven patients with hemophilia B and nine patients with Von Will brand disease (VWD) made up the patients group. The potential impact of gender on the primary comparisons was reduced since the proportion of men and female was similar across patients and control. The control groups mean age was 18.90 ± 3.42 years, whereas the patients mean age was 12.85 ± 6.13 years (Table 1)

3.2. Comparison of Hematological Parameters Between Patients and Healthy Controls

The comparison of complete blood count (CBC) parameters between patients and healthy controls is presented in (Table 2). Significant reductions were observed in mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), hematocrite (HCT), and hemoglobin concentration (Hb). among patients compared with controls.

Patients exhibited lower hemoglobin levels (10.70 ± 0.74 g/dL) than controls (12.55 ± 1.88 g/dL) (p = 0.0002). Likewise, hematocrit values were significantly lower in patients (33.94 ± 2.32%) than in controls (37.58 ± 5.78%) (p = 0.0129). Mean corpuscular volume and mean corpuscular hemoglobin were also significantly decreased in patients (67.33 ± 7.75 fL and 19.79 ± 2.18 pg, respectively) compared with controls (82.36 ± 8.66 fL and 27.88 ± 3.03 pg, respectively) (P less than 0.001).

No statistically important variations were detected within patients and controls in respect to be WBC count, RBC count, MCHC, or platelet count (p > 0.05).

Table 2 Comprehensive CBC Parameter Variance Between Patients and Controls

Parameter	Patients (N=20)(Mean ± SD)	Controls (N=20)(Mean ± SD)	t-value	p-value
WBC ($\times 10^3/\mu L$)	6.17 ± 1.58	6.66 ± 2.18	-0.805	0.4260
RBC ($\times 10^6/\mu L$)	4.48 ± 0.93	4.31 ± 0.76	+0.606	0.5483
HB (g/dL)	10.70 ± 0.74	12.55 ± 1.88	-4.085	0.0002
HCT (%)	33.94 ± 2.32	37.58 ± 5.78	-2.608	0.0129
MCV (fL)	67.33 ±7.75	82.36 ± 8.66	-5.783	< 0.001
MCH (pg)	19.79 ± 2.18	27.88 ± 3.03	-9.681	< 0.001
MCHC (g/dL)	29.16 ± 1.91	28.37 ± 3.45	+0.896	0.3759
Platelets ($\times 10^3/\mu L$)	262.85 ± 87.42	271.80 ± 88.14	-0.322	0.7489

3.3. Comparison Between Hemophilia B and von Willebrand Disease Patients

The hematological profiles of patients with Hemophilia B and VWD were compared to evaluate potential disease-related differences (Table : 3). No, statistically considerable variation were noted in WBC count, RBC count, Hb concentration, HCT, MCV, or MCHC between the two patient groups (p > 0.05).

However, significant differences were identified in MCH and platelet count. Patients with Hemophilia B exhibited higher MCH values than VWD patients (20.65 ± 2.32 pg and 18.73 ± 1.52 pg; p = 0.0469). Furthermore, platelet counts were significantly higher in VWD patients (306.56 ± 89.06 $\times 10^3/\mu L$) than in Hemophilia B patients (227.09 ± 71.07 $\times 10^3/\mu L$) (p = 0.0393).

Table 3 Statistical Separation Between Hemophilia B and VWD CBC Profiles

Parameter	Hemophilia N=11 (Mean ± SD)	Von Willebrand Disease N=9 (Mean ± SD)	T - Value	P - Value
WBC ($\times 10^3/\mu L$)	5.88 ± 1.04	6.54 ± 2.08	-0.927	0.3664
RBC ($\times 10^6/\mu L$)	4.15 ± 0.97	4.87 ± 0.75	-1.828	0.0842

HB (g/dL)	10.91 ± 0.78	10.44 ± 0.64	+1.430	0.1699
HCT (%)	33.95 ± 2.39	33.92 ± 2.38	+0.030	0.9763
MCV (fL)	65.90 ± 10.21	69.08 ± 2.49	-0.908	0.3760
MCH (pg)	20.65 ± 2.32	18.73 ± 1.52	+2.133	0.0469
MCHC (g/dL)	29.57 ± 2.19	28.64 ± 1.47	+1.086	0.2919
Platelets ($\times 10^3/\mu L$)	227.09 ± 71.07	306.56 ± 89.06	-2.222	0.0393

3.4. Effect of Gender on Hematological Parameters

The influence of gender on selected hematological parameters within the patient group is shown in Table 4. There were no statistically important variations found between male as well as female patients regarding hemoglobin concentration or platelet count ($p > 0.05$).

Table 4 Patient CBC Profile Categorized by Biological Sex

Parameter	Male Patients N=11 (Mean ± SD)	Female Patients N=9 (Mean ± SD)	T - Value	P - Value
HB (g/dL)	10.91 ± 0.81	10.44 ± 0.60	+1.411	0.1754
Platelets ($\times 10^3/\mu L$)	249.27 ± 108.65	279.44 ± 54.49	-0.751	0.4623

3.5. Effect of Age on Hematological Parameters

Patients were categorized into three age groups (<10 years, 10–16 years, and >16 years) to evaluate the influence of age on selected CBC parameters. One-way ANOVA demonstrated no significant differences among age groups for either hemoglobin concentration or platelet count ($p > 0.05$) (Table 5).

Table 5 Patient CBC Profile Across Stratified Age Groups

Parameter	< 10 Years (N=7)(Mean ± SD)	10–16 Years N=8 (Mean ± SD)	> 16 Years N=5 (Mean ± SD)	F-Value
HB (g/dL)	10.51 ± 0.62	10.73 ± 0.78	10.92 ± 0.99	0.298
Platelets ($\times 10^3/\mu L$)	285.86 ± 74.65	263.75 ± 108.68	229.00 ± 72.82	0.536

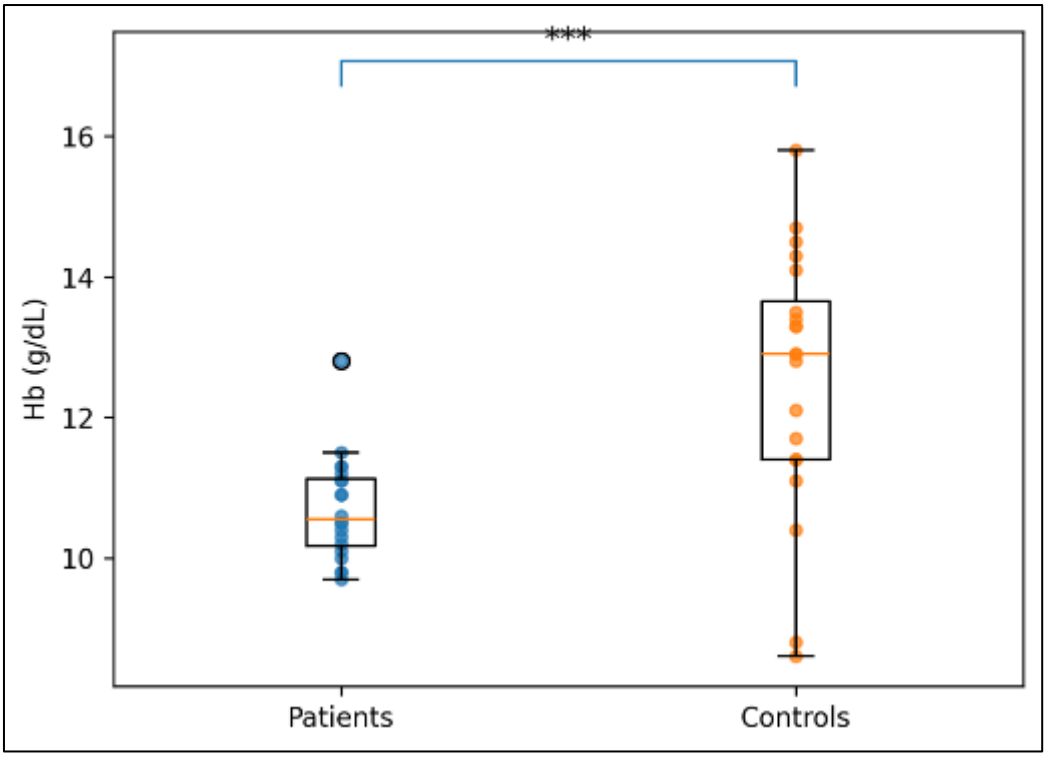


Figure 1 Distribution of hemoglobin concentration (Hb) among patients with inherited bleeding disorders and healthy controls.

Figure 1 illustrates the dispersion of study volunteers based on study and gender group. The proportions of males and females were relatively balanced between patients and controls, with a slight predominance of males within the patient group.

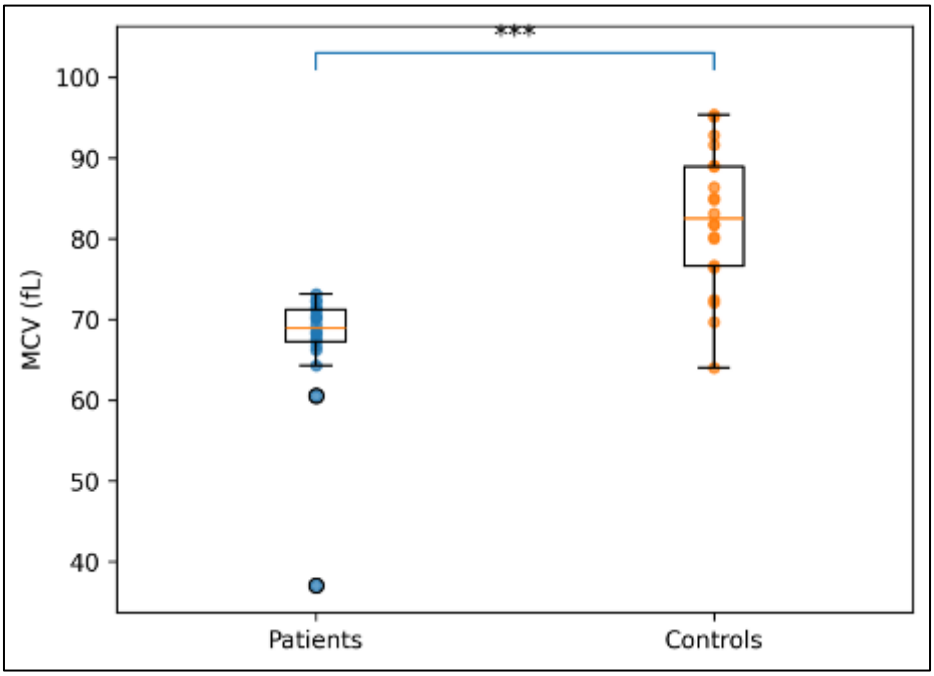
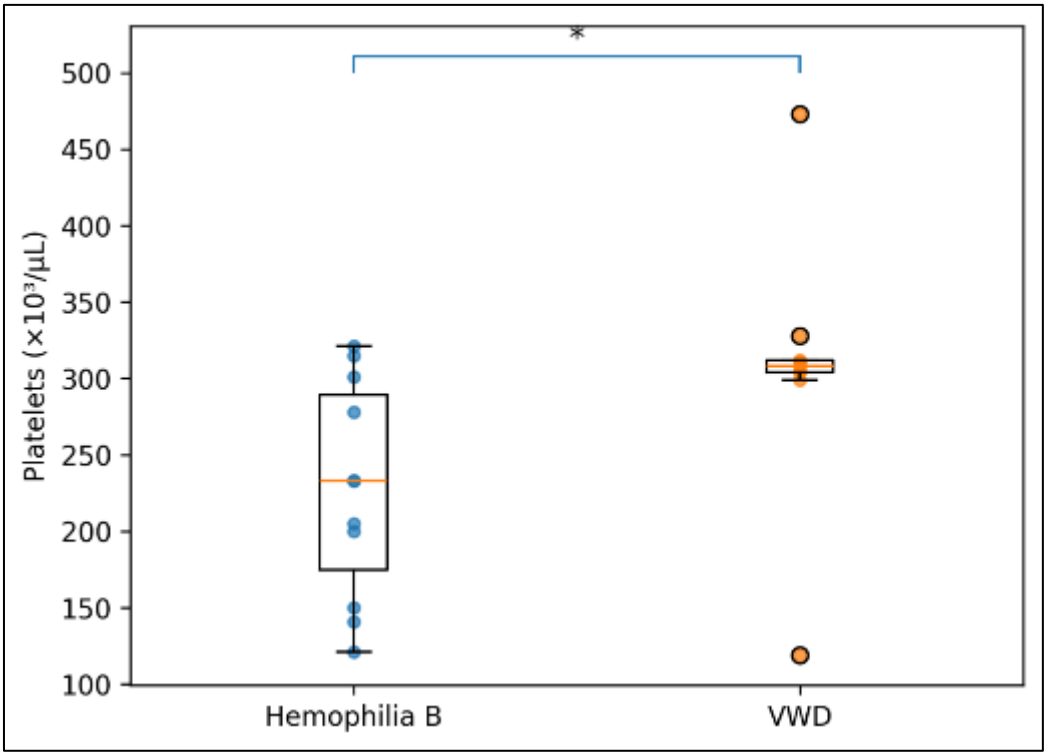


Figure 2 Mean corpuscular volume (MCV) distribution between health controls and Patients with hereditary bleeding disorders.

Hemoglobin levels were consistently lower in patients than in control, as Figer 2 illustrates the patient groups median hemoglobin concentration was lower, and the distribution of results showed little overlap across groups, corroborating the independent samples t-tests finding of a highly significant difference.



Figer 3 Hemophilia B and Von Willbrand disease Patients platelet levels compared.

4. Discussion

The current study assessed demagogical parameters in individuals with hereditary hemorrhagic disorder, such as Von Willebrand disease (VWD) and hemophilia B, and contrasted the results with those of wellness controls While white blood cell count, red blood cell count, mean corpuscular hemoglobin concentration (MCHC), and platelet count did not significantly differ from controls, the results showed significant decreases in hemoglobin concentration, hematocrit, mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH) in patients.

Patients with inherited bleeding disorders showed a marked drop in hematocrit and hemoglobin concentration. Recurrent bleeding episodes, which are frequent clinical signs of both hemophilia B and VWD, may be the cause of these results. Frequent blood loss can eventually result in anima by gradually depleting iron reserves and impairing erythropoiesis (Srivstava et al., 2020).

Confirmed similar findings and highlighted that repeated hemorrhagic events are a significant cause of hematogical abnormalities in patients with inherited coagulation disorders.

Additionally, prolonged mucosal and soft tissue bleeding may negatively impact hemoglobin levels, especially in patients with inadequate therapeutic management, according to Jamas et al., (2024).

Furthermore, compared to health controls, patients MCV and MCH levels were significantly lower, according to the current study. Reduced MCV and MCH are the hallmarks of microcytic hypochromic anima, which is frequently associated with iron deficiency and persistent blood loss Therefore, the reported reduction in certain erythrocyte characteristics may be due to the cumulative effect of many bleeding events. Seidizadeh et al., (2024). Observed similar findings. Suggesting that persistent bleeding in individuals with hereditary bleeding disorders may be the cause ao alterations in red blood cell indices. Furthermore, Connell et al (2021). stressed the need of monitoring hematological parameters in patients with bleeding disorders since prolonged bleeding may increase the risk of iron – deficiency anemia.

The WBC and RBC counts of patients and health controls did not differ significantly. These results imply that rather than leukocyte production or total erythrocyte counts, hereditary bleeding disorders mainly impact the coagulation process Similar findings from earlier research have shown that hematological abnormalities in hemophilia B and VWD are more often linker to hemoglobin concentration and red cell indices than total leukocyte counts (Srivastave et al., 2020 ; James et al., 2024).

Similarly, there was no discernible difference in platelet counts between patients and controls. This finding is in line with the pathophysiology of hemophilia B, where coagulation factor IX deficiency – rather than aberrant platelet production – is the major abnormality. Even though many individuals with hereditary coagulation abnormalities experience bleeding symptoms, prior studies have show that platelet counts are often within normal levels (Mahlangu et al., 2023).

Significant variations in MCH and Platlet counts were found when hemophilia B and VWD patients were compared. Compared to patients with hemophilia B, individuals with VWD had greater platelet counts. Even though both groups platelet counts stayed within physiological ranges, this discrepancy could be the result of different disease processes and compensatory hematological reactions. Since Von Willbrand factor is essential for platelet adhesion and primary hemostasis, variations in VWF may a more direct impact on platelet – related parameters than factor IX deficiency. Seidizadeh et al., (2024) and Platton et al., (2024) have found similar findings on the relationship between VWF anomalies and platelets function.

Age or gender did not significantly affect the patients hemoglobin concentration or platelet count, according to the current study. These results imply that the underlying bleeding problems, rather than demographic variables, were the main cause of the observed hematological changes. Numerous investigation examining hematological traits in individuals with hereditary coagulation problems have revealed similar findings (Connell et al., 2021 ; James et al., 2024).

There are certain limitations to this study even if it offers useful information about hematological changes in Iraq indivuals with hereditary bleeding disorders. The single – center research methodology and rather tiny sample size may restrict how far the result may applied. To further understand the hematological effects of Von Willebrand disease and hemophilia B future multicenter research with bigger patient population and more coagulation biomarkers are advised.

In summary, compared to healthy controls, individuals with hereditary bleeding disorders showed noticeably reduced hemoglobin concentration, hematocrit, MCV, and MCH. Additionally, there were notable differences in platelet counts between patients with hemophilia B and VWD. These results emphasize the significance of regular hematological evaluation in the therapeutic treatment and surveillance of hereditary bleeding disease.

5. Conclusions

When compared to healthy controls, the current investigation showed that individuals with hereditary bleeding problems had notable changes in a number of hematological markers. Patients had substantially reduced hemoglobin concentration, hematocrit, mean corpuscular volume (MCV), and mean corpuscular hemoglobin (MCH), suggesting the existence of hematological abnormalities linked to recurrent bleeding episodes.

White blood cell count, Red blood cell count, mean corpuscular hemoglobin concentration (MCHC) and platelet count did not significantly differ between patients and controls. Additionally, a comparison of individuals with Von Willbrand disease (VWD) and hemophilia B Revealed significant differences in MCH and platelet count, whereas the remaining hematological parameters showed comparable values.

The results of this study emphasize the significance of routine complete blood count (CBC) evaluation in patients with hereditary bleeding disorders, as CBC parameters may offer helpful information about hematological changes linked to the condition. Improved patient evaluation and follow – up may result from routine monitoring.

To validate these results and explore the connection between hematological alteration, disease severity, and other coagulation biomarkers in individuals eith Von Willbrand disease and hemophilia B, further research with bigger sample size and various sites is advised.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest disclosed by the author.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

Funding

This research received no external fund

Availability Of Data

The corresponding author can provide the datasets used and analyzed in this work upon reasonable request.

Limitations

It is important to recognize the limitations of the current investigation. First, because inherited bleeding disease are uncommon in Al – Muthanna Province, the sample size was very small. Second, the results may not be as applicable to other areas because the study was only carried out at one referral facility. Third, iron deficiency anemia could not be directly confirmed since iron status indicators such serum ferritin, transferrin saturation, and serum iron were not assessed. Lastly, the statistical analysis did not account for treatment history or illness severity categorization, which might have an impact on hematological results.

Recognition

The writer would like to sincerely thank the staff of the Hemophilia Center and Al-Hussein Technical Center in Samawah for their assistance in sample collection and laboratory procedures. Appreciation is also extended to the Department of Biology, College of Science, Al-Muthanna University, for providing scientific and administrative support throughout the study.

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