

Knowledge and Awareness of Iron Deficiency Anemia among Young Adults: Implications for Public Health Education

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DOI: <https://doi.org/10.47772/IJRISS.2026.100500813>

Received: 13 May 2026; Accepted: 18 May 2026; Published: 15 June 2026

ABSTRACT

Iron deficiency anemia (IDA) remains a significant public health concern worldwide, particularly among young adults who may be at risk due to dietary habits, lifestyle factors, and limited health awareness. Understanding the level of knowledge and awareness regarding IDA is essential in supporting preventive health education initiatives among students in higher education institutions. This study aimed to determine the level of knowledge and awareness of IDA among Diploma in Pharmacy students at Universiti Teknologi MARA (UiTM) Pulau Pinang, Bertam Campus, and to examine their associations with demographic characteristics. A cross-sectional online survey was conducted from May to June 2024 using a self-administered questionnaire consisting of three sections: demographic characteristics, knowledge of IDA, and awareness of IDA. Data from 138 respondents were analyzed using SPSS version 22.0. Majority of the respondents were female (83.3%), aged between 18 and 22 years old (94.9%), and first-year students (37.7%). More than half of the respondents reported having no family members with medical backgrounds, while 71% had never been diagnosed with IDA. Overall, most respondents demonstrated moderate levels of knowledge (40.6%) and awareness (46.4%) regarding IDA. Semester of study significantly influenced knowledge levels, while age showed a significant association with awareness levels. In addition, a weak but significant positive correlation was observed between knowledge and awareness scores. The findings indicate that although students possess moderate awareness of IDA, important gaps in health literacy remain. Strengthening public health education initiatives within higher education settings may help improve awareness and promote early prevention of IDA among young adults.

Keywords: iron deficiency anemia, public health education, health literacy, young adults

INTRODUCTION

Iron deficiency anemia (IDA) remains one of the most common nutritional disorders worldwide and continues to represent a significant public health concern, particularly in developing countries (Kumar et al., 2022). It has become a significant public health concern worldwide, particularly among certain risk groups in developing countries where poverty, parasitism, and malnutrition are prevalent (Relacion et al., 2021). The World Health Organization (WHO) reported that 1.62 billion of the world's population is anemic (Kumar et al., 2022; Owais et al., 2021). In Malaysia, anemia has a prevalence of 21.3 % and represents a health concern among all high-risk groups, including children, pregnant women, and women of reproductive age (Huong et al., 2022). Significant gender differences in the prevalence and treatment outcomes of IDA have been reported, with women, particularly those of reproductive age, pregnant women, and older women, being more susceptible due to menstrual blood loss and increased iron demands during pregnancy, thereby emphasizing the need for personalized intervention strategies (Bellad et al., 2024).

Recent studies have highlighted limited awareness and knowledge of IDA among young populations. A study conducted among early adolescents in rural Ghana reported that many respondents were unfamiliar with IDA and demonstrated poor understanding of its causes, consequences, and prevention strategies (Wiafe et al., 2021). Similarly, studies conducted among university students have reported notable prevalence rates of IDA, including 85% among students in Manila, Philippines (Relacion et al., 2021), and 13% among female undergraduate medical students in Makkah (Almasmoum et al., 2023). Female students appear to be more vulnerable to IDA compared to males, largely due to factors such as menstrual blood loss, poor nutritional status, and inadequate intake of iron-rich foods (Babelan et al., 2023). In addition, academic demands and unhealthy lifestyle practices among students may further contribute to the risk of IDA. Huong et al. (2022) reported that female students in higher education institutions were more susceptible to IDA because they often prioritized academic commitments over maintaining a balanced and nutritious diet (Huong et al., 2022).

Despite growing awareness efforts, the prevalence of anemia among students remains considerable regardless of gender. Previous studies have identified both modifiable and non-modifiable factors contributing to this issue, including unhealthy lifestyle practices, dietary habits, age, and gender (Relacion et al., 2021). Besides, knowledge has been shown to influence attitudes toward anemia prevention and management. A recent Malaysian cross-sectional study among female university students reported adequate knowledge regarding anemia; however, positive attitudes and preventive practices remained insufficient (Huong et al., 2022). Although numerous studies have explored knowledge and awareness of IDA globally, most research has focused primarily on females, pregnant women, and children. There is a limited attention on this issue to university students with healthcare-related backgrounds, particularly pharmacy students in Malaysia. Young adults, especially pharmacy students, may experience additional academic pressure throughout their studies, which could influence their health awareness and lifestyle behaviours (Minshew et al., 2023). Therefore, this study aimed to assess the level of knowledge and awareness regarding IDA among pharmacy students at UiTM Pulau Pinang, Bertam Campus. The findings may assist educational institutions and relevant stakeholders in developing targeted health education and awareness initiatives to improve students' understanding of IDA and promote preventive health practices.

MATERIALS AND METHOD

Study design and settings

This cross-sectional study is designed to assess pharmacy students' knowledge and awareness of iron deficiency anemia. This study was conducted at Universiti Teknologi Mara (UiTM) Cawangan Pulau Pinang Campus Bertam. The target population for this study is students from Diploma in Pharmacy UiTM Kampus Bertam. The estimated population is 213 students which consists of semesters 2,4 and 6. The sample size for this study is calculated based on the Raosoft Sample Size Calculator with a 95% confidence level and 5% margin of error. From the calculation, the recommended sample size for this study is 138 respondents. Stratified random sampling was employed in this study for the selection of respondents.

Questionnaire development and data collection

The instrument for this study was adapted from previous studies (Balaji & Devaraj, 2021; Relacion et al., 2021; Wiafe et al., 2021) and modified accordingly to align with the objectives of the present study. The instrument subsequently underwent expert review by one pharmacist and one academician to assess the clarity, relevance, and appropriateness of the questionnaire items prior to data collection. The questionnaire assesses knowledge and awareness of iron deficiency anemia. This study is conducted using a self-administration questionnaire consisting of 25 items divided into 3 sections. The first section covered demographic characteristics of respondents (5 items). The items included gender, age, current semester, family members with medical background, and whether the student has been diagnosed with iron deficiency anemia. The second section was the knowledge on iron deficiency anemia (10 items). In this section, the answer is Yes/No/Not sure. The third section was the awareness of iron deficiency anemia (10 items). Like the second section, in the last section, respondents were required to choose the answer to the question with Yes/No/Not sure. This study was conducted online from May 2024- June 2024. The questionnaire was designed and implemented as an online data collection tool using Google Forms. A written consent form was attached at the beginning of the questionnaire to inform

respondents that their participation is voluntary, and all collected data is private and confidential. The link for the survey forms was shared via WhatsApp among Diploma Pharmacy Students.

Data Analysis

The Statistical Package for Social Sciences (SPSS) version 22.0 was used for data analysis. Descriptive statistics were used to analyse the sociodemographic characteristics, knowledge, and awareness of iron deficiency anemia. All the descriptive data was presented in the form of tables and percentages. The chi-square test and Fisher's exact test were done to assess the relationship between the demographic and level of knowledge and awareness of iron deficiency anemia. The chi-square test was used if less than or equal to 20% of expected frequencies are less than 5. If expected frequencies are lower than 5 and more than 20%, the chi-square approximation may not be accurate hence, alternatively, Fisher's Exact Test was used to interpret the relationship between the variables.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Table 1 presents the demographic characteristics of the respondents. Out of 140 distributed questionnaires, 138 were completed and included in the analysis, resulting in a response rate of 98.5%. The majority of respondents were female (83.3%) and aged between 18 and 22 years old (94.9%). In terms of academic year, 37.7% of respondents were first-year students, followed by third-year students (34.8%) and second-year students (27.5%).

More than half of the respondents reported not having family members with medical backgrounds (54.3%). In addition, most respondents indicated that they had never been diagnosed with iron deficiency anemia (71.0%), while a smaller proportion were unsure of their diagnosis status. The predominance of female respondents in the present study is comparable to findings reported in previous studies among pharmacy and healthcare-related students, where female participation was generally higher than male participation (Relacion et al., 2021).

Table 1. Demographic characteristics of the respondents

Demographics		Frequency, n= 138	Percentage (%)
Gender	Male	23	16.7
	Female	115	83.3
Age	18-22 years old	131	94.9
	22-24 years old	5	3.6
	25-30 years old	1	0.7
	>30 years old	1	0.7
Semester/Year of study	Sem 1 / 2 (Year 1)	52	37.7
	Sem 3/ 4 (Year 2)	38	27.5
	Sem 5 / 6 (Year 3)	48	34.8
Family members with medical backgrounds	Yes	63	45.7
	No	75	54.3
Medical history with iron deficiency anemia	Yes	17	12.3
	No	98	71.0
	Not sure	23	16.7

Knowledge levels on IDA

Table 2 summarizes respondents' knowledge regarding IDA. Overall, respondents demonstrated moderate knowledge of IDA, particularly regarding its general definition, common symptoms, and dietary prevention strategies. Most respondents correctly identified anemia as a condition involving a reduced number of red blood cells and recognized symptoms such as fatigue and pale skin. Similar findings have been reported in previous studies among university students in Malaysia and other countries, where respondents generally demonstrated basic understanding of anemia-related concepts (Huong et al., 2022; Wiafe et al., 2021). Respondents also

showed relatively good knowledge regarding the role of meat intake and multivitamin supplementation in anemia prevention and management. These findings may reflect exposure to health-related information among pharmacy students. However, several important gaps in knowledge were identified. A considerable proportion of respondents were uncertain about anemia risk factors, laboratory testing procedures, and the effects of caffeine consumption on iron absorption. In particular, many respondents were unaware that tea or coffee consumption after meals may interfere with iron absorption, despite such dietary habits being common among university students (Relacion et al., 2021).

Knowledge regarding causes of anemia also appeared limited, as less than half of the respondents correctly identified menstrual bleeding as a contributing factor to IDA. These findings are concerning given that female students represent a high-risk group due to menstrual blood loss and increased iron requirements (Bellad et al., 2024). Similar knowledge gaps have been reported among healthcare-related students in India and Indonesia, suggesting that theoretical exposure alone may not be sufficient to promote adequate understanding of IDA prevention and management (Kanna et al., 2022; Perdani & Trismiyana, 2019). The presence of moderate knowledge levels among pharmacy students highlights the need for enhanced educational strategies and health promotion initiatives within higher education settings. As future healthcare professionals, pharmacy students are expected to possess adequate public health literacy regarding common nutritional disorders such as IDA. Strengthening awareness programs, preventive education, and practical health-related learning activities may help improve students' understanding and encourage healthier lifestyle practices.

Table 2. Knowledge on IDA

Knowledge on IDA		Frequency, n=138	Percentage (%)
Anemia is condition that occurs when there is a decreased number of red blood cells in the body.	Yes	131	94.9
	No	2	1.4
	Not sure	5	3.6
Women at childbearing age are highest risk in developing anemia.	Yes	93	67.4
	No	2	1.4
	Not sure	43	31.2
Fatigue and pale skin are a common symptom of anemia.	Yes	133	96.4
	No	1	0.7
	Not sure	4	2.9
Menstrual bleeding can cause anemia.	Yes	60	43.5
	No	20	14.5
	Not sure	58	42.0
Emotional stress can cause anemia	Yes	52	37.7
	No	29	21.0
	Not sure	57	41.3
Haemoglobin level from a complete blood count test is used as an indicator to diagnose anemia	Yes	115	83.3
	No	1	0.7
	Not sure	22	15.9
Any healthcare worker can conduct the laboratory testing for anemia	Yes	18	13.0
	No	63	45.7
	Not sure	57	41.3
Taking caffeine occasionally is beneficial for individuals with anemia.	Yes	8	5.8
	No	43	31.2
	Not sure	87	63
Increased intake of meats can help prevent anemia	Yes	100	72.5
	No	9	6.5
	Not sure	29	21
Consuming multivitamin and folic acid can help in treating anemia.	Yes	110	79.7
	No	0	0
	Not sure	28	20.3

Awareness Regarding IDA

Table 3 summarizes respondents' awareness regarding IDA. Overall, respondents demonstrated moderate awareness of IDA and its associated health consequences. Most respondents were aware that anemia is a global health concern and recognized its potential impact on children's growth, immunity, and intelligence. These findings are comparable to previous studies conducted among university students in the Philippines and India, which also reported moderate levels of awareness regarding the effects of IDA among young adults (Kanna et al., 2022; Relacion et al., 2021). In addition, a high proportion of respondents acknowledged the importance of seeking medical attention when experiencing symptoms of anemia, suggesting a generally positive awareness toward early health-seeking behaviour.

Respondents also demonstrated relatively good awareness regarding dietary sources associated with anemia prevention, particularly the role of green leafy vegetables and meat intake. Similar findings have been reported among healthcare-related students in previous studies, indicating that nutritional awareness may be influenced by educational background and exposure to health-related information (Huong et al., 2022). Nevertheless, several gaps in awareness were identified in the present study. More than half of the respondents were unaware that tea or coffee consumption after meals may reduce iron absorption, while a considerable proportion were uncertain regarding blood testing frequency and treatment options for IDA. These findings may reflect inadequate emphasis on practical preventive knowledge and lifestyle-related factors associated with anemia among students.

The persistence of these awareness gaps among pharmacy students is concerning, as they represent future healthcare professionals who are expected to possess adequate public health literacy regarding common nutritional disorders. Academic stress, irregular eating patterns, and unhealthy lifestyle behaviours commonly observed among university students may further contribute to poor awareness and preventive practices (Al-alimi et al., 2018). Therefore, targeted educational interventions, awareness campaigns, and health promotion initiatives should be strengthened within higher education institutions to improve students' understanding of IDA and encourage healthier lifestyle behaviours.

Table 3. Awareness on IDA

Awareness on IDA		Frequency, n=138	Percentage (%)
Anemia is a global health problem.	Aware	94	68.1
	Slightly aware	41	29.7
	Not aware	3	2.2
Anemia is a life-threatening condition.	Aware	75	54.3
	Slightly aware	53	38.4
	Not aware	10	7.2
Iron deficiency anemia can affect a child's growth, immunity, and intelligence.	Aware	98	71.0
	Slightly aware	29	21.0
	Not aware	11	8.0
Consumption of tea or coffee after a meal can decrease the absorption of iron.	Aware	39	28.3
	Slightly aware	28	20.3
	Not aware	71	51.4
Green leafy vegetables and meats are a good source of iron.	Aware	114	82.6
	Slightly aware	18	13.0
	Not aware	6	4.3
A full blood count should be done once a year to check for anemia.	Aware	53	38.4
	Slightly aware	44	31.9
	Not aware	41	29.7
Individuals with anemia can donate blood regularly.	Aware	15	10.9
	Slightly aware	24	17.4
	Not aware	99	71.7
	Aware	118	85.5

Individuals with symptoms of anemia should seek medical attention.	Slightly aware	18	13.0
	Not aware	2	1.4
Iron deficiency anemia can be treated by iron tablets.	Aware	79	57.2
	Slightly aware	43	31.2
	Not aware	16	11.6
Regular exercise could help in preventing anemia.	Aware	63	45.7
	Slightly aware	46	33.3
	Not aware	29	21

Level of Knowledge Regarding IDA

Respondents' knowledge levels regarding IDA were assessed using a percentage scoring system based on 10 knowledge-related questions. Correct responses were scored as one point, while incorrect and "not sure" responses were scored as zero. Total scores were categorized into good (80–100%), moderate (60–79%), and poor knowledge (<60%) (Alzaben et al., 2023).

As shown in Figure 1, most respondents demonstrated moderate knowledge regarding IDA (40.6%), followed closely by poor knowledge levels (37.7%). Only 21.7% of respondents achieved good knowledge scores. These findings suggest that although respondents possessed basic understanding of IDA, substantial gaps in knowledge remain among pharmacy students. Similar findings have been reported in previous studies among university students, although higher proportions of good knowledge were observed among healthcare students in Tamil Nadu and Indonesia (Kanna et al., 2022; Perdani & Trismiyana, 2019). The moderate level of knowledge observed in the present study highlights the importance of strengthening educational and awareness initiatives related to IDA among young adults in higher education settings.

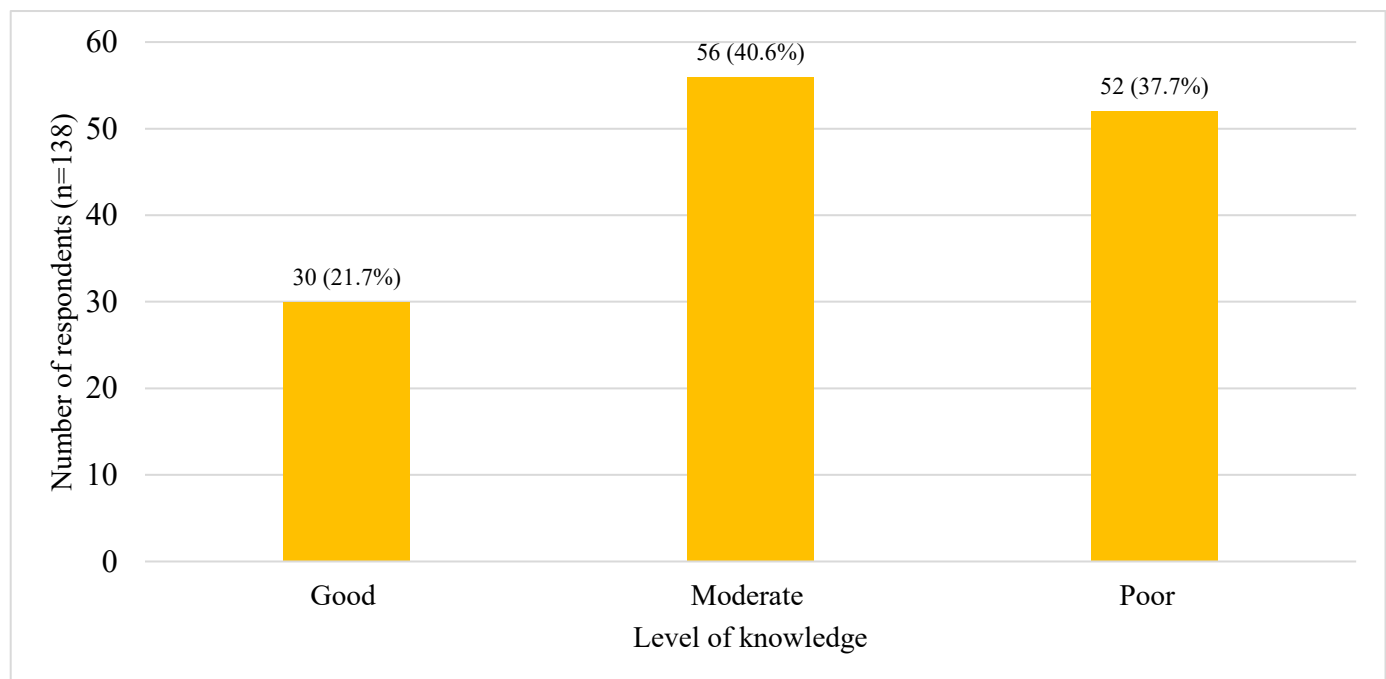


Figure 1. Level of Knowledge regarding IDA

Level of Awareness Regarding IDA

Respondents' awareness levels regarding IDA were assessed using a scoring system based on 10 awareness-related questions. Correct responses were awarded one point, while incorrect and "not sure" responses were scored as zero. The total percentage score was calculated by dividing the number of correct responses by the total score and multiplying by 100. Awareness levels were categorized as poor (0%–39%), moderate (40%–69%), and good (70%–100%) (Zaid et al., 2017). As shown in Figure 2, most respondents demonstrated moderate awareness regarding IDA (46.4%), followed closely by good awareness levels (42.8%). These findings

are consistent with previous studies among university students in Tamil Nadu, which also reported moderate levels of awareness regarding IDA (Kanna et al., 2022). However, studies conducted among adults in Riyadh reported higher levels of good awareness, suggesting possible differences in educational exposure and public health awareness across populations (Mohammad et al., 2020). Although respondents generally demonstrated moderate awareness regarding IDA, the findings indicate that important gaps in preventive awareness and health-related practices remain among young adults. University students are often exposed to lifestyle-related risk factors such as irregular eating habits, poor dietary practices, and academic stress, which may increase their vulnerability to IDA (Kanna et al., 2022). Therefore, strengthening health education interventions and awareness campaigns within higher education institutions may help improve students' public health literacy and encourage preventive health behaviours related to IDA.

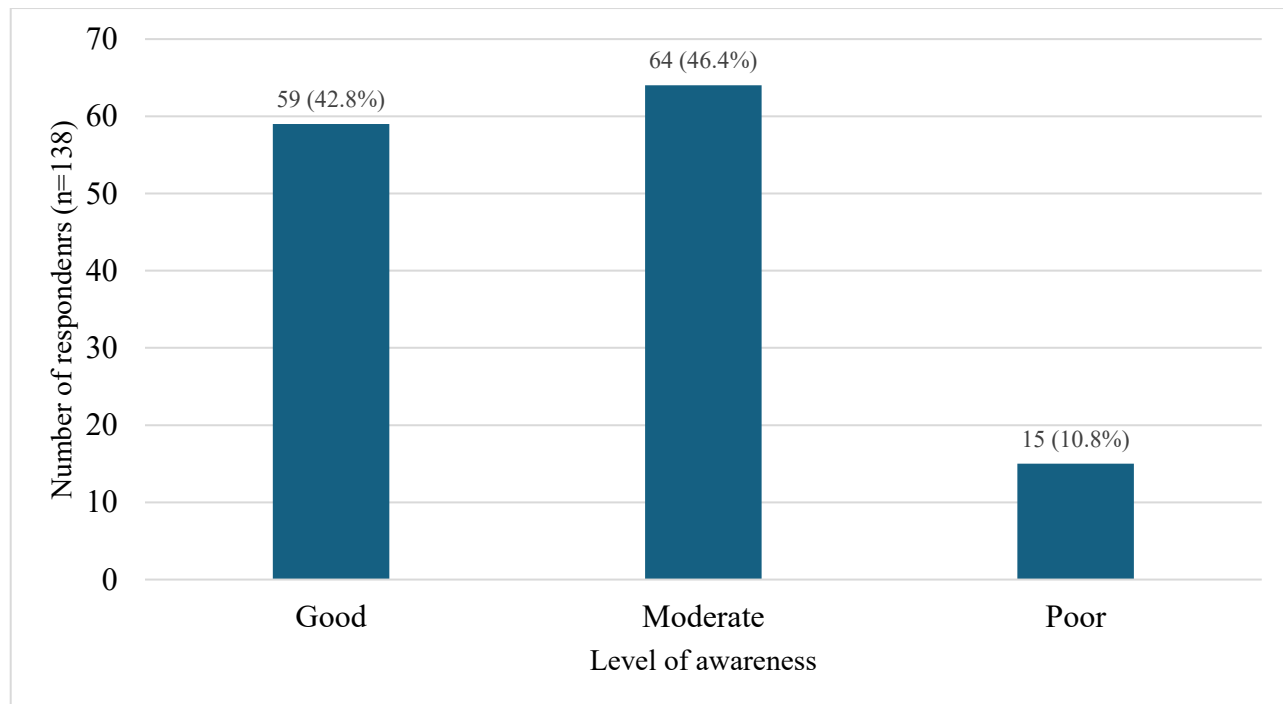


Figure 2: Level of Awareness regarding IDA

Association Between Knowledge and Awareness Levels

The association between knowledge and awareness levels regarding IDA (Table 4) was evaluated using Cramer's V coefficient, as the variables consisted of a 3 X 3 contingency table. The findings revealed a weak but statistically significant positive association between knowledge and awareness levels ($r = 0.214$, $p = 0.012$), indicating that respondents with higher knowledge levels tended to demonstrate greater awareness regarding IDA. Although the association was weak, the findings suggest that adequate theoretical knowledge alone may not necessarily translate into strong awareness and preventive understanding of IDA. For instance, while respondents generally demonstrated basic understanding of IDA symptoms and causes, awareness regarding dietary and lifestyle-related factors remained limited. Similar findings were reported in a Malaysian study, which identified a positive relationship between knowledge and attitudes toward anemia among university students (Huong et al., 2022). These findings highlight the importance of strengthening educational and awareness initiatives to improve public health literacy regarding IDA among young adults.

Table 4. Associations between level of knowledge and awareness of IDA

Knowledge/Awareness	Good knowledge	Moderate knowledge	Poor knowledge	P value, (r)
Good awareness	18	27	14	0.012 (0.24)
Moderate awareness	10	26	28	
Poor awareness	3	3	10	

Association Between Demographic Characteristics and Knowledge Levels

Table 5 presents the association between demographic characteristics and respondents' knowledge levels regarding IDA. A statistically significant association was observed between semester of study and knowledge level ($p = 0.027$), indicating that students in higher semesters tended to demonstrate better knowledge regarding IDA. Increased academic exposure and greater familiarity with health-related topics throughout the study program may contribute to this finding. Similar trends have been reported among healthcare-related students in previous studies (Alhatemi & Haroun, 2023).

There are no significant associations were identified between knowledge levels and other demographic variables, including age, gender, family medical background, and previous diagnosis of IDA ($p > 0.05$). Nevertheless, female respondents demonstrated slightly higher knowledge levels compared to male respondents. This finding may reflect differences in health awareness and exposure to anemia-related information, particularly among women who are more frequently affected by IDA (Relacion et al., 2021). Overall, the findings suggest that educational exposure may play a more important role in influencing IDA knowledge compared to demographic background alone.

Table 5: Association of demographic characteristics with the level of knowledge of respondents

Demographics		Level of knowledge			p- value
		Good (%)	Moderate (%)	Poor (%)	
Gender	Male	3 (2.2)	12 (8.7)	8 (5.8)	0.372 ^a
	Female	27 (19.6)	44 (31.9)	44 (31.9)	
Age	18-22 years old	28 (20.3)	53 (38.4)	50 (36.2)	0.486 ^b
	22-24 years old	1 (0.7)	3 (2.2)	1 (0.7)	
	25-30 years old	1 (0.7)	0 (0)	0 (0)	
	>30 years old	0 (0)	0 (0)	1 (0.7)	
Semester/ Year of study	Sem 1 / 2 (Year 1)	6 (4.3)	20 (14.5)	26 (18.8)	0.027 ^a
	Sem 3/ 4 (Year 2)	14 (10.1)	13 (9.4)	11 (8.0)	
	Sem 5 / 6 (Year 3)	10 (7.2)	23 (16.7)	15 (10.9)	
Family members with medical backgrounds	Yes	16 (11.6)	24 (17.4)	23 (16.7)	0.637 ^a
	No	14 (10.1)	32 (23.3)	29 (21.0)	
Medical history with iron deficiency anemia	Yes	5 (3.6)	8 (5.8)	4 (2.9)	0.646 ^a
	No	21 (15.2)	40 (29.0)	37 (26.8)	
	Not sure	4 (2.9)	8 (5.8)	11 (8.0)	

Chi-square test, significant when p-value <0.05.

a- Chi-square test b- Fisher's Exact test

Association Between Demographic Characteristics and Awareness Levels

Table 6 presents the association between demographic characteristics and awareness levels regarding IDA. A statistically significant association was identified between age and awareness level ($p = 0.033$), suggesting that younger respondents aged 18–22 years demonstrated higher awareness regarding IDA compared to older age groups. Similar findings have been reported in studies conducted among young adults in India, where respondents within the same age range demonstrated greater awareness of anemia-related issues (Balaji & Devaraj, 2021).

No statistically significant associations were observed between awareness levels and other demographic variables, including gender, semester of study, family medical background, and previous diagnosis of IDA ($p > 0.05$). Although female respondents demonstrated slightly higher awareness levels than male respondents, the difference was not statistically significant. The moderate awareness levels observed among respondents indicate that awareness gaps regarding IDA remain present among university students regardless of demographic background. These findings highlight the need for broader health education and awareness programs targeting young adults in higher education settings.

Table 6: Association of demographic characteristics with the level of awareness of respondents

Demographics		Level of awareness			p- value
		Good (%)	Moderate (%)	Poor (%)	
Gender	Male	6 (4.3)	14 (10.1)	3 (2.2)	0.242 ^a
	Female	53 (38.4)	50 (36.2)	12 (8.7)	
Age	18-22 years old	59 (42.8)	59 (42.8)	13 (9.4)	0.033 ^b
	22-24 years old	0 (0)	4 (2.9)	1 (0.7)	
	25-30 years old	0 (0)	0 (0)	1 (0.7)	
	>30 years old	0 (0)	1 (0.7)	0 (0)	
Semester/ Year of study	Sem 1 / 2 (Year 1)	23 (16.7)	24 (17.4)	5 (3.6)	0.821 ^a
	Sem 3/ 4 (Year 2)	18 (13.0)	17 (12.3)	3 (2.2)	
	Sem 5 / 6 (Year 3)	18 (13.0)	23 (16.7)	7 (5.1)	
Family members with medical backgrounds	Yes	28 (20.3)	28 (20.3)	7 (5.1)	0.940 ^a
	No	31 (22.5)	36 (26.1)	8 (5.8)	
Medical history with iron deficiency anemia	Yes	11 (8.0)	4 (2.9)	2 (1.4)	0.129 ^a
	No	42 (30.4)	46 (33.3)	10 (7.2)	
	Not sure	6 (4.3)	14 (10.1)	3 (2.2)	

Chi-square test, significant when p-value <0.05.

a- Chi-square test b- Fisher's Exact test

CONCLUSION

This study assessed the knowledge and awareness of IDA among Diploma in Pharmacy students at UiTM Pulau Pinang Bertam Campus. Overall, respondents demonstrated moderate levels of knowledge and awareness towards IDA. Semester of study was significantly associated with knowledge levels, while age showed a significant association with awareness levels. In addition, a weak but significant positive association was identified between knowledge and awareness level. The findings highlight the need to strengthen health education and awareness initiatives related to IDA among university students, particularly future healthcare professionals. Educational interventions such as seminars, awareness campaigns, workshops, and digital health promotion activities may help improve students' understanding of IDA prevention, management, and healthy lifestyle practices.

Enhancing public health literacy at the university level may also contribute to early prevention and better health-seeking behaviours among young adults. Nevertheless, several limitations should be considered when interpreting the findings of this study. The study was limited to Diploma in Pharmacy students at UiTM Pulau Pinang Bertam Campus and may not be generalizable to broader populations. Future studies involving students from multiple universities and academic disciplines are recommended to provide more comprehensive comparative insights regarding knowledge and awareness of IDA among young adults. Furthermore, future research may benefit from adopting a mixed-methods approach by incorporating qualitative interviews or focus group discussions to explore students' perceptions, misconceptions, and personal experiences related to IDA in greater depth.

ACKNOWLEDGEMENT

The authors would like to thank the Diploma in Pharmacy students for their help in the data collection: Haifa Izzati Zulkarnain, Norsyakira Norazmie and Muhammad Irfan Mohd Yunos. The authors also appreciate the support of UiTM Cawangan Pulau Pinang for facilitating the execution of this study. The authors used AI-assisted language editing tools to improve clarity and grammar during manuscript preparation. All intellectual content, interpretation of data and final decisions remain the responsibility of the authors. All authors reviewed and approved the final manuscript.

Conflict Of Interest

The authors declare no conflict of interests.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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