

**Original Article**

# Association between Hemoglobin Concentration and Red Blood Cell Count among Female College Students: A Cross-Sectional Study

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**ABSTRACT:** *Background: Hemoglobin concentration and red blood cell (RBC) count are fundamental hematological parameters that reflect the oxygen-carrying capacity of blood and overall physiological health. Young women are particularly vulnerable to hematological deficiencies due to nutritional demands, menstrual blood loss, and lifestyle factors. Monitoring hematological status among female college students is important for promoting health and academic performance. Objective: To assess hemoglobin concentration and RBC count and determine their relationship among female college students aged 17–24 years. Methods: A cross-sectional study was conducted during the academic year 2024–25 among 162 female students of Shri Shiv Chhatrapati College, Junnar, Maharashtra. Participants were enrolled in the Arts, Commerce, and Science faculties. Blood samples were collected by qualified medical professionals through the Health Department in collaboration with the Sports Department. Descriptive statistics and Spearman's rank correlation analysis were used to evaluate the relationship between hemoglobin concentration and RBC count. Results: The mean hemoglobin concentration was  $11.82 \pm 1.63$  g/dL, while the mean RBC count was  $4.48 \pm 0.54$  million/ $\mu$ L. Spearman's rank correlation revealed a statistically significant positive relationship between hemoglobin concentration and RBC count ( $r = 0.214$ ,  $p = 0.006$ ). Conclusion: Hemoglobin concentration demonstrated a significant positive association with RBC count among female college students. Regular hematological screening and health awareness programs may contribute to improved health outcomes in this population.*

**KEYWORDS:** Hemoglobin, Red Blood Cell Count, Female Students, Hematology, College Health, Cross-Sectional Study.

## 1. INTRODUCTION

Hemoglobin and red blood cells are critical components of the circulatory system and are essential for maintaining adequate oxygen transport throughout the body. Hemoglobin is a protein found within red blood cells that binds oxygen in the lungs and delivers it to tissues and organs. Adequate hemoglobin concentration and normal RBC count are therefore fundamental indicators of physiological health.

Young women formed a target population of vulnerable persons regarding hematological deficits. Various issues impact hemoglobin concentration and red blood cell count, including low iron intake in the diet, loss of blood due to menstruation, increased nutritional needs during adolescence or pregnancy, and lifestyle habits. Decreased hemoglobin concentrations may lead to anemia, a condition associated with fatigue, decreased physical performance, impaired cognitive function and reduced quality of life.

The group of college students is an important target since they are at a critical phase regarding health, because during this period, they are subject to academic demands as well as a change in lifestyle and more independence in food choice. Hematological status in Female College Students as a Synopsis of Health and Need for Preventive measures

Associations between hemoglobin concentration and RBC count have been observed in previous studies. It is biologically logical that these parameters have a positive correlation, as hemoglobin is contained in red blood cells. Nonetheless, this association may be driven differently depending on demographic, nutritional and physiological factors.

The present study was conducted among female students of Shri Shiv Chhatrapati College, Junnar, Maharashtra, during the academic year 2024–25. The study aimed to evaluate hemoglobin concentration and RBC count and determine the relationship between these two important hematological parameters.

## 2. REVIEW OF RELATED LITERATURE

The researcher has reviewed many research articles and found some of them very similar to the current study; a few of them were excluded. Gupta et al. (2012) reported a study among adolescent girls in North India and reported a high prevalence of anemia. The study emphasized that nutritional deficiencies and eating behaviours played an important role in influencing

hemoglobin levels among female adolescents. Regular health care using screening and nutrition education programs was stressed by the researchers.

Toteja et al. Raj A, Sreenivasan TV: Anemia prevalence of adolescent girls in India. (2006) Toteja et al (2006) conducted a study which looked at the Anemia in adolescent girls in India. Their results show that anaemia continues to be a major public health problem in young women. The study advocated earlier identification and intervention strategies to increase hematological health.

Methos: WHO (2011) The world health organization standard preparation for hemoglobin concentration/anaemia characterization. WHO explains that hemoglobin assessment is one of the most valuable tests for determining anemia and overall hematological status in population-based research.

Balarajan et al. Balarajan et al (2011) studied the presence and causes of anemia among populations in low-and middle-income countries, stating that the most common underlying cause of lower hemoglobin levels is iron deficiency. The study found that adolescent and young adult females are one of the most vulnerable populations due to both nutritional and physiological factors.

Kassebaum (2016). Anemia is a component of the Global Burden of Disease and continues to affect many women in the world as 2. The study underscored the need for monitoring hemoglobin concentrations along with other hematological parameters to facilitate better public health interventions.

Kaur and Kaur (2021) studied hemoglobin levels of female college students and reported that a large number were found to have mild to moderate anemia. Nutrition education and health screening programs were essential, according to this study.

Patil et al. In a study conducted by Patil et al. (2023) among female college students of Maharashtra, it was found that dietary iron intake was negatively associated with hemoglobin levels [40]. Periodic health check-ups and nutrition-specific interventions are suggested for female students.

## **2.1. SUMMARY OF LITERATURE REVIEW**

The reviewed studies consistently indicate that anemia and reduced hemoglobin concentration remain common health concerns among adolescent girls and young women. Previous researchers have reported that nutritional status, iron intake, and physiological factors significantly influence hematological parameters. Several studies have also identified a positive relationship between hemoglobin concentration and RBC count. However, limited evidence is available regarding female college students from Junnar and the surrounding semi-urban regions of Maharashtra. Therefore, the present study contributes valuable information regarding the hematological status of female college students and the relationship between age, hemoglobin concentration, and RBC count.

## **3. OBJECTIVES**

1. To assess hemoglobin concentration among female college students.
2. To assess RBC count among female college students.
3. To determine the relationship between hemoglobin concentration and RBC count.

## **4. HYPOTHESIS**

- $H_0$ : There is no significant relationship between hemoglobin concentration and RBC count among female college students.
- $H_1$ : There is a significant relationship between hemoglobin concentration and RBC count among female college students

## **5. METHODOLOGY**

### **5.1. STUDY DESIGN**

A cross-sectional analytical study was conducted among female students of SSC College, Junnar, Maharashtra.

### **5.2. PARTICIPANTS**

The study included 162 female students aged between 17 and 24 years enrolled in undergraduate and postgraduate programs in Arts, Commerce, and Science faculties. Students from First Year undergraduate classes through Master's degree programs were included in the study.

### 5.3. DATA COLLECTION

Blood samples were collected by expert medical professionals under the Maharashtra Government health services following standard clinical procedures. Hemoglobin concentration and red blood cell (RBC) count were assessed using approved laboratory techniques.

### 5.4. VARIABLES

The study examined the following variables:

1. Age (years)
2. Hemoglobin concentration (g/dL)
3. Red blood cell count (million cells/ $\mu$ L)

### 5.5. STATISTICAL ANALYSIS

Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were calculated. Spearman's rank correlation coefficient (rho) was used to determine the relationships among age, hemoglobin concentration, and RBC count. Statistical significance was set at  $p < 0.05$ . Data analysis was performed on 162 valid observations.

## 6. RESULTS

**TABLE 1 Descriptive Statistics**

|                    | N   | Minimum | Maximum | Mean    | Std. Deviation |
|--------------------|-----|---------|---------|---------|----------------|
| Age                | 162 | 17.00   | 24.00   | 19.2778 | 1.33398        |
| Himoglobin         | 162 | 7.20    | 16.20   | 11.8222 | 1.63399        |
| RBC                | 162 | 2.29    | 6.38    | 4.4776  | .54302         |
| Valid N (listwise) | 162 |         |         |         |                |

Table 1 shows the descriptive statistics of the study participants (N=162). The age of the participants ranged from  $19.28 \pm 1.33$  (SD) years. Hemoglobin levels varied between 7.20 and 16.20g/dL, with a mean value of  $11.82 \pm 1.63$ g/DL (SD). The red blood cell (RBC) count ranged from 2.29 to  $6.38 \times 10^6$  / $\mu$ L, with a mean of  $4.48 \pm 0.54 \times 10^6$  / $\mu$ L. The valid number of observations for all variables was 162, indicating that there were no missing data in the dataset. These findings provide an overview of the demographic and hemotological characteristics of the study population.

Interpretation: The study population consisted predominantly of young adults with an average age of approximately 19 years. The mean hemoglobin levels, while the average RBC count remained within the expected physiological range.

**TABLE 2 Spearman's Rank Correlation -2-Tailed**

|                |            |                         | Age   | Himoglobin | RBC    |
|----------------|------------|-------------------------|-------|------------|--------|
| Spearman's rho | Age        | Correlation Coefficient | 1.000 | -.061      | .124   |
|                |            | Sig. (2-tailed)         | .     | .440       | .115   |
|                | Himoglobin | Correlation Coefficient | -.061 | 1.000      | .214** |
|                |            | Sig. (2-tailed)         | .440  | .          | .006   |
|                | RBC        | Correlation Coefficient | .124  | .214**     | 1.000  |
|                |            | Sig. (2-tailed)         | .115  | .006       | .      |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

This table shows the Spearman's rho correlation analysis among Age, Hemoglobin, and RBC count for 162 participants. Correlation between Age and Hemoglobin Correlation coefficient ( $r$ ) = -0.061 p-value = 0.440. There is a very weak negative correlation between age and hemoglobin level. Since the p-value is greater than 0.05, this relationship is not statistically significant. This means that, in this sample, age is not significantly associated with hemoglobin levels.

- Correlation between Age and RBC: Correlation coefficient ( $r_s$ ) = 0.124, p-value = 0.115. There is a weak positive correlation between age and RBC count. However, the p-value is greater than 0.05, so the relationship is not statistically significant. Therefore, age does not show a meaningful association with RBC count in this study.
- Correlation between Hemoglobin and RBC: Correlation coefficient ( $r$ ) = 0.214, p-value = 0.006. There is a weak positive correlation between hemoglobin and RBC count. The p-value is less than 0.01, indicating the relationship is statistically significant at the 1% level. This suggests that higher RBC counts tend to be associated with higher hemoglobin levels.

## 7. CONCLUSION

Age does not have a significant relationship with either hemoglobin or RBC count. Hemoglobin and RBC count show a significant positive correlation, although the strength of the relationship is weak. Spearman's rho correlation analysis revealed a statistically significant weak positive correlation between hemoglobin and RBC count ( $r = 0.214$ ,  $p = 0.006$ ). However, age was not significantly correlated with hemoglobin ( $r = -0.061$ ,  $p = 0.440$ ) or RBC count (SSSSSr = 0.124,  $p = 0.115$ ).

## 8. DISCUSSION

The findings support the biological relationship between hemoglobin concentration and RBC count. The positive correlation observed in the present study is consistent with established hematological principles and previous research. Although the magnitude of the correlation was modest, the statistical significance indicates a meaningful association within the study population. Regular screening can help identify students at risk of hematological deficiencies.

## 9. RECOMMENDATIONS

1. Regular hemoglobin screening should be conducted among female college students.
2. Nutritional awareness programs focusing on iron-rich diets should be organized.
3. Health and fitness interventions may be implemented through college health and sports departments.
4. Further studies with larger samples and additional hematological variables are recommended.

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