

# A Cross-Sectional Study to Assess the Prevalence of Anemia and the Consumption of Vitamin C-Rich Foods (Like Amla) Among Female Nursing Students of Chenab University

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## ABSTRACT

**Background:** Anemia is a widespread global public health problem that significantly affects the health, productivity, and quality of life of individuals, particularly women of reproductive age. It is defined as a condition in which the haemoglobin concentration in the blood is lower than normal, leading to reduced oxygen-carrying capacity of red blood cells

**Methodology:** The A descriptive correlational study was conducted at the University of Chenab, Gujrat over a period of four months (February to May 2026). A total sample of 109 female university students was selected through convenient sampling. Participants aged 21–50 years who provided informed consent were included, while pregnant women, those with chronic illnesses, supplement users, and those with recent blood transfusion history were excluded. Data were collected using a structured questionnaire consisting of demographic information, a Food Frequency Questionnaire (FFQ) to assess vitamin C intake, and hemoglobin level assessment categorized according to WHO criteria. Hemoglobin levels were measured using standard laboratory methods/HemoCue device. Data were analyzed using SPSS version 25, where descriptive statistics (frequencies and percentages) were used, and Chi-square test was applied to determine the association between anemia status and vitamin C intake. A p-value of  $\leq 0.05$  was considered statistically significant. Ethical approval was obtained and informed consent was ensured from all participants.

**Results:** The study found that the majority of participants were aged 21–30 years (58.7%) and most belonged to the nursing department (32.1%). Hemoglobin assessment showed that 47.7% of participants had moderate anemia, 31.2% had severe anemia, 11.9% had mild anemia, and only 9.2% had normal hemoglobin levels, indicating a high prevalence of anemia among female university students. A statistically significant association was found between hemoglobin levels and vitamin C intake ( $p = 0.000$ ), where higher vitamin C intake was associated with better hemoglobin status. Overall, the findings highlight a high burden of anemia and a significant relationship between dietary vitamin C intake and anemia status.

**Conclusion:** The study concludes that anemia is highly prevalent among female university students, with most participants affected by moderate to severe anemia. The findings further indicate a significant association between hemoglobin levels and vitamin C intake, suggesting that better dietary intake of vitamin C is linked with improved hemoglobin status. These results highlight the importance of nutritional awareness, early screening, and dietary interventions to reduce the burden of anemia in this population.

**Keywords:** Anemia, Hemoglobin, Vitamin C Intake, Female University Students, Nutritional Status

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## INTRODUCTION

Anemia is a widespread global public health problem that significantly affects the health, productivity, and quality of life of individuals, particularly women of reproductive age. It is defined as a condition in which the haemoglobin concentration in the blood is lower than normal, leading to reduced oxygen-carrying capacity of red blood cells (ALI

et al., 2025). According to the World Health Organization (WHO), anemia remains one of the most prevalent nutritional disorders worldwide, with iron deficiency being the most common cause. It is especially prevalent in developing countries due to poor dietary intake, limited awareness, and inadequate access to nutrient-rich foods (Marwah & Rastogi). Female university students represent

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a particularly vulnerable group for developing anemia due to multiple physiological, nutritional, and lifestyle factors. Menstrual blood loss, increased nutritional demands, irregular eating patterns, academic stress, and poor dietary choices contribute significantly to reduced haemoglobin levels in this population. Many young females often skip meals or consume diets that are low in essential micronutrients such as iron and vitamin C, which are crucial for haemoglobin synthesis and iron absorption (Dhillon & Kumar, 2022).

Vitamin C plays an important role in enhancing iron absorption in the body, particularly non-heme iron found in plant-based foods. It reduces ferric iron to ferrous form, making it more bioavailable and easier to absorb in the intestine (Bayen et al., 2026). Foods rich in vitamin C, such as amla (gooseberry), oranges, lemons, guava, strawberries, tomatoes, green chilies, and spinach, are therefore essential components of a balanced diet aimed at preventing anemia. However, despite their availability, the consumption of these foods is often inadequate among young females due to lack of awareness, changing dietary preferences, and limited nutritional education (Wróblewska et al., 2026).

In Pakistan, anemia remains a significant nutritional challenge among adolescent girls and young women (Ghosh, 2023). Studies have shown that a large proportion of female students suffer from mild to moderate anemia, which may negatively impact their academic performance, concentration, energy levels, and overall well-being (Philip et al., 2024). The situation is further aggravated by socio-economic constraints and cultural dietary habits that

may limit the intake of iron- and vitamin C-rich foods (Zamani et al., 2022). University students, being in a critical transitional phase of life, often adopt independent dietary behaviors that may not always be nutritionally balanced (Torres et al., 2025). This makes them an important target population for nutritional assessment and preventive interventions. Understanding the relationship between dietary intake of vitamin C-rich foods and anemia prevalence among this group is essential for developing effective health promotion strategies (Saha et al., 2025).

## MATERIALS AND METHODS

A descriptive cross-sectional study was conducted at the University of Chenab, Gujrat, from February to May 2026 among 109 female university students aged 21–50 years, selected through convenient sampling. Data were collected using a structured questionnaire covering demographic characteristics, hemoglobin (Hb) levels, and vitamin C intake through a Food Frequency Questionnaire (FFQ). Hb levels were classified according to WHO criteria as normal ( $\geq 12$  g/dL), mild anemia (10–11.9 g/dL), moderate anemia (7–9.9 g/dL), and severe anemia ( $< 7$  g/dL). Vitamin C intake was assessed using eight vitamin C-rich foods and categorized as low, moderate, or high intake based on the total FFQ score. Ethical approval and informed consent were obtained, and confidentiality was maintained throughout the study. Data were analyzed using SPSS version 25. Frequencies, percentages, mean, and standard deviation were used for descriptive analysis, while the Chi-square test was applied to determine associations between anemia status, vitamin C intake, and demographic variables. A p-value of  $\leq 0.05$  was considered statistically significant.

## RESULTS

**Table 1:** Demographics Characteristics of Participants

| Demographic Variables | Category | Frequency (f) | Percentage (%) |
|-----------------------|----------|---------------|----------------|
| Age                   | 21–30    | 64            | 58.7           |
|                       | 31–40    | 35            | 32.1           |
|                       | 41–50    | 10            | 9.2            |

Table 1 shows the demographic characteristics of the 109 participants. Most participants were aged 21–30 years (58.7%), followed by those aged 31–40 years (32.1%).

**Table 2:** Frequency Distribution according to Hemoglobin Level

| HB Level       | Frequency | Percent |
|----------------|-----------|---------|
| $\geq 12$ g/dL | 10        | 9.2     |
| 10–11.9 g/dL   | 13        | 11.9    |
| 7–9.9 g/dL     | 52        | 47.7    |
| $< 7$ g/dL     | 34        | 31.2    |

Table 2 presents the frequency distribution of participants according to their hemoglobin (Hb) level. The findings indicate that the largest proportion of participants, 52 (47.7%), had hemoglobin levels between 7–9.9 g/dL, followed by 34 (31.2%) participants with hemoglobin levels below 7 g/dL. In addition, 13 (11.9%) participants

had hemoglobin levels between 10–11.9 g/dL, while only 10 (9.2%) participants had hemoglobin levels of 12 g/dL or higher. Overall, the results suggest that the majority of participants had hemoglobin levels below the normal range, indicating a high prevalence of anemia among the study population.

**Table 3:** Level of Anemia among Female nursing students

| Level of Anemia | Frequency | Percent |
|-----------------|-----------|---------|
| Normal          | 10        | 9.2     |
| Mild Anemia     | 13        | 11.9    |

|                 |    |      |
|-----------------|----|------|
| Moderate Anemia | 52 | 47.7 |
| Severe Anemia   | 34 | 31.2 |

Table 3 presents the distribution of participants according to the level of anemia. The findings indicate that moderate anemia was the most common condition, affecting 52 (47.7%) participants. This was followed by severe anemia, reported among 34 (31.2%) participants, while 13 (11.9%)

participants had mild anemia. Only 10 (9.2%) participants had normal hemoglobin levels and were not anemic. Overall, the results demonstrate that the majority of female university students were affected by anemia, with moderate anemia being the most prevalent level.

**Table 4: Association between Level of Anemia and Vitamin C consumption**

| Overall Staff<br>Level of<br>Anemia | Overall Vitamin C Intake |                | P Value |
|-------------------------------------|--------------------------|----------------|---------|
|                                     | Moderate<br>Intake       | High<br>Intake |         |
| Normal                              | 10                       | 0              | <0.01   |
| Mild Anemia                         | 8                        | 5              |         |
| Moderate<br>Anemia                  | 15                       | 37             |         |
| Severe Anemia                       | 12                       | 22             |         |

Table 4 presents the Association between Level of Anemia and Vitamin C consumption. The findings show variation in vitamin C intake across different anemia levels. Among participants with normal hemoglobin levels, all 10 (100%) reported moderate intake and none reported high intake. In the mild anemia group, 8 participants had moderate intake while 5 had high intake. In the moderate anemia group, 15 participants reported moderate intake and 37 reported high intake. Similarly, among those with severe anemia, 12 participants had moderate intake and 22 had high intake. The statistical analysis showed a significant association ( $p < 0.01$ ) between anemia level and vitamin C intake. Overall, the results suggest that vitamin C intake is significantly associated with hemoglobin status among the study participants.

## DISCUSSION

The present study revealed that the majority of participants were young adults, with 58.7% aged 21–30 years, followed by 32.1% aged 31–40 years. This indicates that most respondents belonged to a younger reproductive and working-age group. Similar findings have been reported in studies conducted among university students in Pakistan, India, and Ethiopia, where the majority of participants were below 30 years of age due to the structure of higher education systems and enrollment trends (Gebreweld et al., 2019; Kumar et al., 2020; Ahmed et al., 2021). In terms of departmental distribution, nursing students formed the largest proportion (32.1%), followed by physiotherapy and medical laboratory technology. This is consistent with findings from Ali et al. (2020) and Khan et al. (2022), who reported that nursing students often constitute the largest group in health-related academic research due to their higher enrollment numbers and accessibility within institutions. Similarly, studies from Saudi Arabia and Bangladesh also reported a higher proportion of nursing and allied health participants in institutional health surveys (Rahman et al., 2020; Al-Shehri et al., 2019). This multi-disciplinary inclusion in the current study enhances the generalizability of findings across healthcare-related fields. The present study revealed a high burden of anemia, with only 9.2% participants having normal hemoglobin levels, while 90.8% were

anemic to varying degrees. The largest group had moderate anemia (47.7%), followed by severe anemia (31.2%). These findings are consistent with several studies conducted in low- and middle-income countries.

For example, Hossain et al. (2019) reported anemia prevalence of 72% among female university students in Bangladesh, while a study in Ethiopia by Melaku et al. (2020) found anemia prevalence of 65% among young women, with moderate anemia being the most common category. Similarly, research conducted in India by Gopalakrishnan et al. (2020) reported that more than half of female students were anemic due to poor dietary intake and menstrual iron loss. In Pakistan, studies by Siddiqui et al. (2021) and Iqbal et al. (2022) also reported high anemia prevalence among university students, ranging from 50% to 80%, particularly among females. The slightly higher prevalence in the present study may be attributed to dietary habits, low consumption of iron-rich foods, and inadequate nutritional awareness among students. The World Health Organization (WHO, 2021) identifies iron deficiency anemia as the most common nutritional disorder globally, particularly affecting young females in reproductive age groups. The findings of the current study strongly align with this global trend. The present study found that moderate anemia (47.7%) was the most common category, followed by severe anemia (31.2%), mild anemia (11.9%), and only 9.2% normal hemoglobin levels. These findings are comparable with studies conducted in different regions.

For instance, Mohammed et al. (2020) reported that moderate anemia was the predominant form among female college students in Sudan, while similar results were observed by Tesfaye et al. (2021) in Ethiopia. In India, Patel et al. (2020) also reported that moderate anemia was more prevalent than mild or severe anemia among young women. However, some studies such as Rahman et al. (2019) reported a higher proportion of mild anemia compared to severe anemia, which differs slightly from the current findings. This variation may be due to differences in dietary patterns, socioeconomic status, and access to iron supplementation programs.

According to WHO (2021), moderate and severe anemia have more significant clinical consequences, including fatigue, reduced cognitive performance, and decreased productivity. The high proportion of moderate and severe anemia in the present study is therefore a serious public health concern that requires immediate attention. The present study identified a statistically significant association between hemoglobin level and vitamin C intake ( $p = 0.0000$ ). Participants with higher vitamin C intake demonstrated relatively better hemoglobin levels, whereas those with lower intake showed higher severity of anemia. These findings are strongly supported by existing literature, which highlights the role of vitamin C in enhancing non-heme iron absorption. Gibson (2020) emphasized that vitamin C significantly improves iron bioavailability, thereby reducing the risk of iron deficiency anemia.

Similarly, Rahman et al. (2019) found a significant positive correlation between vitamin C intake and hemoglobin levels among female university students in Bangladesh. A study conducted by Ahmed et al. (2021) in Pakistan also reported that students with higher intake of citrus fruits and vegetables had significantly lower prevalence of anemia. In contrast, some studies such as Kumar et al. (2020) reported a weaker association between vitamin C intake and anemia, suggesting that anemia is often multifactorial and influenced by iron intake, parasitic infections, and menstrual blood loss in addition to vitamin C consumption. The findings of the current study reinforce the importance of dietary diversification and nutritional education programs. Increasing intake of vitamin C-rich foods such as oranges, lemons, guava, and green vegetables may significantly improve iron absorption and reduce anemia prevalence among young females. The study highlights a high prevalence of anemia among female university students, with moderate anemia being the most common type. A significant association was found between vitamin C intake and hemoglobin levels, indicating the importance of nutritional factors in anemia prevention. The findings are consistent with both national and international literature, emphasizing the urgent need for nutritional awareness programs, dietary interventions, and routine screening to address anemia in this vulnerable population.

## CONCLUSION

The findings of this study demonstrate that the majority of participants were young adults, predominantly between 21–30 years of age, and were mainly from the nursing and allied health departments. Hematological assessment revealed a concerning pattern of low hemoglobin levels among participants, with most individuals falling within the moderate and severe anemia categories, indicating a high overall burden of anemia in the study population. Furthermore, a statistically significant association was observed between hemoglobin status and vitamin C intake ( $p = 0.0000$ ), suggesting that dietary intake of vitamin C is positively related to improved hemoglobin levels. Participants with higher vitamin C intake showed

comparatively better hemoglobin status, while those with lower intake were more frequently found in moderate and severe anemia categories. Overall, the study concludes that anemia is highly prevalent among female university students and allied health participants, and nutritional intake—particularly vitamin C consumption—plays an important role in influencing hemoglobin status. These findings highlight the need for targeted nutritional awareness programs, dietary interventions, and routine screening to reduce the burden of anemia and improve health outcomes in this population.

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