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Association between knowledge, attitude, and behavior on nutritional anemia among female undergraduate students: a cross-sectional study

Hubungan antara pengetahuan, sikap, dan perilaku dengan anemia gizi pada mahasiswi: sebuah studi cross-sectional

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Abstract

Anemia is a common health issue among adolescent girls, including female students. Adolescents tend to experience various behavioral changes that affect their health, including anemia. Good health behaviors are shaped by positive attitudes and knowledge. This study aimed to analyze the relationship between knowledge, attitude, and behavior related to nutritional anemia and the incidence of anemia among female undergraduate students at the Jember Regency. This observational study used a cross-sectional design. This study was conducted between February and May 2024 at the University of Jember. The sample consisted of 109 respondents, selected through multistage sampling. Data were collected through questionnaires, anthropometric measurements, and hemoglobin levels using point-of-care testing (POCT) blood tests. Data analysis was performed using the chi-squared test. Significant relationships were found between behaviors related to anemia and anemia (p=0,009; PR= 1,58), knowledge of anemia and anemia (p=0,013; PR= 1,45), and attitudes toward anemia and anemia (p=0,013; PR= 1,52). These findings indicate that behavior, knowledge, and attitudes related to anemia are associated with the incidence of anemia. We expected adolescents to be more proactive in preventing anemia and in seeking more information about it. Educational institutions should integrate anemia prevention education (nutrition, importance of iron supplements, and healthy eating patterns) into campus curricula. Moreover, they provide iron-rich foods and vitamin C source meals for faculty canteens.

Keywords: anemia, female student, knowledge, attitude, behaviour, dietary habit

Abstrak

Anemia merupakan salah satu masalah kesehatan yang rentan dialami oleh remaja putri, termasuk mahasiswi. Remaja cenderung mengalami perubahan ragam perilaku yang mempengaruhi masalah kesehatannya termasuk anemia. Perilaku kesehatan yang baik terbentuk oleh sikap yang positif dan pengetahuan yang baik. Tujuan dari penelitian ini untuk menganalisis hubungan pengetahuan, sikap dan perilaku terkait anemia dengan kejadian anemia pada mahasiswi Universitas Jember. Penelitian observasional ini menggunakan pendekatan *cross-sectional*. Penelitian dilakukan Februari hingga Mei 2024 di Universitas Jember. Sampel didapatkan 109 responden dengan teknik *multistage sampling.* Pengambilan data melalui pengisian kuesioner oleh responden, pengukuran antropometri, dan pemeriksaan kadar hemoglobin. Analisis data menggunakan uji *Chi-Square.* Hasil penelitian menyatakan bahwa terdapat hubungan antara pengetahuan, sikap dan perilaku terkait anemia dengan kejadian anemia dengan *p-value* masing-masing (p= 0,031), (p= 0,013) dan (p=0,009). perilaku, pengetahuan, dan sikap terkait anemia berhubungan dengan kejadian anemia. Diharapkan remaja dapat lebih aktif lagi dalam melakukan upaya pecegahan anemia serta mencari informasi lebih mengenai anemia.

Kata Kunci: Anemia, mahasiswi, pengetahuan, sikap, perilaku, kebiasaan makan

Introduction

Anemia, characterized by reduced hemoglobin (Hb) levels or red blood cell (RBC) counts, impairs the body's ability to meet oxygen transport needs, leading to adverse health outcomes such as fatigue, cognitive decline, and reduced productivity (Chaparro & Suchdev, 2019). While the physiological and nutritional causes of anemia are well documented, there is growing recognition that knowledge, attitudes, and behaviors play a role in influencing its prevalence. Adolescents, particularly females, are at heightened risk due to menstruation, dietary restrictions influenced by societal pressures, and increased nutritional demands during rapid growth phases (Indonesian Ministry of Health, 2018; Utami et al., 2022).

Despite various government interventions such as iron supplementation programs and nutritional education, the prevalence of anemia among Indonesian adolescents, based on the 2023 Indonesian Health Survey (IHS), was 15,5% in 2023. In detail, the prevalence of anemia among female adolescents in this age group is 18%, while among male adolescents it is 14,4% (Kementerian Kesehatan Republik Indonesia, 2024). However, these efforts largely targeted high school students, leaving a significant gap in addressing anemia among university students. Female undergraduates face unique challenges such as demanding academic schedules and limited access to nutritious meals, often resorting to unhealthy dietary practices (Asiffa & Umaysaroh, 2020; Yani et al., 2023). This gap is particularly concerning as this demographic is at a critical stage of life where anemia could have long-term consequences on health and future pregnancies (Aulia & Noor Yuliati, 2018).

Existing literature highlights the importance of addressing knowledge, attitudes, and behaviors in anemia prevention. For instance, studies have shown that higher knowledge levels correlate with positive attitudes toward health and proactive behaviors that reduce anemia risk (Bahar, 2023; Saputri & Noerfitri, 2022). However, the effectiveness of knowledge-based interventions varies depending on how well they translate into meaningful behavioral changes. Research by Fitriyani et al. (2023) emphasizes that adolescents' lifestyle choices are often influenced by modern trends and technology, despite adequate knowledge about anemia. Furthermore, studies conducted in school settings have established significant relationships between knowledge, attitudes, and behaviors with anemia incidence (Bahar, 2023). However, limited research has explored these relationships among university students, a population that bridges adolescence and adulthood.

While much is known about anemia among high school students and pregnant women in Indonesia, there is a lack of focused research on female university students who are equally vulnerable due to their transitional life stages. This study addresses this gap by analyzing the interplay between knowledge, attitudes, and behaviors related to anemia among female undergraduate students at the University of Jember. This study hypothesizes that knowledge, attitude, and behavior regarding anemia are associated with the incidence of anemia.

By identifying these relationships within a university setting, this study aimed to identify targeted interventions that can effectively address the specific needs of this population.

Methods

This study employed a quantitative research design that utilized observational analysis with a cross-sectional data-collection technique. The independent variables included knowledge, attitudes, and behaviors related to anemia, whereas the dependent variable was the incidence of anemia among female students. The study population consisted of all female undergraduate students enrolled at the Jember University. The study was conducted from February to May 2024.

A multistage sampling technique was employed to select the participants. First step: sample of the faculties calculated by the sample fraction, $m = f_1 \times M = 0,4 \times 15$ faculties = 6 faculties. The process of selecting faculties was carried out randomly using the wheel of names, resulting in six faculty members: Faculty of Teacher Training and Education, Faculty of Agricultural Technology, Faculty of Agriculture, Faculty of Social and Political Sciences, Faculty of Public Health, and Faculty of Medicine. Second step: sample of the study programs calculated by the sample fraction, $n = f2 \times N = 0,4 \times 25$ study programs = 10. The process of selecting the study programs was conducted randomly using

the wheel of names, resulting in sociology, Indonesian Language Education, Agrotechnology, Public Health, Mathematics Science, Medical Education, Agricultural Industrial Engineering, English Language Education, Business Administration, Agribusiness. Third step: The total sample of female students from each study program was calculated using the Slovin formula ($n=N/(N.d^2+1)$, $n=(4195/(4195*0,1^2+1)=98$), with the correction sample resulting in 109. Fourth step: Proportionate random sampling techniques are used for populations that are not proportionally homogeneous, so representatives from each study program are needed. Samples were then collected consecutively (Table 1).

Table 1. Sample of female students from selected study program

Study Program	Population (Ni)	Sample (ni)
Sosiology	537	14
Indonesian Education	441	11
Agrotechnology	335	9
Public Health	647	17
Mathematics Science	469	12
Medical Education	343	8
Agricultural Industrial Engineering	255	7
English Education	366	9
Business Administration	451	12
Agribusiness	351	10

The inclusion Criteria: Female students aged 18-24 years; not menstruating or fasting during hemoglobin measurement, not pregnant, and willing to participate in the study. Exclusion Criteria: Female students with diseases (e.g., tuberculosis, liver failure, cancer), those who had undergone surgery within approximately five months prior to the study, and individuals with a family history of thalassemia.

Data were collected through questionnaires, anthropometric measurements, and hemoglobin level blood tests. Sociodemographic and dietary habits (Age, Parental education background, place of residence, duration and cycle of menstruation, Body Mass Index (BMI), animal-based and plant-based protein, fast food, coffee, tea, and milk after meals, not paying attention to the nutritional content of the food, and hemoglobin level). Anemia status was assessed through blood tests using point-of-care testing (POCT) with the Hemoque brand Easy Touch device. Hemoglobin levels were measured under the supervision of the UNEJ Medical Center (UMC). Hemoglobin levels below 12 mg/dL indicated anemia. Data on knowledge, attitudes, and behaviors related to anemia were collected using Google Forms. Knowledge was evaluated using a Likert scale, with 1 indicating correct answers and 0 indicating incorrect answers. The total score was compared with the highest expected score, multiplied by 100%, and categorized as good (>75%) or poor (≤75%). Attitudes and behaviors were categorized as good or poor based on the mean values if normally distributed; otherwise, median values were used. Categories were defined as poor if below the mean or median and good if at or above these thresholds.

Data analysis was conducted using both univariate and bivariate methods, and univariate analysis was used to assess the distribution and frequency of variables. The categorization of knowledge, attitude, and behavior variables used the mean value if the data were normally distributed. However, if the data were not normally distributed, the median was used. Poor if less than the mean or median and good if more than or equal to the mean or median. Bivariate analysis using the chi-square test was performed to evaluate the relationships between variables at a significance level of 95%. Validity and reliability tests were conducted at the Faculty of Cultural Sciences and Faculty of Pharmacy, University of Jember. Based on the validity and reliability tests, 10 questions were obtained for the knowledge questionnaire related to anemia, 14 for the attitude questionnaire related to anemia, and 11 for the behavior questionnaire related to anemia. The study was approved by the Health Research Ethics Committee of FKG UNEJ on April 24, 2024 (approval number 2523/UN25.8/KEPK/DL/2024).

Result and Discussion

This study aimed to assess the prevalence of anemia among female university students using both univariate and bivariate analyses to explore contributing factors. The findings reveal critical insights into the health status of this demographic group, highlighting the importance

of dietary habits, menstrual health, and psychological factors. Anemia, defined as a reduction in hemoglobin (Hb) and/or red blood cell (RBC) counts below normal levels, poses significant health risks, particularly among young women, who are often in a transitional life stage approaching adulthood and potential motherhood. The findings indicated that a substantial proportion of the respondents exhibited signs of anemia, which correlated with lifestyle choices and dietary habits prevalent among this demographic group.

Table 2. Socio-demographic Characteristics and the Dietary Habits of Female Undergraduate Students

Variabel	n	%
Age (years old)		
≤20	33	30,3
>20	76	69,7
Faculty		
Health	26	23,9
Non-Health	83	76,1
Father's education		
Primary	21	19,3
Secondary and above	88	80,7
Mother's education		
Primary	33	30,3
Secondary and above	76	69,7
Accomodation		
Hosteler (kos/kontrak/asrama)	95	87,2
Living with parent/family	14	12.8
Duration of Menstruation cycle		
Abnormal	47	43,1
Normal	62	56,9
Menstruation cycle		
Short	20	18,3
Normal	59	54,1
Long	30	27,5
Nutritional status		
Underweight	31	28.4
Normal	45	41,3
Overweight	18	16,5
Obesity	15	13,8
Coffee, tea, milk (after meal)		
Always	4	3,7
Frequently	31	28,4
Occasionally	44	40,4
Never	30	27,5
Animal-Based Protein		
Always	22	20,2
Frequently	61	56
Occasionally	22	20,2
Never	4	3,7
Plant-Based Protein		
Always	16	14,7
Frequently	45	41,3
Occasionally	45	41,3
Never	3	2,8
Fastfood		
Always	3	2,8
Frequently	30	27,5
Occasionally	59	54,1
Never	17	15,6
Not Paying attention to the nutritional content of the food		
Always	16	14,7
Frequently	49	39,4
Occasionally	40	36,7
Never	10	9,2
Skip the breakfast		
Always	18	16,5
Frequently	29	26,6
Occasionally	41	37,6
Never	21	19,3
Hemoglobin level		
≥12 mg/dl	60	55
<12 mg/dl	49	49,9

Univariate analysis (Table 2) revealed that a significant majority of the respondents (67,7%) were aged 20 years. This demographic primarily consists of upper-semester students who often face increased academic pressure and busy schedules, which can adversely affect their dietary choices. The high demands of academic life may lead to neglect of food selection (Dev, 2023). Moreover, 76,1% of the respondents hailed from non-health-related fields, indicating a potential gap in their knowledge and awareness regarding health issues, particularly anemia. This lack of awareness is critical, as previous studies have shown that insufficient understanding of anemia can contribute to its high prevalence among female students (Woldegebriel et al., 2020). The importance of nutritional education is underscored by findings that suggest that effective nutrition education can significantly enhance knowledge about anemia, thereby necessitating the development of tailored educational programs that consider the respondents' educational backgrounds (Maričić et al., 2020).

The relationship between educational background and health literacy is also evident in the literature. For instance, studies indicate that individuals with higher educational levels tend

to have better health literacy, which is crucial for making informed dietary choices and for understanding the health risks associated with anemia (Yanisah & Widati, 2023). Furthermore, interventions aimed at improving knowledge about anemia have been shown to increase iron supplementation among adolescent girls, highlighting the effectiveness of targeted health education (Li et al., 2021).

Most respondents had parents with at least a secondary education, with 80,7% fathers and 69,7% mothers having completed high school or higher. This educational background is crucial, as previous research highlights the significant role parents play in shaping family consumption habits, which, in turn, influence adolescents' dietary patterns (Rafique & AlSheikh, 2018). Most respondents (87,2%) lived in boarding houses or dormitories, a living arrangement associated with unhealthy eating patterns and poor food quality, as noted by Faizah et al.(Faizah et al., 2022). Limited access to nutritious food in such environments can adversely affect students' eating habits and potentially lead to various health problems (Rizwan, 2023).

Furthermore, the study found that 56,9% of the respondents reported normal menstrual duration, while 54,1% reported regular menstrual cycles. Normal menstrual cycles are typically regulated by the balance between estrogen and progesterone, which is essential for the maintenance of the uterine lining (Asanidze et al., 2023). However, stress has been identified as a significant contributing factor to menstrual cycle irregularities among students (Aolymat et al., 2023; Takmaz et al., 2021). In terms of nutritional status, 41,3% of the respondents were classified as having a normal nutritional status, while the remainder exhibited either undernutrition or overnutrition. Stress was identified as a contributing factor affecting nutritional status, as students experiencing high levels of stress often engage in unhealthy eating behaviors, either overeating or undereating (Matsuura, 2023; Mussa, 2024). The knowledge assessment revealed that 62,4% of the respondents had good knowledge of anemia, with many correctly identifying its definition, symptoms, and management strategies. This knowledge is often acquired by experts or accessible media (Chiba, 2023; Parveen et al., 2022). However, a notable proportion of respondents (37,6%) displayed poor knowledge regarding the causes and long-term effects of anemia. Respondents' attitudes towards anemia were generally positive, with over half (50,5%) demonstrating a good attitude, likely due to increased awareness of the dangers associated with anemia, particularly among women. Nonetheless, misconceptions persisted, such as the belief that anemia symptoms could be solely identified by appearance, and a lack of awareness regarding the importance of iron supplements (Jain, 2023). Behaviorally, while more than half of the respondents practiced good hygiene and consumed protein and vegetables regularly, many neglected to take iron supplements during menstruation and did not pay attention to the nutritional content of their meals. This gap between awareness and practice indicates the need for improved implementation of healthy eating habits in daily life (Taufiq et al., 2019). Univariate analysis revealed that 60% of the respondents experienced anemia, a condition likely exacerbated by academic pressures that lead to neglect of nutritional needs and a lack of knowledge about iron-rich foods. The economic constraints associated with living in boarding houses further contribute to this issue (Faizah et al., 2022; Rizwan, 2023). These findings underscore the need for targeted educational interventions aimed at enhancing knowledge about nutrition and anemia, particularly among students living in environments that may limit their access to healthy food options.

The dietary habits of female undergraduate students, particularly their consumption of coffee, tea, and animal- and plant-based proteins, have significant implications for their risk of anemia. The data indicated that a substantial portion of these students occasionally consumed coffee, tea, or milk after meals (40,4%), and frequently consumed these beverages (28,4%). This pattern of consumption is critical because both coffee and tea are known to inhibit iron absorption owing to their high polyphenol content, which can form complexes with non-heme iron in the gastrointestinal tract, thereby reducing its bioavailability (Siebenthal et al., 2023; Sung et al., 2018). Moreover, the frequent consumption of animal-based protein (56%) and plant-based protein (41,3%) among these students suggests a varied diet, yet the overall

dietary pattern may still predispose them to anemia. A lack of sufficient protein intake has been associated with an increased risk of anemia, as proteins are essential for the synthesis of hemoglobin and other components of red blood cells (Yushananta et al., 2021). Additionally, occasional consumption of fast food (54,1%) and the tendency to skip breakfast (37,6%) may further exacerbate nutritional deficiencies, particularly iron and other essential nutrients necessary for maintaining healthy hemoglobin levels (Alghamdi et al., 2018; Elzaki et al., 2019).

The students' reported lack of attention to the nutritional content (39,4%) was of particular concern. This lack of awareness can lead to an inadequate intake of iron-rich foods and vitamin C, which enhances iron absorption. Studies have shown that the simultaneous consumption of vitamin C and iron-rich foods can significantly improve iron bioavailability, whereas consumption of coffee or tea with meals can diminish iron bioavailability (Karaoğlu et al., 2010; Nogueira-de-Almeida et al., 2023). The dietary habits observed in this population suggest a potential risk of developing iron deficiency anemia, especially given that many female students may not meet their iron requirements owing to these dietary choices (Fitripancari, 2023; Wartiningsih, 2023). Furthermore, occasional skipping of breakfast may contribute to inadequate overall nutrient intake, which is critical for maintaining iron levels. Breakfast is often an opportunity to consume iron-rich foods, and missing this meal can lead to cumulative deficiency over time (Ansari et al., 2012). The combination of these factors—high consumption of iron inhibitors (coffee and tea), insufficient protein intake, and poor dietary awareness—highlights the need for targeted nutritional education and interventions aimed at improving the dietary habits of female undergraduate students to mitigate the risk of anemia.

The Relationship between Female University Students' Knowledge Regarding the Incidence Of Anemia

The Chi-Square analysis conducted in this study revealed a significant relationship between female university students' knowledge of anemia and the incidence of anemia at Jember University (P = 0,013), with a prevalence ratio (PR) of 1,45 that indicates that female students with poor knowledge of anemia prevention is 1,45 likely to experience anemia compared to those with good knowledge (Table 3). This finding aligns with that of Al-Alimi et al. (2018), which indicated a significant correlation between knowledge and the occurrence of anemia among university students (Al-Alimi et al., 2018). Specifically, among the 41 respondents with poor knowledge, 13 (36,7%) were not anemic, while among the 68 respondents with good knowledge, 32 (55,3%) were anemic. This paradox suggests that poor knowledge does not always correlate with anemia and potentially other factors, such as adequate dietary intake. Conversely, even with good knowledge, some respondents may still experience anemia because of a lack of awareness regarding nutritional needs or adherence to dietary trends that overlook essential nutrients.

The majority of respondents demonstrated a good understanding of anemia, which was expected given that university students are typically in late adolescence and are presumed to have some awareness of iron deficiency anemia. This is supported by Edison (2023), who noted that students could accurately respond to questions regarding the impact and prevention of anemia (Edison, 2023).

However, many students incorrectly identified the causes and long-term effects of anemia, despite correctly answering questions regarding its definition, symptoms, and management strategies. This discrepancy may stem from the general nature of the health education received, which often lacks emphasis on the critical details surrounding anemia, resulting in an incomplete understanding of the condition (Yang et al., 2022). These findings highlight the need for targeted educational interventions that focus on the specific causes and consequences of anemia. Such interventions could enhance student awareness and understanding, ultimately leading to better health outcomes. Previous studies have shown that educational programs significantly improve knowledge and attitudes towards anemia, suggesting that tailored educational materials could be beneficial in addressing gaps in understanding (Hamali et al., 2020;.

Furthermore, the results indicate that, while knowledge is essential, it must be coupled with practical dietary guidance to effectively combat anemia among university students.

Table 3. The relationship between female university students' knowledge, attitude, and behaviour regarding the incidence of anemia

Variable	Hemoglobin Level				Total		p-value	PR
	Anemia (<12 mg/dl)		Not Anemia (≥12 mg/dl)					
	n	%	n	%	n	%		
Knowledge								
Poor	28	46,7	13	26,5	41	37,6	0,031*	1,45
Good	32	53,3	36	73,5	68	62,4		
Attitude								
Poor	36	60	18	36,7	54	49,5	0,013*	1,52
Good	24	40	31	63,2	55	50,5		
Behaviour								
Poor	36	60	17	34,7	53	48,6	0,009*	1,58
Good	24	40	32	65,3	56	51,4		

The Relationship between Female University Students' Attitudes Regarding the Incidence Of Anemia

The results of this study indicated a significant relationship between female university students' attitudes towards anemia and the incidence of anemia (p = 0,013) with a prevalence ratio (PR) of 1,52 that indicates that female students with poor attitudes toward anemia prevention is 1,52 likely to experience anemia compared to those with good attitudes (Table 3). Cross-tabulation revealed that, among the 54 respondents with negative attitudes, 18 (36,7%) were not anemic, whereas among the 55 respondents with positive attitudes, 24 (40%) were anemic. This finding is consistent with previous research, which also demonstrated a significant association between attitudes and the occurrence of anemia (Taşgin & Coskun, 2018). The study suggests that respondents with poor attitudes but no anemia may be compensated for by careful attention to their iron intake, while those with positive attitudes who still experience anemia may be influenced by socioeconomic factors and family support (Taşgin & Coskun, 2018).

Most respondents in this study exhibited a positive attitude towards anemia, recognizing it as a serious health issue. However, some students still held misconceptions such as believing that anemia symptoms could be identified solely by appearance, feeling that iron supplements were unnecessary, and neglecting to address the symptoms of anemia while continuing their daily activities. Kusuma and Kartini (2021) noted that adolescent girls with positive attitudes are more likely to engage in preventive measures against anemia (Kusuma & Kartini, 2021).

Nevertheless, it is also possible for students with positive attitudes to fail to effectively prevent anemia due to modern lifestyle influences and a lack of self-awareness regarding their health (Hajam, 2024). These findings highlight the complexity of the relationship between attitude and health outcomes. While a positive attitude towards anemia is beneficial, it does not always translate into proactive health behaviors. This disconnect may stem from a lack of comprehensive education regarding anemia, which fails to address critical aspects such as the importance of iron-rich diets and the need for regular health checkups. The influence of modern lifestyles can lead to neglect of essential health practices, even among those who are aware of the risks associated with anemia (Hajam, 2024).

The Relationship between Female University Students' Behaviors Regarding the Incidence of Anemia

The results of this study indicated a significant relationship between female university students' behaviors regarding anemia and the incidence of anemia (p = 0,009), with a prevalence ratio (PR) of 1,58 that indicates that female students with poor anemia prevention is 1,58 likely to experience anemia compared to those with good behavior (Table 3). Cross-tabulation revealed that, among the 53

respondents exhibiting poor preventive behaviors, 17 (34,7%) were not anemic, whereas among the 56 respondents demonstrating good preventive behaviors, 24 (40%) were anemic. This finding is consistent with the research conducted by Diana et al. (2020), which also highlighted a significant association between behaviors related to anemia and its occurrence (Diana et al., 2020). This study suggests that subjects with inadequate preventive behaviors may still avoid anemia because they maintain a normal nutritional status, which includes regular consumption of both animal- and plant-based proteins as sources of iron as well as fruits that provide vitamin C to enhance iron absorption. Furthermore, the results indicated that improved preventive behaviors were correlated with a lower incidence of anemia (Seu et al., 2019). In this study, most respondents exhibited good behaviors regarding anemia prevention.

However, the presence of anemia among those with good behavior suggests that this behavior does not guarantee the absence of anemia. This could be attributed to the fact that a significant number of respondents were either underweight or overweight, with 64 respondents practicing good hygiene by washing their hands before meals and regularly consuming protein and green vegetables. These findings underscore the complexity of the relationship between health behaviors and anemia. Although good dietary practices and hygiene are essential for preventing anemia, they may not be sufficient on their own, particularly if other factors, such as body weight and overall nutritional intake, are not adequately addressed. This aligns with previous research indicating that nutritional status, including body mass index (BMI), plays a critical role in the prevalence of anemia (Gi et al., 2020; Kamruzzaman, 2021; Utari & Al Rahmad, 2022).

Moreover, the study highlights the importance of comprehensive health education that not only promotes good dietary habits but also addresses the multifaceted nature of anemia, including the need for awareness of other contributing factors, such as socioeconomic status and lifestyle choices. As suggested by Kamruzzaman (2021), understanding the interplay between various determinants of health can lead to more effective interventions aimed at reducing the prevalence of anemia among young women (Kaewpawong et al., 2022; Kamruzzaman, 2021).

A limitation of our study is that data on dietary habits, menstrual history, and behaviors were collected via questionnaires, which are subject to recall and social desirability biases. Students may have overreported positive behaviors or underreported unhealthy habits, thereby affecting the reliability of the data. For example, students may have reported healthier behaviors than they actually practice aligning with perceived expectations, which could underestimate the prevalence of poor dietary habits or nonadherence to supplementation. Moreover, the cross-sectional nature of the study limits the ability to infer causality between knowledge, attitudes, behaviors, and anemia incidence. Longitudinal studies are needed to establish temporal relationships.

These findings have important implications for university health programs, and policies such as universities should implement tailored nutrition education initiatives focusing on anemia prevention, emphasizing not only knowledge but also practical dietary guidance. These programs should address the impact of dietary inhibitors, such as coffee and tea, on iron absorption, the importance of regular iron-rich meals, and the role of vitamin C in enhancing iron bioavailability. Given the lower health literacy among students from non-health faculties, specific educational campaigns should be designed to raise awareness and promote healthy behaviors in this group. Lastly, universities could improve access to nutritious food options in dormitories and faculty canteens, perhaps through subsidized meal plans or collaborations with food providers to ensure the availability of iron-rich and balanced meals.

Conclusion

This study underscores the significant relationship between knowledge, attitudes, and behaviors regarding anemia among female university students. The findings reveal that, while many students possess good knowledge and positive attitudes towards anemia, these factors alone do not guarantee the absence of the condition. Specifically, the study found a significant association between students' attitudes and the incidence of anemia (p. This indicates that students with positive attitudes were less likely to experience anemia. However, the presence of anemia among those with good

attitudes suggests that additional factors are at play.

Moreover, this study highlights the importance of preventive behaviors in managing anemia. Although the majority of respondents demonstrated good preventive behaviors such as maintaining proper hygiene and consuming iron-rich foods, the occurrence of anemia among some students indicated that these behaviors must be complemented by a comprehensive understanding of nutritional needs and health practices. Factors such as socioeconomic status, dietary habits, and lifestyle choices also contribute significantly to the risk of anemia. University students need a multifaceted approach to anemia prevention among female university students, incorporating education, awareness, and practical strategies to improve dietary intake and overall health. Educational institutions should integrate anemia prevention education (nutrition, importance of iron supplements, and healthy eating patterns) into campus curricula.

Moreover, they provide iron-rich foods and vitamin C source meals for faculty canteens. This approach is essential for reducing the prevalence of anemia and promoting better health outcomes in this vulnerable population.

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