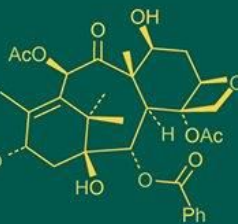
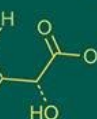


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(12): 865-871
www.biochemjournal.com
Received: 24-09-2024
Accepted: 06-11-2024

KV Sudha

Ph.D. Scholar, Department of Food and Nutrition, College of Community Science, University of Agricultural Sciences, Dharwad, Karnataka, India

Hemalatha S

Professor and Head, Department of Food Processing Technology, College of Community Science, UAS Dharwad, Karnataka, India

Uma N Kulkarni

Professor and Head, Department of Food and Nutrition, College of Community Science, UAS Dharwad, Karnataka, India

Edna Antony

Sr. Scientist, IGFRI, Dharwad, Karnataka, India

Anil Kumar GK

Assistant Professor, Department of Animal Science, College of Agriculture, UAS, Dharwad, Karnataka, India

Corresponding Author:**KV Sudha**

Ph.D. Scholar, Department of Food and Nutrition, College of Community Science, University of Agricultural Sciences, Dharwad, Karnataka, India

A comparative study on knowledge, attitude and practice regarding anaemia in anaemic and non-anaemic young adult girls

KV Sudha, Hemalatha S, Uma N Kulkarni, Edna Antony and Anil Kumar GK

DOI: <https://doi.org/10.33545/26174693.2024.v8.i12Sk.3206>

Abstract

Globally, anaemia is the most widespread and persistent nutritional problem. Especially in developing countries like India, its most common in college going students. This study aimed to assess knowledge, attitude and practices (KAP) towards anaemia among young adult girls. A cross-sectional institution-based study was conducted among 120 undergraduate young adult girl students. Results showed that out of the 120 students, 83 (69.17%) students had normal haemoglobin levels greater than 12 g/dl. 12 students (10%) had mild anaemia with haemoglobin levels between 11 and 11.9 g/dl. And 24 students had moderate anaemia. One student had severe anaemia. There was a significant association between haemoglobin levels of the subjects and KAP. Scores of KAP was higher in non-anaemic group when compared to anaemic group.

Keywords: Iron deficiency anaemia, haemoglobin, knowledge, attitude and practice

Introduction

Iron deficiency anaemia (IDA) is one of the most common nutritional disorders globally. Anaemia is a condition when the number of red blood cells and the oxygen-carrying capacity are insufficient to meet all the body's physiological needs. The World Health Organization (WHO) has estimated that anaemia affects around 56 percent of the global population, with prevalence rates varying from 35 percent to 75 percent across different geographical regions. Among young adults worldwide, anaemia affects approximately 30 percent to 55 percent of individuals. This condition remains a significant public health challenge globally, particularly impacting developing countries like India. Iron deficiency anaemia is especially prevalent among adolescent girls during their growth phases and among college-going populations (Sinha *et al.*, 2012) ^[29].

There are several factors that contribute to anaemia, including dietary iron deficiency, parasitic infestations, infectious diseases such as malaria, deficiencies in essential micronutrients like folate, vitamin B12, and vitamin A, and inherited conditions affecting red blood cells (RBCs) like thalassemia. Young adults, especially females, are increasingly vulnerable to anaemia due to increased iron requirements during puberty, excessive menstrual losses (associated with conditions like polymenorrhea and menorrhagia), inadequate intake of dietary iron (particularly from animal sources) and poor dietary habits (Estima *et al.*, 2009) ^[10]. Iron deficiency resulting in low haemoglobin (Hb) concentrations leads to fatigue, reduced work capacity, impaired cognition, and consequently, poor academic performance among students (Halterman *et al.*, 2001) ^[14]. Changes in lifestyle and behaviour, such as increased consumption of readily available fast foods, inadequate and inappropriate dietary habits, and a sedentary lifestyle, makes individual susceptible to nutritional disorders such as being underweight, obese, and anaemia (Singh *et al.*, 2018) ^[28].

Anaemia is common among women of reproductive age, with young female students being particularly susceptible to developing Iron Deficiency Anemia (IDA) due to demanding schedules and academic stress. These factors often lead to neglecting a healthy lifestyle and poor dietary choices (Ganasegeran *et al.*, 2012) ^[11]. IDA typically results in fatigue and weakness caused by a reduced oxygen supply to the body, which can impair productivity and

hinder academic performance (Soleimani and Abbaszadeh, 2011) [30]. A person suffering from iron deficiency anaemia is at serious danger of cognitive decline and stunted growth, as well as diminished mental and physical abilities, reduced productivity at work, and a diminished life quality in general. Student attention is disrupted, their physical strength, academic performance and productivity are lowered and the danger of infection is increased when students have IDA (Ahmad *et al.*, 2015) [2]. Preventing IDA involves adopting healthier lifestyle habits, especially by incorporating iron-rich foods into the diet (WHO, 2003) [36]. IDA is a common problem in Asia; however, studies are mostly done on pregnant women and children. There is limited data available for female university students (Alzaheb and Al-Amer, 2017) [4]. Therefore, it is crucial to collect information on KAP with regard to IDA among female university students. Nutrition-related KAP studies assess and explore the people's KAP relating to nutrition, diet, foods and closely related hygiene and health issues. The current study aimed to determine the KAP pertaining to anaemia among young adult girls and to know the association between anaemia and KAP.

Materials and Methods

This cross-sectional study was conducted in the year 2024. All the first year undergraduate girl students who were residing in ladies hostel were selected for the study. Permission was obtained from the ethical committee of the University of Agricultural Sciences, Dharwad.

Exclusion criteria: Students with chronic illness and who were on supplements and students who refused to participate in the study.

Inclusion Criteria: Students willing to give informed consent/assent, age between 18 and 21 years, under no history of any medications, students who were willing to give blood sample for estimating haemoglobin and students

staying in hostel were taken for study.

Informed verbal and written consent was obtained from all participants upon explaining the objectives and methodology of the study, ensuring ethics and confidentiality.

For haemoglobin estimation intravenous blood was taken by inserting a needle into a vein in the arm. The blood samples were collected in vacutainer tubes (lavender/ purple colour tubes) by the technician. Blood samples collected were sent to the Neuberger Anand Diagnostics Laboratory for haemoglobin assessment (Sudha *et al.*, 2024) [31].

The World Health Organization (WHO) has classified anaemia into four groups based on haemoglobin levels. These categories are:

- **Normal:** >12 g/dl.
- **Mild:** 11 to 11.9 g/dl.
- **Moderate:** 8.0 to 10.9 g/dl.
- **Severe:** <8.0 g/dl.

Knowledge, attitude and practice of selected students: To assess the knowledge, attitude and practices of anaemic and non-anaemic young adult girls regarding anaemia, a KAP questionnaire containing 36 questions was developed. The available literature was thoroughly reviewed before finalizing the domains of KAP questionnaire and structuring the entire framework. The KAP questionnaire was divided into three major sections namely knowledge, attitude and practices, each of which was further divided into subsections containing varied number of questions. All questions were close ended and were having three options. For every question, all correct answer in knowledge section, a positive attitude in attitude section and a correct practice in practice section was placed under option (a). All incorrect answers, a negative attitude and a wrong practice in knowledge, attitude and practice sections, respectively were placed under option (b), whereas no response for any question in KAP questionnaire regardless of the section it belongs to was placed under option (c).

S. No	Section/subsection	No of questions
A	Knowledge	
A(i)	Anaemia: Heard of anaemia, if yes, definition of anaemia, know subjects haemoglobin level, normal haemoglobin level, signs and symptoms of anaemia and effect /consequences of anaemia.	6
A(ii)	Risk factors: Age as risk factor, regarding vulnerable age group and risk factors (Body mass index, nutritional inadequacy, poor access of health facilities etc)	3
A(iii)	Causes: Inadequate iron intake, factors that hinder iron absorption, factors that help iron absorption and foods which rich in iron,	4
A(iv)	Preventive strategy: government programmes and beneficiaries	3
A(v)	Preventive strategy: individual level (deworming and preventive measures like adequate diet, health and hygiene and iron supplementation)	2
	Sub-total (A)	18
B	Attitude	
B(i)	Perceived severity and perceived susceptibility	2
B(ii)	Diagnosis: perceived importance and self confidence	2
B(iii)	Treatment: perceived benefits, barriers and self confidence	2
B(iv)	Preventative strategy: perceived benefits, importance and self confidence (iron and folic acid supplements, including iron rich food, frequent consumption of junk and unhealthy food, health and hygiene, skipping meals and consumption of tea/coffee just before or after meal)	6
	Sub-total (B)	12
C	Practices	
C(i)	Dietary : Consumption of fermented or germinated foods, tea/coffee/carbonated drinks	2
C(ii)	Hygiene and sanitation: Washing hands, wearing footwear, filter water and using mosquito nets.	4
	Sub-total(C)	6
	Total	36

Scoring

Knowledge Questions: Each knowledge question had 3 options. For each correct answer at option (a), '1' mark was allocated and for both an incorrect answer and a no response, '0' mark was allocated. So the knowledge score of the subjects was the summation correct answers on the knowledge test.

Attitude Questions: For a positive attitude '1' mark was allocated and for both a negative attitude as well as for no response '0' mark was allocated. Thus the attitude score for subjects was the summation of positive attitude in attitude test.

Practices Questions: For a correct practice '1' mark was allocated. A '0' mark was allocated to wrong practice and to no response. So the practice score for subjects was the summation of correct practice in practice test.

Assessment of KAP scores: The overall KAP scores of the subjects were assessed using the sum score of each outcome based on Bloom's cut-off point (60-80%). Having a score above the cut-off point was considered as having high levels of knowledge, positive attitude and good practice. Similarly a score below the cut-off i.e. <60% considered as low level of knowledge, negative attitude and bad practice. Scores for all questions under each components covered were summed and categorized according to Bloom's cut-off.

Assessment of KAP Scores

Scores	Knowledge component	Attitude component	Practice component
80-100%	High level of knowledge	Positive attitude	Good
60-80%	Medium level of knowledge	Neutral attitude	Fair
Less than 60%	Low level of knowledge	Negative attitude	Poor

(Yimer *et al.*, 2014)

Data analysis for association with haemoglobin and knowledge, attitude and practice was done using SPSS software version 17.0

Results and Discussion

The table 1 shows the distribution of young adult girls based on haemoglobin classification among 120 students. Out of the 120 students, 83 (69.17%) students had normal haemoglobin levels greater than 12 g/dl. 12 students (10%) had mild anaemia with haemoglobin levels between 11 and 11.9 g/dl. 24 students (20%) had moderate anaemia. And only one girl had severe anaemia. This distribution highlighted that most young adult girls in the study maintained normal haemoglobin levels, though a significant minority experienced varying degrees of anaemia. Anaemia is a term given to a pathological process in which erythrocyte, haemoglobin, hematocrits, and concentration of red blood cells per unit volume are deranged as compared to the reference values respectively. These values can vary in accordance with age and stage of developmental life, gender, and as a function of hormonal stimulation (Jordao *et al.*, 2009) [17]. Iron deficiency is the most advanced stage of anemia characterized by many features including low hemoglobin levels (Whitney *et al.*, 2011) [34]. A study at King Abdulaziz University in Saudi Arabia found a 26 percent prevalence of anaemia among female university students (Al-Sayes *et al.*, 2011) [3]. Similarly, research at the University of Sharjah reported an anaemia prevalence of 26.7 percent among female students (Sultan, 2007) [32]. Another study at the University of Peshawar in Pakistan revealed a 23.9 percent prevalence of anaemia among non-pregnant women (Khan *et al.*, 2018) [18]. Pandey and Singh (2013) [22] also reported 30.20 percent of college students were anaemic.

Among these 120 girls, 37 were in anaemic category. Hence, for further study 35 anaemic and 35 non anaemic girls were taken for studying the knowledge, attitude and practice regarding anaemia. Table 2 presented the data on the association between haemoglobin levels and knowledge, attitude, and practices among anaemic and non-anaemic young adult girls. A significant association was observed between haemoglobin and knowledge levels. Among the

anaemic girls, 2 (2.9%) had high-level knowledge, 29 (41.4%) showed moderate-level knowledge and 4 (5.7%) had low-level knowledge regarding anaemia. Conversely, among the non-anaemic girls, knowledge level was high in 20 (28.6%) girls, 15 (21.4%) had moderate-level knowledge and none had low-level knowledge. In both anaemic and non-anaemic girls, majority of them knew about the anaemia. But the subjects did not know their haemoglobin levels and did not have knowledge about the normal haemoglobin level. Most of the girls had the knowledge of the signs and symptoms, risk factors and causes of anaemia. Most of them did not have the knowledge about the iron enhancing and inhibiting factors. However, the knowledge regarding the anaemia was more in non-anaemic students.

Attitudes towards anaemia play a crucial role in its management and prevention which may vary widely based on knowledge, awareness, cultural context and personal experience with the condition. In the present study, there was a significant association between haemoglobin levels of the subjects and attitude. Among the anaemic participants, 12 (17.1%) exhibited a positive attitude, 18 (25.7%) had a neutral attitude, and 5 (7.1%) had a negative attitude. In contrast, 18 (25.7%) of the non-anaemic participants had a positive attitude, 17 (24.3%) had a neutral attitude, and none had a negative attitude. The total showed 30 (42.9%) with a positive attitude, 35 (50%) with a neutral attitude and 5 (7.1%) with a negative attitude. In both anaemic and non-anaemic girls, most of them answered that they are not anaemic and are not confident to identify anaemia just through physical examination. Most of the young adult girls responded that it is not bad to take tea/coffee just before or after meal. Positive attitude with respect to anaemia was more in non-anaemic students.

A significant association was found between haemoglobin levels and practice. Among the anaemic participants, 14 (20%) had good practices and 21 (30%) had fair practices and none displaying poor practices. Among the non-anaemic participants, 26 (37.1%) had good practices and 9 (12.9%) had fair practices and none showing poor practices. Most of the girls responded that they consume tea/coffee/carbonated drinks just after the meals. Majority of the girls don't use mosquito nets to protect themselves from flies/mosquitoes.

Good practices with respect to the anaemia were more in non-anaemic students.

This data highlighted the significant associations between haemoglobin levels and the knowledge, attitude, and practices among young adult girls that showed higher haemoglobin levels were associated with higher knowledge, more positive attitudes and better practices.

In this study, only young adult girls who were staying in the hostel were included. Hence, the food frequency was same for them. Details were taken from the hostel. A nutritious breakfast comprise of carbohydrates, proteins, fats, fibre, vitamins, and minerals, particularly iron and vitamin C, crucial for sustained energy release. It was observed that skipping breakfast was prevalent among hostel students in various studies. Reasons cited for skipping breakfast were late awakening, lack of morning hunger or dissatisfaction with the available food options. Skipping meals and having an imbalanced diet is common among college students, as observed in Bangladesh, and this may contribute to IDA. Many studies revealed a higher prevalence of anaemia among those skipping meals (Shill *et al.*, 2014) [26]. The lack of fruit and vegetable intake in the diet is considered a contributing factor to poor health status, as noted in studies such as Moy *et al.* (2009) [21].

Frequency of purchase of snacks largely depends on the socio-economic conditions potentially leading to skip the meals in hostel. Poor eating habits, including meal skipping, frequent snacking, and consumption of fast food, are significant public health concerns among university students. These behaviours predispose them to dietary deficiencies, as highlighted by Kurubaran *et al.* (2012) [19]. Fast food is often preferred by students due to its appealing flavour, aroma, and taste, as noted in studies such as Aziz *et al.* (2017) [6].

The mean daily iron loss through menstruation over a 28-day cycle averages about 0.56 mg/day (Chandra *et al.*, 2017) [9]. Despite simple diagnosis, anaemia often goes unrecognized for prolonged period due to its nonspecific clinical symptoms and insufficient testing. Anaemia is linked with reduced work capacity and enduring impacts on learning, cognitive function, attention, behaviour and growth. Early detection of the disease and its contributing factors is crucial step towards effective management (Sam *et al.*, 2017) [24].

In the hostel, tea or coffee is served twice a day i.e immediately after breakfast and after snacks. As a result, students typically consume tea or coffee right after these meals and snacks. This shows the lack of knowledge regarding inhibitory factors such polyphenols and tannins present in tea/coffee. Patimah *et al.* (2016) [23] concluded that poor dietary knowledge has been linked to iron deficiency anaemia (IDA). Additionally, it has been observed that consuming tea with meals can hinder iron absorption in the body, potentially contributing to lower haemoglobin levels (Appanah *et al.* 2009) [5]. Taking tea or coffee during or after meal decreases iron absorption and can lead to IDA. Tea consumption of >4 cups per day was related to a higher IDA prevalence, mainly due to the presence of iron absorption inhibitors (polyphenols and calcium) (Sung *et al.*, 2018) [33].

Hamed (2020) [15] conducted study in Medical Clinics at Students' University Hospital using a purposive non-probability sample of 370 college females. Data collection involved self-administered questionnaires covering

knowledge, attitudes, health-seeking behaviour, and nutritional practices related to anaemia. The study revealed that most participants had incorrect knowledge about iron nutrition and anaemia, as well as incorrect practices (94.1%, 65%, and 87.8%, respectively). Only a small minority had a positive attitude towards anemia (13.8%), while more than half displayed a neutral attitude (58.6%). It was recommended to have educational program for anaemic university females. Huong *et al.* (2022) [16] assessed the knowledge, attitude, practices (KAP), and health-seeking behavior (HSB) towards anaemia among 180 undergraduate female students at a Malaysian medical university. Data from an online questionnaire revealed that 60 percent of participants had appropriate knowledge and a positive attitude towards anaemia, but 52.9 percent consumed fewer iron-rich foods, 81.7 percent skipped meals, and many showed poor nutritional status and practices. A significant relationship was found between knowledge and both attitude and practice. Despite good knowledge, most students lacked positive attitudes and practices, making them prone to IDA, which impacted their health-seeking behaviour. Sudha *et al.* (2024) [31] reported that the majority of anaemic college students were underweight due to the inadequate iron consumption. And there was significant association between the anaemia and body mass index.

A cross-sectional study using a convenient sampling technique was conducted on 150 girls aged 20-21 years (Shahzad *et al.*, 2017) [25]. A standardized KAP questionnaire from FAO Guidelines on iron deficiency anaemia and Hb levels were determined. Results showed 19.3 percent had mild, 51.3 percent had moderate, and 13.3 percent had severe anaemia, with only 16 percent having normal Hb levels. Although 54 percent had good knowledge, the Pearson correlation with Hb levels was low. Despite 79 percent having a positive attitude, the correlation was inversely related. A significant positive correlation was found between dietary practices and Hb levels. The study highlighted the increasing trend of iron deficiency anaemia among young girls, related to lifestyle and dietary habits and recommended a study with a representative sample. Female students enrolled in higher education could be more susceptible to IDA because they prioritise academic activities than consuming adequate diets. Insufficient knowledge, attitude, and practices (KAP) on IDA prevention can be classified as risk factors because they invigorate poor dietary habits and negligence in prevention activities. Poor dietary habits, such as skipping meals and eating fast food, are considered a public health concern among university students, making them vulnerable to nutritional deficiencies (Ganasegeran *et al.*, 2012) [11].

This study found that young adult girls with good knowledge of anaemia were more likely to have better anaemia status compared to those with poor knowledge, showing a significant protective effect of knowledge against anaemia. This suggests that a better knowledge level may mitigate anaemia risk. A higher level of knowledge corresponds to a better attitude and vice versa. Good knowledge and change in attitude can help achieve the necessary shift in behaviour towards healthy foods to prevent IDA (Shahzad *et al.*, 2017) [25]. Knowledge on IDA has significant relationship with practice on prevention of anaemia (Ghimire *et al.*, 2013) [12]. A study in Putrajaya, which observed that a high level of knowledge reflected a positive attitude towards anaemia (Adznam *et al.*, 2018) [1].

Benfo *et al.* (2023) ^[7] revealed that the majority of Ghanaian students were aware of anaemia and its prevention in theory, but they did not translate the knowledge into practical dietary habits that could improve anaemia status. Malay *et al.* (2018) ^[20] conducted a cross-sectional study on 100 students at Saveetha University in Chennai and discovered that their fundamental understanding of anaemia and haemoglobin is adequate but they lack expertise in clinical criteria such as anaemia diagnosis and therapy. Inappropriate and lack of knowledge and indifferent attitude regarding healthy eating among females and consequent unhealthy eating behaviour result in deterioration of their anaemic state. That behaviour required intense modification. Achieving the desired changes in health and nutrition behaviour depends on gaining sufficient knowledge, proper attitudes, healthy practice, and adequate self-efficacy (Ghosh *et al.*, 2020) ^[13]. Hence, knowledge as a modifiable risk factor that crucially links to anaemia prevention should be highlighted and enhanced through targeted health education and interventions.

Based on the discussion above, it is imperative to strengthen students' dietary knowledge and reinforce good food-based prevention practices against IDA. The synergistic effect of improved knowledge and attitude are more likely to prompt practices against IDA. A recent study by Singh *et al.* (2019) ^[27] noticed a statistically significant change in KAP among Delhi adolescent girls before and after providing health education. Researchers suggest that achieving the desired change of behaviour towards nutrition and health depends on gaining sufficient knowledge, changing attitude, and developing acceptable practices related to health and nutrition. Health authorities can adopt proactive measures to address anaemia among university females both at the individual and community levels. This includes educating women about anaemia, its causes, and its health implications. Additionally, integrating nutritional training for healthcare professionals, such as physicians, nurses, and nutritionists, can play a pivotal role in achieving this goal (Bilkis, 2015) ^[8].

Table 1: Distribution of young adults (girls) based on haemoglobin classification.

Haemoglobin level (g/dl)	Number of students (n = 120)
Normal (>12)	83 (69.17%)
Mild (11 -11.9)	12 (10 %)
Moderate (8.0 - 10.9)	24 (20 %)
Severe (<8.0)	1 (0.83 %)
Total	120

Values in parentheses indicate percentage.

Table 2: Association between haemoglobin and knowledge, attitude and practices in anaemic young adult girls

Characters	Anaemic	Non-anaemic	Total	Chi square
Knowledge				23.182**
High level	2 (2.9)	20 (28.6)	22 (31.4)	
Moderate level	29 (41.4)	15 (21.4)	44 (62.9)	
Low level	4 (5.7)	0 (0)	4 (5.7)	
Total	35 (50)	35 (50)	70 (100)	
Attitude				6.229*
Positive attitude	12 (17.1)	18 (25.7)	30 (42.9)	
Neutral attitude	18 (25.7)	17 (24.3)	35 (50)	
Negative attitude	5 (7.1)	0 (0)	5 (7.1)	
Total	35 (50)	35 (50)	70 (100)	
Practice				8.40**
Good	14 (20)	26 (37.1)	40 (57.1)	
Fair	21 (30)	9 (12.9)	30 (42.9)	
Poor	0 (0)	0 (0)	0 (0)	
Total	35 (50)	35 (50)	70 (100)	

** Significant at $p \leq 0.01$

* Significant at $p \leq 0.05$

Values in parentheses indicate percentage.

Conclusion

The non - anaemic young adult girl students had higher level of knowledge; positive attitude and good practice towards preventing anaemia. This study highlighted that anaemic young adult girl students are prone to IDA due to a lack of KAP and thus recommends intervention programmes through educational institutions to improve KAP and take preventive measures against the risk factors of IDA in this population. Furthermore, a more homogenous and larger sample size may have been able to reveal clearer and more immediate differences. To address iron deficiency anaemia (IDA) among girls, food-based strategies should be prioritized. These strategies can include consumer education aimed at diversifying diets to include iron-rich foods and fruits containing Vitamin C, which enhances iron absorption. Also emphasizing specific issues such as iron hindering factors present in foods and the benefits of iron enhancers like Vitamin C. Addressing physiological, socioeconomic, and behavioural factors is crucial. It's essential to promote comprehensive nutritional knowledge about anaemia by making nutritional education sessions mandatory. Thus, improving KAP towards anaemia among the students is necessary to garner awareness on the prevention of IDA.

Acknowledgement

We thank the PG (Dean) and members of the ethics committee for giving permission to conduct this study. We also acknowledge the full cooperation and participation of the first year undergraduate girl students UAS Dharwad.

Conflict of Interest

All authors declare that they have no conflicts of interest.

References

- Adznam SH, Sedek R, Kasim MZ. Assessment of knowledge, attitude, and practice levels regarding anaemia among pregnant women in Putrajaya, Malaysia. *Pakistan Journal of Nutrition*. 2018;17(11):578-585.
- Ahmad MM, Dardas LA, Ahmad H. Cancer prevention and care: A national sample from Jordan. *Journal of Cancer Education*. 2015;30(2):301-311.
- Al-Sayes F, Gari M, Qusti S, Bagatian N, Abuzenadah A. Prevalence of iron deficiency and iron deficiency anemia among females at university stage. *Journal of Medical Laboratory and Diagnosis*. 2011;2(1):5-11. Available from: <http://www.academicjournals.org/JMLD>
- Alzaheb RA, Al-Amer O. The prevalence of iron deficiency anemia and its associated risk factors among a sample of female university students in Tabuk, Saudi Arabia. *Clinical Medicine Insights: Women's Health*. 2017;10:1179562X17745088.
- Appanah TP, Ooogarah PB, Ruggoo A. Awareness and consumption of iron among Mauritian female factory workers. *Nutrition & Food Science*. 2009;39(2):168-175.
- Aziz F, Ali MM, Jabeen F. Prevalence of overweight and obesity among young female students in association with BMI. *RADS Journal of Biological Research and Applied Sciences*. 2017;8(1):1-4.
- Benfo A, et al. Exploring the perspective of young adults about anemia prevention; The contributions of knowledge about at-risk groups and consequences of anemia. *BMC Public Health*. 2023;23:NA.
- Bilkis S. Girls' education and empowerment: Impact of secondary level schooling on rural women's lives in Bangladesh [dissertation]. Dhaka: The University of Dhaka; 2015.
- Chandra S, Gupta N, Patel SK. Study of iron status indicators in different phases of menstrual cycle in first-year medical college females. *International Journal of Research in Medical Sciences*. 2017;5:46-49.
- Estima C de CP, Costa RS da, Sichieri R, Pereira RA, Veiga GV da. Meal consumption patterns and anthropometric measurements in adolescents from a low socioeconomic neighborhood in the metropolitan area of Rio de Janeiro, Brazil. *Appetite*. 2009;52(4):735-739.
- Ganasegeran K, Al-Dubai SA, Qureshi AM, Al-Abed AAA, Rizal AM, Aljunid SM. Social and psychological factors affecting eating habits among university students in a Malaysian medical school: A cross-sectional study. *Nutrition Journal*. 2012;11(1):1-7.
- Ghimire N, Pandey N. Knowledge and practice of mothers regarding the prevention of anaemia during pregnancy, in teaching hospital, Kathmandu. *Journal of Chitwan Medical College*. 2013;3(5):14-17.
- Ghosh S, Kabir MR, Alam MR, Chowdhury AI, Al Mamun MA. Balanced diet-related knowledge, attitude, and practices (KAP) among adolescent school girls in Noakhali district, Bangladesh: A cross-sectional study. *International Journal of Adolescence Medicine and Health*. 2020;1(ahead-of-print). Available from: <https://doi.org/10.1515/ijamh-2020-0106>.
- Halterman JS, Kaczorowski JM, Aligne CA, Auinger P, Szilagyi PG. Iron deficiency and cognitive achievement among school-aged children and adolescents in the United States. *Pediatrics*. 2001;107(6):1381-1386.
- Hamed LA. Knowledge, attitudes, and nutrition practices of anemic college females. *Evidence-Based Nursing Research*. 2020;2(4):1-11.
- Huong C, Chua JL, Ng RY, Panse DK, Misra S, Sumera A. Knowledge, attitude and practices (KAP) towards anaemia among female university students in Malaysia: A cross-sectional survey. *Malaysian Journal of Nutrition*. 2022;28(2):203-215.
- Jordao RE, Bernardi JL, Barros Filho ADA. Prevalence of iron deficiency anemia in Brazil: A systematic review. *Revista Paulista de Pediatria*. 2009;27(1):90-98.
- Khan T, Khan ZA, Kochhar S, Singh B, Goyal GL, Sharma R. Unfeasible body mass index and its association with low haemoglobin concentration: A correlation study among undergraduate medical students. *International Journal of Research in Medical Sciences*. 2018;6(12):4002-4007. Available from: <https://doi.org/10.18203/2320-6012.ijrms20184898>.
- Kurubaran G, Sami AR, Ahmed MQ, Al-Abed AA. Social and psychological factors affecting eating habits among university students in a Malaysian medical school: A cross-sectional study. *Nutrition Journal*. 2012;11:48.
- Malay KK, Duraisamy R, Brundha MP, Kumar MP. Awareness regarding anemia among 1st-year dental undergraduate students. *Drug Invention Today*. 2018;10(8):NA.
- Moy FM, Johari S, Ismail Y, Mahad R, Tie FH, Wan Ismail WMA. Breakfast skipping and its associated factors among undergraduates in a public university in Kuala Lumpur. *Malaysian Journal of Nutrition*. 2009;15(2):165-174.
- Pandey S, Singh A. A cross-sectional study of nutritional anemia among medical students in a medical college at Bilaspur, Chhattisgarh. *National Journal of Medical Research*. 2013;3(2):143-146.
- Patimah S, Royani I, Mursaha A, Thaha AR. Knowledge, attitude and practice of balanced diet and correlation with hypochromic microcytic anemia among adolescent school girls in Maros district, South Sulawesi, Indonesia. *Biomedical Research*. 2016;27:NA. Available from: <http://www.alliedacademies.org/abstract/knowledge-attitudeand-practice-of-balanced-dietand-correlation-with-hypochromicmicrocytic-anemiaamong-adolescent-school-girls--3737.html>.
- Sam SM, Udaykumar P. Does knowledge and increased awareness among our female postgraduate medical students contribute to improve their hemoglobin levels? *Asian Journal of Pharmaceutical and Clinical Research*. 2017;10(1):347-350.
- Shahzad S, Islam K, Azhar S, Fiza S, Ahmed W, Murtaza Z. Impact of knowledge, attitude and practice on iron deficiency anemia status among females of reproductive age group (20-21 years old) studying in Government Home Economics College Lahore, Pakistan. *International Archives of BioMedical and Clinical Research*. 2017;3(4):31-36.

26. Shill KB, Karmakar P, Kibria MG, Das A, Rahman MA, Hossain MS, et al. Prevalence of iron-deficiency anaemia among university students in Noakhali Region, Bangladesh. *Journal of Health, Population and Nutrition*. 2014;32(1):103-110.
27. Singh M, Honnakamble RA, Rajoura OP. Knowledge, attitude and practice change about anemia after intensive health education among adolescent school girls of Delhi: An intervention study. *International Journal of Medicine and Public Health*. 2019;9(3):71-73.
28. Singh V, Pandey PT, Haider J. Study of gender correlation with weight, height and BMI on haemoglobin. *International Journal of Physiology*. 2018;6(4):143-147.
29. Sinha AK, Karki GM, Karna KK. Prevalence of anemia amongst adolescents in Biratnagar, Morang district, Nepal. *International Journal of Pharmacy and Biological Archives*. 2012;3:1077-1081.
30. Soleimani N, Abbaszadeh N. Relationship between anaemia, caused from the iron deficiency, and academic achievement among third grade high school female students. *Procedia - Social and Behavioral Sciences*. 2011;29:1877-1884.
31. Sudha KV, Hemalatha S, Kulkarni UN, Antony E, Kumar AGK. Prevalence and association of haemoglobin and body mass index of young adult girls - A cross-sectional institutional study. *Biological Forum - An International Journal*. 2024;16(7):17-21.
32. Sultan AH. Anemia among female college students attending the University of Sharjah, UAE: Prevalence and classification. *Journal of the Egyptian Public Health Association*. 2007;82(3-4):261-271. PMID: 18410711.
33. Sung ES, Choi CK, Kim NR, Kim SA, Shin MH. Association of coffee and tea with ferritin: Data from the Korean National Health and Nutrition Examination Survey (IV and V). *Chonnam Medical Journal*. 2018;54(3):178-183.
34. Whitney EN, Rolfes SR, Crowe T, Cameron-Smith D, Walsh A. *Understanding Nutrition*. Cengage Learning; 2011.
35. World Health Organization. *Prevention of iron deficiency anemia in adolescents: A role of weekly iron and folic acid supplementation*. Geneva: WHO; 2011.
36. World Health Organization. *Technical Report Series*. Geneva: WHO; 2003. Report No.: 789.
37. Yimer M, Abera B, Mulu W, Bezabih B. Knowledge, attitude and practices of high-risk populations on louse-borne relapsing fever in Bahir Dar city, north-west Ethiopia. *Science Journal of Public Health*. 2014;2(1):15-22.