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Original Research Paper

Assessment of Iron Deficiency Anemia Prevalence and Related KAP

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Abstract: Anemia is a major public health issue with detrimental impacts on physical health, cognitive abilities, and academic output. While traditionally linked to vulnerable groups, recent studies indicate a high prevalence among seemingly healthy young adults, highlighting the need to assess their knowledge, attitudes, and practices (KAP) to guide preventive measures. This study aimed to identify the prevalence of anemia among university students, assess their KAP regarding the condition, and investigate the relationship between anemia status and KAP scores. **Methods:** A cross-sectional study was conducted involving 100 students at Al-Zahraa University of Women in Karbala, Iraq. KAP data were collected using an online structured, self-administered questionnaire, and hemoglobin levels were determined using a hematocrit analyzer. Data were analyzed using SPSS version 26. **Results:** The results showed an average hemoglobin level of 12.41 ± 1.06 g/dl, with a total anemia prevalence of 34% (25% mild, 9% moderate). Knowledge levels were poor in 38% of students, moderate in 45%, and good in 17%. Furthermore, 52% exhibited poor practices, while attitudes were predominantly neutral. Statistical analysis revealed a significant relationship between anemia status and both knowledge and practice scores, but no significant relationship with attitudes. **Conclusion:** In conclusion, anemia is a medium-level public health concern among university students in Iraq, supported by gaps in knowledge and prevention practices. Targeted educational interventions, regular screening, and nutritional programs are essential to reduce anemia prevalence and promote healthier habits.

Keywords: Anemia; KAP; University students; Public health

1.Introduction

Anemia is a major public health concern that affects millions of individuals worldwide. It is characterized by a reduction in the concentration of hemoglobin or red blood cell count, which reduces the oxygen-carrying capacity of the blood and can cause different clinical manifestations that include fatigue, pallor, dizziness, etc. shortness of breath, and poor cognitive performance [1]. Among university students, these symptoms can hurt their daily functioning, academic performance, concentration, and overall quality of life [1,2]. While anemia is often associated with vulnerable populations such as the young, pregnant women, and the elderly, recent research has pointed out its prevalence among apparently healthy young people, including students studying at universities [2,3]. Assessing anemia prevalence is not enough for effective intervention. It is equally important for the understanding of students' knowledge, attitudes, and practices (KAP) regarding anemia. Knowledge refers to noises about anemia's definition, causes, symptoms, and prevention strategies. Attitudes reflect how seriously students perceive the condition, their perceived susceptibility, and motivation

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to engage in preventative behaviors; and practices include the actual behaviors adopted (including dietary habits, iron supplementation, health-seeking behaviors, as well as lifestyle choices [5,6]. It is imperative to understand KAP. Because it gives insight into behavioral gaps of the kind that may persist despite knowledge and thus guides effective public health interventions. Several studies have highlighted a gap in KAP among university students. Only 13.8% had a positive attitude toward the prevention of anemia, and almost 87% did not. Follow behaviors that may reduce their risk [6]; Lifestyle, socioeconomic, and demographic factors are also contributing factors to anemia among university students. Dietary habits, irregular meals, eating low 2 of Iron-rich foods, high tea or coffee consumption, and skipping breakfast have been associated with increased anemia risk [3,7]. Physiological causes, e.g., menstruation in Female students, low body mass index (BMI), and chronic health problems, also have a significant role in determining susceptibility [4,8]. Moreover, while some students may have some awareness of anemia, this knowledge does not always translate into preventive behaviors, highlighting the need for interventions that address knowledge and behavior [9]. Given the significant prevalence of anemia in the student population of universities, and the possibility of impairing an all-inclusive evaluation by assessing cognitive and physical performance. The prevalence of the KAP analysis is indicated. Such an approach enables researchers and policymakers to identify critical knowledge gaps, misperceptions, and risky behaviors that support the persistence of anemia in this population; Significantly, the correlation of KAP data with a real anemia condition will help to showcase the effectiveness of existing educational or nutritive interventions and guide the development of new strategies; By intervening on these objectives, the study will present holistic evidence to educate health policies of the people reducing the prevalence of anemia and improving population health outcomes among university students.

Overview and Prevalence of Anemia in Iraq

Anemia is a major and ongoing public health problem in Iraq, exacerbated by vulnerable population groups such as children, women of reproductive age, and pregnant women [10]. According to the most recent national statistics of 2018, the Iraq Multiple Indicator Cluster Survey (MICS 6), prevalence rates are overwhelmingly high:35.8% among children (6-59 months), 33.3% for non-pregnant women of reproductive age (15-49 years), 39.8% of pregnant women, which is a severe public health problem according to WHO standards [12]. A subsequent 2022 SMART The Nutrition Survey validates the continuation of this severe burden, especially among young children and women [11].

Important Risk Factors and Causes in the Iraqi Context

Nutritional Deficiencies: The main cause is iron deficiency, which is worsened by nutritional habits that are characterized by low levels of bioavailable iron and micronutrients (Vitamin A, B12, and folate). Excessive use of tea (with tannins) during meals. Cultural practice inhibits iron absorption [12,13].

Conflict and Economic Hardship Decades of war and sanctions have interrupted food systems, lowered household incomes, and a lack of access to diverse, nutrient-rich foods. Food insecurity is one of the direct causes of poor nutritional status [14]. Close birth spacing and high rates of fertility: This exhausts women's iron stores, meaning WRA and pregnant women are particularly vulnerable [15]. Infectious Diseases and Parasitic Infestations: Malaria (in some areas) and intestinal worms (e.g., schistosomiasis, soil-transmitted helminths) are responsible for blood loss and anemia, especially in children [16]. Limited Health Service Access Despite efforts, coverage of preventive services such as iron and folic acid (IFA) supplementation of pregnant women and children, and deworming programs, is not consistent [17].

Literature Review Anemia

Among university students has attracted increasing scholarly attention in recent years, due to its ability to impair cognitive function, academic performance, and general well-being. Several cross-sectional and observational studies have reported the prevalence of anemia in tertiary education settings, emphasizing both the nutritional and non-nutritional determinants. For example, Khan [18] did a study at the University of Peshawar (Pakistan) and found that 23.9% of female students were anemic, in comparison with male students, only 1.5%, which also underscores a gender difference.

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Anemia burden of this population [18]. Such gender-based differences may reflect physiological vulnerabilities, nutritional habits, and socio-cultural influences that have a differential effect on female students.

Beyond the question of prevalence, a growing number of researchers have employed the concept of Knowledge-Attitudes- Practices (KAP) frameworks to learn the perception of students concerning anemia, what they know about it, and how their behaviors are consistent (or inconsistent) with preventive measures. A cross-sectional study in Malaysian female university students ("SCARF" study) reported that 44.5% had poor knowledge related to anemia, and Eighty-four-point one percent showed unfavorable attitudes toward the condition. Importantly, the study also found that better knowledge was related to slightly improved anemia status, though there were instances where the authors noted that knowledge was not always able to lead to improved dietary or prevention practices [19]. This gap between knowledge and Recurrent throughout the literature is the idea that awareness is not enough, that it must be followed by practice, to influence behavioral change. In a similar vein, Hamed (2020) assessed the knowledge, attitudes, and nutrition practices of anemic college students females in Egypt, who report worryingly poor levels of correct knowledge (on iron nutrition and anemia) and practice: 94.1% had wrong dietary practices, 65% had insufficient disease related knowledge, and 87.8% did not engage in behaviors that have been known to prevent or manage anemia. Only 13.8% expressed a positive attitude, whereas the majority had a neutral attitude [20]. This finding refers to an urgent necessity of educational interventions that are custom-made and, that is, not generic provide information, but also have the effect of positive motivation to act. Studies in other

Geographical locations reinforce the role of behavioral determinants. In Indonesia, Emiliana et al (2024) studied female undergraduate students and found that knowledge, attitude, and behaviors were significantly associated with their anemia status: participants who had better knowledge and more positive attitudes had a lower prevalence of nutritional anemia (p-values<0.05), and their These were mediated by health behavior (dietary iron intake or use of supplements) [21]. To supplement these individual-level studies, more systemic investigations have included contextual factors such as institutional support and environmental influences. For instance, Soin (2022) found that students' behaviors and anemia status are associated not only with their knowledge and attitudes, but also with a degree of school or institutional support (e.g., health-promoting policies, availability of nutritional services) [22]. Another important strand in the literature is about the last mile translation from knowledge to long-term behavior change. In one study of medical students in India, Singh (2015) compared students from rural and urban backgrounds and reported interesting differences: although urban students demonstrated more knowledge of iron deficiency anemia, rural students more often practiced positive behaviors (e.g., eating green vegetables, not drinking tea immediately after eating), which means behavior may not always have a straightforward relationship to knowledge [23]. Signal the need for culturally sensitive, behaviorally informed educational designs. In addition to student-focused research, some of the literature addresses knowledge gaps of future health professionals themselves. Al-Hejaj (2024), in a study of nursing students, found that even in this well-educated sample of students, a substantial proportion did not have an overall understanding of iron-deficiency Anemia; 1/2 - 2/3 had iron deficiency anemia themselves, and knowledge was somewhat different in the morning and evening cohorts. Their understanding of anemia not only affects their own health but may also have an influence on how they educate and care for the patients in the future [24].

Correlational studies have also discussed the relationship between nutritional status, the number of times food is consumed, and anemia in student populations. As an illustration, Rosmiati et al. (2023) considered young female students in Indonesia and found that the percentage of anemic students was 38.9% of the respondents. Further, eating frequency (3 meals/day), knowledge, attitude, and nutritional status (e.g., BMI) were significantly associated with the risk of anemia [25]. These findings indicate that eating regular meal patterns and basic nutritional knowledge can work as protective factors against anemia in student populations.

Aim and Objectives of Research

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Despite the richness of international data, there is a major research gap in Iraq. No study has been known to evaluate the biochemical prevalence of anemia and associated Knowledge, Attitudes, and Practices (KAP) among Iraqi university students. The main objective of this research is to fully evaluate the prevalence of anemia among university students and to investigate the extent to which the students' knowledge, attitudes, and practices (KAP) impact their risk and management of the condition.

The plan is to achieve the following specific objectives:

1-Measure the prevalence of anemia by capillary hemoglobin measurement.

2-Assess the level of knowledge of the causes, symptoms, and prevention of anemia.

3-Evaluate attitude towards the seriousness of anemia, susceptibility to anemia, and preventive behaviors.

4-Describe practices concerning dietary iron intakes and supplement use, and health seeking behavior.

5. Explore the relationship between anemia status and demographics (e.g., academic year, BMI).

6-Analyze the correlations of the anemia status and KAP domain scores.

2. Methodology

Survey instruments/data collection tools

KAP related to anemia was assessed using a structured self-administered questionnaire (in Arabic language, and using Google Forms, online), an information sheet, and an electronic consent statement. Hematocrit Analyzer (hemoglobin [Hb] and hematocrit measurement) AL-Zahraa Center for Medical and Pharmaceutical Research Sciences (ZCMPRS), AL-Zahraa University for Women. Disposable microcuvettes and sterile lancets for collecting capillary blood. Internet-connected computers/smartphones for completing the questionnaire. Data management software (Google Forms, Excel, Statistical Package for the Social Sciences).

Study Design and Setting

This study used a cross-sectional approach with the combination of a questionnaire-based KAP study and biochemical hemoglobin (Hb) to study the prevalence of anemia and its factors among university students. The study was carried out at AL-Zahraa University for Women in Karbala, Iraq, and Hb measurements were performed only at the AL-Zahraa Center for Medical and Pharmaceutical Research Sciences (ZCMPRS). Data collection was directed at fifth-year female pharmacy students in the months of September-November 2025. This setting is ideal because of the academic stress, varying dietary habits of students, and the relevance to work of pharmacists in the future in preventing anemia.

Population and Sample

Undergraduate female students of AL-Zahraa University for Women, in the 2025-2026 academic year, were selected as the study population. Inclusion criteria: Students aged 18 years and above, currently enrolled in the pharmacy program, willing to complete the questionnaire and provide a finger-prick blood sample for Hb measurement at ZCMPRS. Exclusion criteria: chronic diseases known to influence the level of Hb (e.g., thalassemia), pregnancy. A target sample of 100 students was achieved, which was determined. Normal range of Hb employed: 12-16g/dL (altered to female standards as recommended by WHO).

Sampling Method

A convenience sampling approach was adopted, and the link to the online questionnaire was spread through official university portals, email lists, and social media groups for students. Participants completing the questionnaire were then invited to Hb determination, on-site at ZCMPRS, using the Hematocrit Analyzer. One response per account was enforced using the settings in Google Forms.

Study Questionnaire

The KAP questionnaire was developed by researchers based on validated tools. The questionnaire was 28

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questions split into four parts and written in the Arabic language and administered electronically using Google Forms (accessible at: https://docs.google.com/forms/d/1FAIpQLSdSudGo7m3V1oPehUFuDtkXS/DAi4RCXviFm_GlclY4GpNkA/viewform). It was pilot-tested on 20 students (who were not included in the main study) to make sure it was clear and to determine how long it would take to complete (10-12 minutes).

In Section A, one will answer the following questions: Demographic and Background Data.

Section B: Knowledge Assessment consisted of 15 questions

Section C: Attitudes Assessment: Had 5 questions

Section D: Practices Assessment: Contained 8 questions

Hb Measurement Procedure

Capillary blood samples were taken by sterile finger-prick (after alcohol swab and hand hygiene) from 100 participants and processed at AL-Zahraa Center for Medical and Pharmaceutical Research Sciences (ZCMPRS) by a Hematocrit Analyzer. Samples were placed in disposable microcuvettes for immediate on-site measurement. Normal reference ranges were used: Hemoglobin 12-16 g/dL; Hematocrit 36-47%. Classification of anemia was defined as Hb < 12 g/dL (females), according to WHO standards. Quality control: The device was calibrated according to the manufacturer's instructions; the results were recorded with sample numbers 1-100.

Scoring scheme and grades of knowledge

The questionnaire contained 30 items across three domains (12 knowledge, 8 attitudes, 10 practices). The maximum objective score was 22 points, derived from the knowledge (12 points) and practice (10 points) sections. Each correct answer received 1 point, while incorrect and "not-sure" answers received 0 points. Attitudes were assessed using mean Likert scores. To evaluate the KAP levels, the total score was converted into a percentage and categorized based on established standard KAP assessment guidelines [5, 20] as follows:

Poor knowledge: ≤ 50%

Fair knowledge: 51–75%

Good knowledge: > 75%

Data Collection Procedure

The questionnaire was shared electronically using the Google Forms platform over two months (September-November 2025). The link was distributed via official university portals, email lists, and social media groups for students from each of the participating institutions. Weekly reminders were placed to increase response rates. To minimize the risk of duplicate submissions, the form settings were made to limit one response per user account, and those who did not meet the inclusion criteria were excluded from the final analysis. Participants who were scheduled for Hb testing at ZCMPRS.

Data Analysis

Data was exported to Excel and then to the statistical package, the Statistical Package and Data Analysis (SPSS) version 26. The demographics, KAP scores, and anemia prevalence were summarized by descriptive statistics (frequencies, means, SD, medians) using 100 Hb measurements (e.g., percent below 12g/dl). Inferential analyses: chi-square/Fisher exact (to test categorical relationships, e.g., anemia vs. gender); independent t -tests/ANOVA (to test relationships between continuous KAP scores, by anemia status). For all statistical tests, a p-value < 0.05 was considered statistically significant.

3. Results and discussion

Participant Characteristics and Anemia Prevalence

The present study utilized an electronic survey, collecting responses from 365 university students who completed the KAP questionnaire on anemia. Most of the participants were young adults (approximately 18-25 years old) representing various academic stages (Figure 1).

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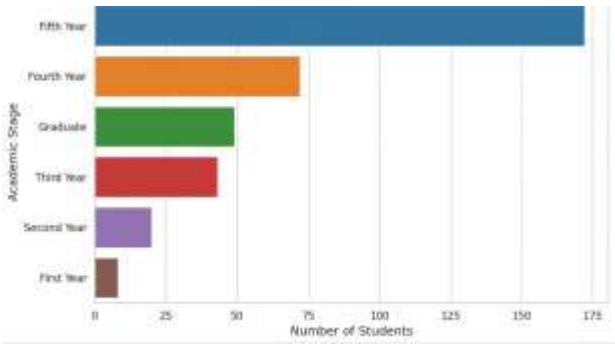

Fig 1: Academic stage distribution

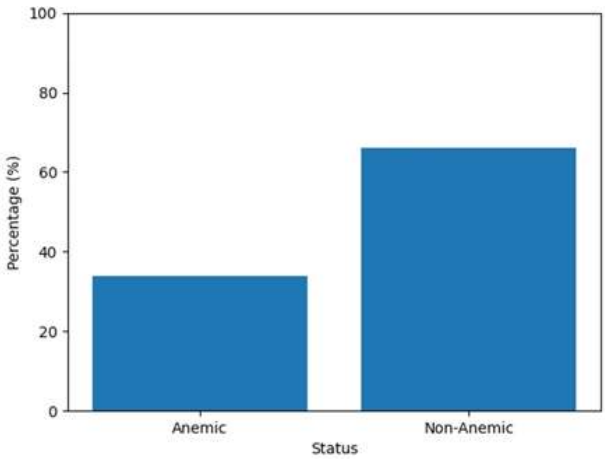

Fig 2: Prevalence of Anemia among University Students

To determine the clinical prevalence of anemia, a subset of 100 students at the Al-Zahraa Center of Medical and Pharmaceutical Research Sciences underwent hemoglobin (Hb) testing using a calibrated Hematocrit Analyzer. The average hemoglobin level among the tested cohort (n=100) was 12.41 ± 1.06 g/dL, ranging from 9.6 g/dL to 14.6 g/dL. Based on the World Health Organization (WHO) threshold for females (Hb < 12 g/dL), 34 students were classified as anemic. This yielded a total prevalence of 34% (Table 1). Regarding severity, 25% of the total sample exhibited mild anemia (Hb 11.0-11.9 g/dL), and 9% had moderate anemia (Hb 8.0-10.9 g/dL), with no identified cases of severe anemia (<8.0 g/dL). This 34% prevalence indicates a moderate public health problem and reveals a clinically important burden of anemia within a seemingly healthy university population. These results align with Alqahtani et al. (2024), who reported a significantly higher prevalence among female students at Jazan University, at 66.0% [26]. The findings also mirror the national statistics from the Iraq MICS 2018, which reported a 33.3% anemia rate among women of reproductive age [10]. This suggests that access to higher education does not necessarily confer protection against nutritional susceptibility, thereby affirming WHO estimates of the disproportionate burden of anemia among young women in the region [1].

Table 1: Hemoglobin Indices and Anemia Prevalence

Indicator	Value
Number of students tested for Hb	100
Mean Hb (g/dL)	12.41 g/dL
Standard deviation of Hb	1.06 g/dL
Minimum Hb value	~9.6 g/dL
Maximum Hb value	~14.6 g/dL
Number of anemic cases (Hb < 12)	34 students
Anemia prevalence	34%

Knowledge Assessment: Gaps in Professional Training:

The knowledge assessment yielded a mean score of 6.8 ± 2.1, corresponding to 56.7%. Categorically, 38% of the students demonstrated poor knowledge, 45% had fair knowledge, and only 17% exhibited good knowledge (Table 2). While general theoretical awareness regarding the causes and symptoms of anemia was relatively high (Figure 6), critical knowledge gaps persisted. The lowest correct response rates pertained to practical nutritional knowledge: identifying iron absorption inhibitors (e.g., tea/coffee), knowing daily iron requirements, and recognizing asymptomatic anemia. Despite their medical background, these lapses reflect a disconnect between academic education and practical health literacy. This aligns closely with findings by Al-Hejaj (2024), who noted significant knowledge gaps regarding the pathophysiology and prevention of iron-deficiency anemia among nursing students in Baghdad [24]. Similarly, Hamed (2020) reported insufficient knowledge of practical anemia among 65% of female college students in Egypt [20].

Table 2: Knowledge level categories

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Knowledge Level	n	%
Poor (≤50%)	38	38%
Fair (51–75%)	45	45%
Good (>75%)	17	17%

Attitudes Toward Anemia: Indifference as an Obstacle.

The mean attitude score among participants was 3.1 ± 0.8. Nearly half of the participants (47%) displayed neutral attitudes toward anemia prevention, while 29% held negative attitudes, and only 24% held positive attitudes (Table 3). Interestingly, while the majority conceptually acknowledged anemia as a serious health problem and supported preventive measures (Figure 7), this did not translate into personal proactive attitudes. This prevailing indifference acts as a major obstacle to preventive behavior. This trend exactly mirrors findings by Emiliana (2024), where Indonesian undergraduates displayed neutral to negative attitudes toward anemia despite having basic awareness [21]. As highlighted by Soin (2022), university students often recognize the significance of anemia generally but fail to perceive their own personal susceptibility, leading to the motivational deficit observed in our cohort [22].

Table 3: Attitudes Distribution

Attitude Level	n	%
Negative	29	29%
Neutral	47	47%
Positive	24	24%

Preventive Practices: The Main Driver of Anemia

Practices related to anemia prevention were generally suboptimal, with a mean score of 4.9 ± 1.9 (49%). Alarmingly, 52% of students were classified as having poor practices, 34% had fair practices, and only 14% adopted good practices (Table 4). Behavioral data revealed widespread unfavorable habits: Most students consumed iron-rich foods only "sometimes" (Figure 3), typically ate only two main meals per day (Figure 4), and nearly half skipped breakfast regularly (Figure 5). Furthermore, while a reasonable proportion underwent Hb testing, regular use of iron supplements was rare (Figure 8), and the primary response to fatigue was simply resting rather than seeking medical consultation (Figure 10). On a positive note, a high percentage expressed a strong future intention to improve their dietary habits (Figure 9). These poor practices are the primary modifiable determinants of anemia in this setting. This is directly supported by Alharbi. (2025) and Alqahtani (2024), who attributed high anemia rates in university students to identical lifestyle factors, particularly meal irregularity and the immediate post-meal consumption of tea/coffee [26, 27].

Table 4: Practice classification

Practice Level	n	%
Poor	52	52%
Fair	34	34%
Good	14	14%

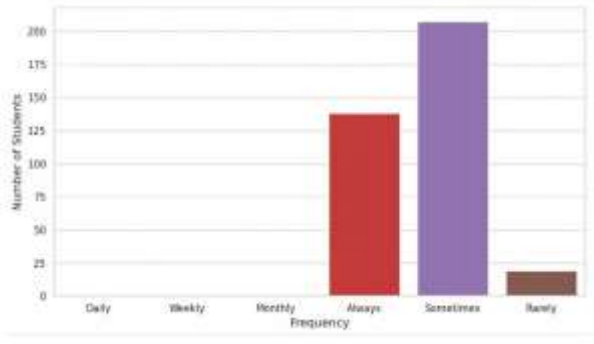

Fig 3: Iron-rich food consumption

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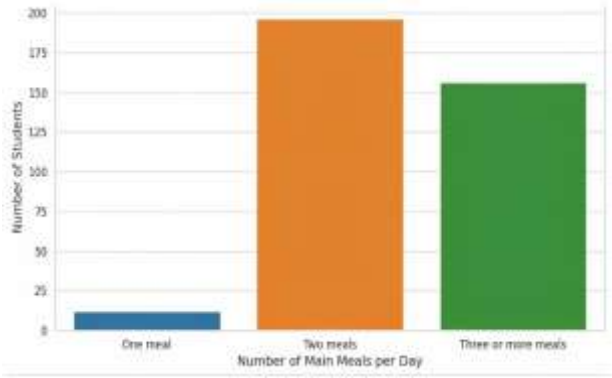

Fig 4: Daily meal frequency

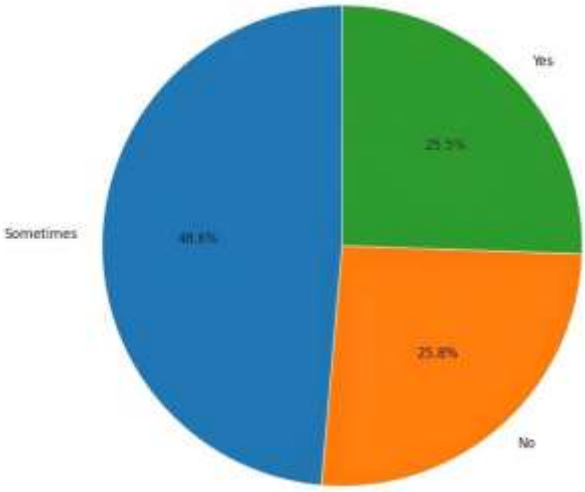

Fig 5: Breakfast Habit.

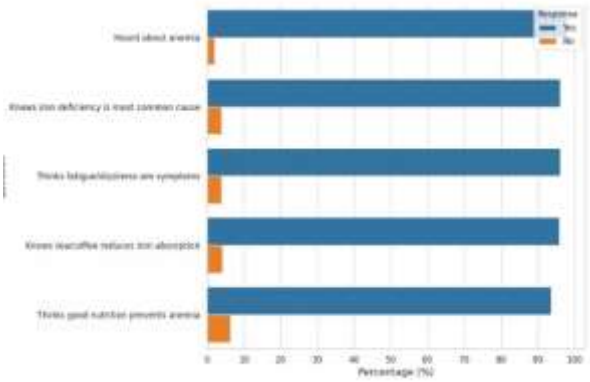

Fig 6: Anemia knowledge questions.

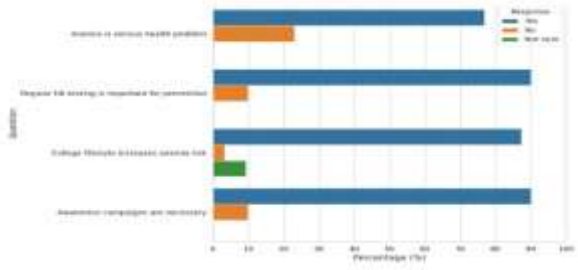

Fig 7: Anemia Attitude questions.

Causal Relationship between KAP Scores and Anemia.

Inferential statistical analysis revealed significant associations between anemia status and KAP variables. Independent t-tests demonstrated that anemic students had significantly lower knowledge scores (5.9 ± 1.8 vs. 7.3 ± 2.0; $p = 0.001$) and practice scores (4.1 ± 1.5 vs. 5.4 ± 1.9; $p = 0.003$) compared to their non-anemic peers. However, there was no statistically significant difference in attitude scores between the two groups ($p = 0.08$) (Table 5). Chi-square tests further validated these findings, showing that low knowledge ($\chi^2 = 9.87$, $p = 0.007$) and poor practices ($\chi^2 = 11.23$, $p = 0.004$) were significantly correlated with an increased prevalence of anemia. Binary logistic regression identified poor practices as the strongest predictor; students with poor practices were three times more likely to be anemic. This KAP interplay demonstrates a sequential pathway where nutritional knowledge deficits lead to poor dietary practices, which ultimately drive the high clinical prevalence of anemia, a finding that perfectly coincides with recent structural models proposed by Kaewpawong (2022) [29]. Consequently, notable correlations between anemia and the two were obtained. There was no statistically significant correlation between the level of attitude and anemia status ($p > 0.05$). Poor practices were 3 times more likely to be anemic in the students; better predictors of anemia are the poor practices, as indicated in Table 6.

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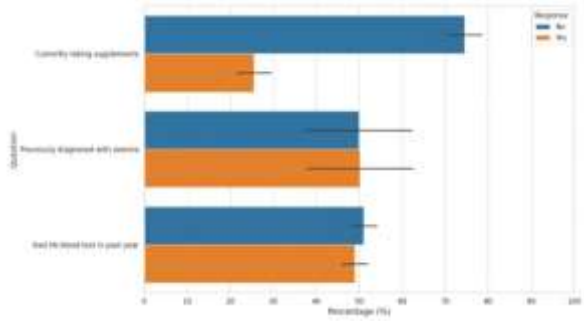

Fig 8: Key health behavior.

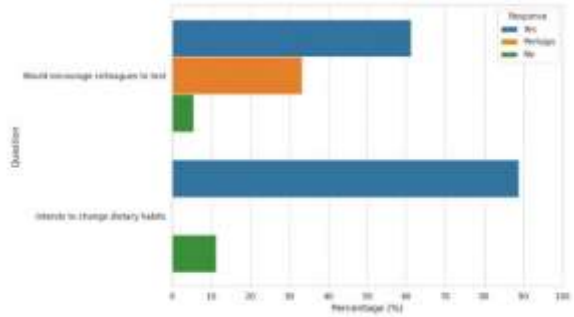

Fig 9: Future intentions.

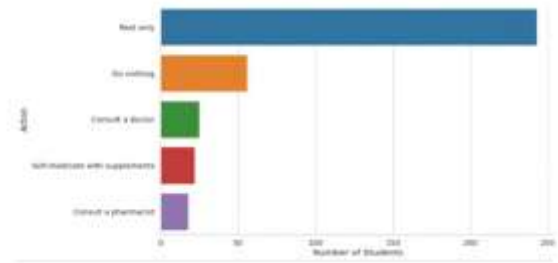

Fig 10: Action taken when feeling tired.

Table 5: Association between anemia and KAP

Variable	Anemic (Mean ± SD)	Non-anemic (Mean ± SD)	p-value
Knowledge	5.9 ± 1.8	7.3 ± 2.0	0.001
Practice	4.1 ± 1.5	5.4 ± 1.9	0.003
Attitude	2.9 ± 0.7	3.2 ± 0.8	0.08

Table 6: Binary Logistic Regression Predicting Anemia Status

Variable	Adjusted OR	95% CI	p-value
Poor knowledge	2.6	1.2-5.7	0.015
Poor practices	3.1	1.4-6.8	0.004

Conclusion

As the study shows, anemia is a major public health issue. Varying knowledge and preventive gaps are notable among Iraqi university students' practices. The best predictor was determined to be poor preventive practices for anemia. Whereas some level of knowledge was related to anemia status, awareness on its own cannot help in mitigating risk. Hence, effective interventions should emphasize knowledge and health behavior enhancement. Implementing formulated educational and behavioral interventions in university health programs can contribute to decreasing the level of anemia and enhancing future health outcomes among students. The strength of the study is that is contained biochemical Hb measurement in a structured KAP evaluation, which makes it possible to investigate the knowledge-practice directly anemia relationships. Nevertheless, causality is not possible in the cross-sectional format.

Convenience sampling by a single university restricts the ability to generalize and infer. An Hb-only test cannot differentiate iron-deficiency anemia from other anemias prevalent in Iraq.

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Author's Contributions

The author, at this moment, declares that the work presented in this article is original, that they will bear any liability for claims relating to the content of this article, and that the study was done under the supervision of the College of Pharmacy, University of Al-Zahraa for Women, without any external funding.

Ethics

The Scientific Research Ethics Committee at Al-Zahraa University for Women approved this study. Electronic informed consent was obtained from all participants. The first page of the online questionnaire was a detailed information sheet with information about the study that included the study's aim (prevalence of anemia and KAP assessment), voluntary anonymous participation, confidentiality of the data, Hb measurement procedure via the Hematocrit Analyzer at the ZCMPRS, and the right to withdraw from the study without consequence. Going on to the questions or Hb testing implied consent. All data were coded and safely stored.

Conflict of interest

The authors declare no conflict of interest.

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