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Correlation of hemoglobin level and platelets count in anemic and non-anemic patients attending Madhesh Institute of Health Sciences (MIHS), Nepal

Uday Kant Jha[1*], Birendra Kumar Jha[2], Rajib Kumar Pandey[3], Amit Kumar Patel[4], Uday Chandra Yadav[5], Soniya Kumari Sah[6], Jyoti Kumari[7], Sweta Yadav[8]

1 Department of Hematology, Faculty of Health Science, Rajarshi Janak University, Nepal.
*Corresponding Author dr.udaykant@gmail.com orcid.org/ 0000-0002-5083-4797
2 Department of Biochemistry, Janaki Medical College, Trihbuvan University, Nepal.
akshatjmc@yahoo.com orcid.org/0000-0003-1549-128X
3 Department of Biochemistry, Faculty of Health Science, Rajarshi Janak University, Nepal.
rajibpnd82@gmail.com orcid.org/0009-0000-8976-5517
4 Department of Pathology, National Medical College and Teaching Hospital, Nepal.
amitkumarpatel01985@gmail.com orcid.org/0000-0002-4541-0252
5 Department of Hematology, Madhesh Institute of Health Science, Janakpurdham, Nepal.
udayhematologist@gmail.com orcid.org/0009-0004-8870-5490
6 School of Health Sciences, Rajarshi Janak University, Nepal.
soniyashah612@gmail.com orcid.org/0009-0001-8586-5024
7 School of Health Sciences, Rajarshi Janak University, Nepal.
jyotisahjnp@gmail.com orcid.org/0009-0000-9412-9347
8 School of Health Sciences, Rajarshi Janak University, Nepal.
Swetay175@gmail.com orcid.org/0009-0000-2839-9429

Abstract

Introduction: *Anemia is a condition characterized by a reduced number of red blood cells or lower levels of hemoglobin. The World Health Organization estimates that 1.62 billion individuals globally are affected by anemia, which represents 24.8 percent of the population, highlighting its significant public health concern in both developing and developed nations. Platelets play a vital role in maintaining homeostasis and are often affected by underlying hematological conditions including anemia. The relationship between anemia and platelet count is complicated and is poorly understood. The study aimed to assess the hemoglobin level and platelets count among patients visiting tertiary level care center of Madhesh Province, Nepal and evaluate their association in anemic and non-anemic patients.*

Methodology: *The hospital based cross-sectional comparative study was conducted among 350 patients visiting tertiary care center to analyze blood samples for hemoglobin level and platelet counts and their correlation was assessed.*

Result: *The mean hemoglobin level was 9.97 ± 1.54 g/dL in anemic individuals and 13.46 ± 1.95 g/dl in non-anemic individuals. Platelet counts were 1.81 ± 0.96 lakhs/µl in anemic and 2.03 ± 0.73 lakhs/µl in non-anemic individuals. Anemia found more prevalence in females (36.85%), underweight (15.14%), and vegetarians (34.28%). In overall patients, a weak positive correlation was observed between hemoglobin and platelet count (r = 0.10, p = 0.047) while a very strong positive correlation was observed among anemic patients(r=0.975, p=0.002).*

Conclusion: *Anemia was found more prevalent in females, underweight and vegetarians as well as a very strong positive correlation between hemoglobin levels and platelets counts were observed among anemic patients.*

Keywords: Anemia, Platelets, Hemoglobin, Madhesh Province, MIHS

1.0 Introduction

Hemoglobin (Hb) is an iron-containing, pigmented molecule present in red blood cells (RBCs) that plays a crucial role in carrying oxygen from the lungs to body tissues and transporting carbon dioxide from the tissues back to the lungs. It is as an iron-containing oxygen transport metalloid-protein present in the red blood cell of all vertebrate (Maton et al., 2003). The production of hemoglobin continues in RBC during its early stages of development from the pro-erythroblast to the reticulocyte in the bone marrow.

The normal hemoglobin concentration ranges from 12 to 18 g/dl in males and 11 to 16 g/dl in females. All blood cells, including red blood cells (RBCs), originate from haemopoietic stem cells located in the bone marrow. Bone marrow is thought to have an impact on the variables that affect all blood cells (Berad & Gurbani, 2016). Anemia is a condition characterized by a reduction in either the number of RBC or Hb levels within those cells, leading to inadequate oxygen-carrying capacity to fulfill the body's physiological requirements. The physiological demands vary depending on factors such as age, gender, height, ethnicity, and various stages of pregnancy (WHO, 2011). According to the World Health Organization (WHO), anemia is defined in adult males as a hemoglobin level below 13 g/dl. For non-pregnant women aged 15 years and older, as well as adolescents aged 12 to 15 years, anemia is diagnosed when hemoglobin levels fall below 12 g/dl. In children aged 5 to 12 years, hemoglobin levels less than 11.5 g/dl indicate anemia. Furthermore, the severity of anemia is classified into three categories for adult males: mild (11–12.9 g/dl), moderate (7–10.9 g/dl), and severe (below 7 g/dl). For non-pregnant females aged 15 years and above, anemia severity is categorized as mild (11–11.9 g/dl), moderate (8-10.9 g/dl), and severe (less than 8 g/dl) (Okeke, 2011).

Globally, iron deficiency remains the leading cause of anemia. However, deficiencies in other essential micronutrients, including vitamin B12, folate, riboflavin, vitamin A, and copper, also significantly contribute to the risk and development of anemia (Kafle et al., 2021). Platelets are small, irregular shaped clear cell fragments which lacks nucleus containing DNA. They are derived from the fragmentation of precursor megakaryocytic (Campbell, 2015). They circulate in the blood of mammals and are involved in homeostasis leading to the formation of blood clot. Platelets are typically about 2 to 4 micrometers in size. The main function of platelets is to help maintain homeostasis. Their normal count usually ranges from 150 to 450 lakhs/µl. They are produced in the bone marrow and are involved in forming platelet plugs, contracting clots, and repairing damaged blood vessels (Jundi et al., 2025). Mature RBCs and platelets display similar physiological patterns and are simultaneously involved in multiple pathological conditions (Kumar et al., 2017). Both RBCs and platelets have a stage in peripheral blood known as reticulocytes for RBCs and reticulated platelets for platelets (Rajagopal et al., 2015).

Previous studies have shown that anemia can lead to either a significantly increased platelet count (thrombocytosis) or a decreased platelet count (thrombocytopenia) (Samanta & Senapati, 2017). However, there is less information on relation between low or high level of Hb on platelet count. This research was aimed to explore the relationship, which might be of great importance

for both physicians and researcher. Patients with anemia often show alterations in their platelet counts, which can influence essential physiological processes such as platelet plug formation, clot retraction, and blood vessel repair. However, in many healthcare settings, particularly in developing countries like Nepal, there is limited understanding of the extent and characteristics of these changes. The principal function of hemoglobin is to carry oxygen from the lungs to the tissues to burn nutrients to release energy and also to carry the resultant carbon-dioxide back to the lungs to be dispensed from the organism (Kansal et al., 2023). This hypoxia induced by anemia increases morbidity and mortality.

2.0 Methodology

The study was comparative cross sectional study, conducted during February to June, 2025 in Madhesh Institute of Health Sciences (MIHS), a tertiary level health care center of capital city of Madhesh Province, Nepal, Patients attending medicine outpatient department were involved in this study. The online sample size calculator (Kohn & Senyak, 2025) gave sample size of 304, however 350 were included in this study. All the patients, visiting medicine departments were eligible to participate in the study, except pregnant women, patients with known hematological disorders (leukemia, thrombocytopenia, or other platelets affecting conditions). Patients having history of recent blood transfusion, on anticoagulant therapy, severe systemic illness or recent infection that can influence platelets count were also excluded. A structured Performa was administered to collect demographic information, dietary habit, smoking and alcohol consumption behaviors. Height and weight were measured with the help of a stadiometer and digital weighing machine, respectively. The hemoglobin level and platelet counts were recorded form the laboratory reports. Data were entered into Excel sheet and transferred to SPSS version 16.0. Mean, standard deviation, frequency and percentage were calculated as descriptive statistics and correlation between hemoglobin and platelet count was observed using Pearson correlation coefficient.

2.0 Results

The general characteristics of 350 patients are presented in Table 1.

Table 1: General characteristics of patients (n=350)

Characteristics	Anemic (184) n (%)	Non-anemic (166) n (%)	Overall (350) n (%)
Gender			
Male	55 (49.5)	56 (50.5)	111 (31.71)
Female	129 (54)	110 (46)	239 (68.28)
Age [Mean ± SD], years	35±22	35±19	35±21
<20	63 (18.0)	43 (12.28)	106 (30.28)
20-30	43 12.28)	54 (15.42)	97 (27.71)
30-40	18 (5.14)	23 (6.57)	41 (11.71)
>40	60 (17.14)	46 (13.14)	106 (30.28)

Among 350 patients enrolled in this study, 111 (31.71%) were male and 239 (68.28%) were female. The overall mean age of the participants was 35±21 years. A total of 106 participants (30.28%) were under 20 years of age, followed by 97 participants (27.71%) aged between 20 and 30 years. Among the 239 female patients, 129 (54%) were diagnosed with anemia and among 111 male 55 (49.5%) were diagnosed as anemic. Thus, the prevalence for anemic female was found higher than that of male, as shown in Table 1. Around one third of patients were of age below 20 years, followed by age of in between 20-30 years (27.71%). 129 (54%) of female patients were diagnosed with anemia, an incidence that showed fairly larger prevalence compared to that of male patients.

Table 2 represents the anthropometric measurements for anemic (n=184), non-anemic (n=166), and overall (n=350) participants. The mean height for anemic patients was observed as 1.58±0.12 m, mean weight of 54.65±10.21 kg and the mean BMI 20.88±3.25 kg/m².

Table 2: Anthropometric parameter of patients (n=350)

Variables	Anemic (184) Mean ± SD	Non-anemic (166) Mean ± SD	Overall (350) Mean ± SD
Height (meter)	1.58±0.06	1.50±0.15	1.56±0.12
Weight (Kg)	54.65±8.47	51±11	52.71±10.21
BMI (Kg/m2)	20.88±3.33	21.66±3.12	21.25±3.25

The distribution of patients on the basis of body mass index (BMI) is shown in Table 3. Majority (63.14%) of patients had normal BMI, followed by 22.85% underweight and 14% over weight. Out of 80 underweight patients, 53(66.2%) were observed anemic

Table 3: Distribution of patients on the basis of BMI (kg/m^2) as per WHO criteria (n=350)

Characteristics	Anemic (184) [n (%)]	Non-anemic (166) [n (%)]	Overall (350) [n (%)]
Underweight (<18.5 kg/m^2)	53 (66.2)	27 (33.8)	80 (22.85)
Normal (18.5-24.9 kg/m^2)	111 (50.2)	110 (49.8)	221 (63.14)
Overweight and Obese (>25 kg/m^2)*	20 (40.8)	29 (59.2)	49 (14.0)

**Overweight (25-29.9) and Obese (30 and above)*

Table 4 presents the distribution of patients on the basis of their Life Style and dietary habits. The overwhelming majority of patients were non-smoker (88.28%) and non-alcoholic (86.85%), showing good health habit. The population of vegetarian and non-vegetarian patients were 45.43% and 57.57% respectively. 102 (64%) of patients having vegetarian dietary habit and 82 (43%) of participants having non-vegetarian dietary habit were found having anemia. The hemoglobin levels and platelet counts of anemic and non-anemic patients are shown in Table 5, The anemic patients had significant lower values of these two parameters compared to non-anemic patients,

Table 4: Life style behaviors and dietary habit of patients (n-350)

Characteristics	Response	Anemic (184) [n (%)]	Non-anemic (166) [n (%)]	Overall (350) [n (%)]
Smoking	Yes	17 (4.85)	24 (6.85)	41 (11.71)
	No	167 (47.41)	142 (40.57)	309 (88.28)
Alcohol Consumption	Yes	19 (5.42)	27 (7.71)	46 (13.14)
	No	165 (47.14)	139 (39.71)	304 (86.85)
Dietary Habit	Vegetarian	102 (64)	57 (36)	159 (45.42)
	Non-Vegetarian	82 (43)	109 (57)	191 (54.57)

The correlation between platelet count and anemia was established using Pearson's correlation method. A very strong positive correlation between hemoglobin and platelet counts is observed in patients, categorized as anemic (r=0.97, p=0.002), however a positive but weak correlation between hemoglobin and platelets counts is seen among all patients (n-350), as shown in Tables 6 and 7.

Table 5: Hematological parameters of patients (n=350).

Variables	Anemic (184) Mean ± SD	Non-anemic (166) Mean ± SD	Overall (350) Mean ± SD
Hemoglobin level (g/dl)	9.97±1.54	13.46±1.95	11.63±3.17
Platelet Count (lakhs/µl)	1.81±0.96	2.03±0.73	1.92±0.87

Table 6: Correlation between hemoglobin level and platelet count among patients (n=350).

Parameters	Hemoglobin level	Platelet count
Hemoglobin level	1	0.105
Platelet count	0.105	1
P value	0.047	

Table 7: Correlation between hemoglobin level and platelet count among anemic patients (n=350)

Parameters	Hemoglobin level	Platelet count
Hemoglobin level	1	0.975
Platelet count	0.975	1
P value	0.002	

4.0 Discussions

The study found that anemic individuals had a mean hemoglobin level of 9.97 ± 1.54 g/dL, while non-anemic individuals had a higher mean of 13.46 ±1.95 g/dl. The corresponding platelet counts were 1.81 ± 0.96 lakhs/µl, for anemic and 2.03 ± 0.73 lakhs/µl for non-anemic participants. The overall correlation coefficient (r = 0.105, p = 0.047) suggests a weak positive correlation between hemoglobin and platelet count. The previous study concluded that individuals with hemoglobin levels below 11g/dl had significantly higher platelet counts than those with hemoglobin levels between 11-14 g/dl (Okoroiwu et al., 2015). Similarly, another study had reported a statistically significant inverse linear relationship between hemoglobin concentration and platelet count indicating that platelet production increases as anemia worsens (Kafle et al., 2021). However, when analyzing the correlation separately among anemic (N = 184) and non-anemic (N = 162) patients, a distinct pattern emerged. Among anemic patients, a very strong positive correlation (r = 0.975) was observed, with a highly significant p= 0.002. This suggests that in individuals with anemia, hemoglobin levels and platelet counts were strongly *interdependent*, potentially due to underlying pathophysiological mechanisms such as bone marrow compensation, iron metabolism, or the body's response to low oxygen levels.

Similarly, among non-anemic patients, a strong positive correlation (r = 0.822) was observed, with a p-value of 0.018. Although this correlation is slightly weaker than in anemic individuals, it still indicates a substantial association between hemoglobin levels and platelet count in individuals without anemia. In consideration to BMI, the study found that 66.2 % of underweight patients were anemic. This suggests a potential link between malnutrition and anemia. In regard to dietary habit, we have found that 64% of vegetarian patients were anemic, whereas only 43% of non-vegetarian patients were found to be anemic. This dietary pattern was significantly associated with an increased risk of anemia and worse anemia-related biomarkers in another study (Paramastri et al., 2001-15). However, smoking and alcohol consumption did not saw significant association with anemia.

5.0 Conclusion

Our study found a weak overall positive correlation between hemoglobin levels and platelet count (r = 0.105, p = 0.047). However anemic individuals showed a very strong positive correlation (r = 0.975, p = 0.002). Additionally, anemia was more prevalent in underweight individuals (66.2%) and vegetarians (64%), suggesting a link with malnutrition and dietary habits.

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