



Knowledge, Attitude And Practice (KAP) On Anemia Among Female Healthcare Workers In Tertiary Care Hospital

P. Sneha, Ms. E. Lakshmi, Dr. Vinitha Krishnan, Ms. Anusuya

MSc. Clinical Nutrition and Dietetics, Associate Professor, HOD of Clinical Nutrition, Senior Dietitian

Department of Clinical Nutrition and Dietetics, SRM Medical College And Research Centre, SRM Institute
For Science and Technology, Kattankulathur, Chengalpattu, Chennai, India

Abstract: Anemia, a prevalent global health concern disproportionately affecting women, demands attention to the knowledge, attitudes, and practices (KAP) related to iron deficiency anemia (IDA) among female healthcare workers. This descriptive correlational study aimed to assess KAP regarding anemia among 115 female healthcare workers in a tertiary care hospital. The sample comprised female healthcare workers from various departments, including medical and non-medical, within the tertiary care hospital. A validated questionnaire from the Food and Agriculture Organization (FAO) on KAP related to anemia was utilized, assessing demographic information, background variables, and KAP related to anemia. Results shows, no significant difference was found between occupation and KAP, suggesting that occupational roles insignificantly impact anemia-related KAP in this population. Furthermore, there was no association found between occupation and KAP, the type of job or position within the healthcare sector does not significantly influence how individuals perceive, understand, or act upon issues related to anemia.

While a positive correlation existed between knowledge and attitude toward anemia prevention, no significant relationship was observed between attitude and practice, indicating that positive attitudes did not consistently translate into healthy practices. Meal skipping, particularly breakfast, irregular eating habits, high level of tea and coffee consumption and low rest hours among female healthcare workers were identified as contributors to the risk of IDA. These findings highlight the importance of not just improving knowledge and attitudes but also ensuring that there are effective strategies and interventions in place that can translate this knowledge and attitude into practical actions among healthcare workers. This might involve more targeted training programs, practical workshops, or institutional support to bridge the gap between knowledge, attitude, and practice.

Key words- Anemia, Knowledge, Attitude, Practice, Female healthcare workers, Tertiary care hospital

INTRODUCTION

Anemia, originating from the ancient Greek term "anaimia," which means "lack of blood" [1], is a widespread dietary deficiency around the world. Anemia affects over one-third of the global population [2]. Anemia is a serious health issue, particularly for young children, pregnant and postpartum women, and menstrual adolescent girls and women. Anemia is a disorder characterized by low blood and hemoglobin levels, as well as a lack of circulating red blood cells (RBCs), which are required for oxygen transfer [3]. This eventually causes a decrease in the capacity of a cell to carry oxygen and resulting in many other ailments, including the heart, kidneys, and other organs, generating situations such as cardiopulmonary, kidney failure, higher risk of infections, and cognitive problems [4]. The most common

symptoms are shortness of breath, dizziness, chest pain, pale complexion, headache, and an increase in heartbeat. [5]. Anemia is particularly common in poorer countries like Asia and Africa, and it is frequently associated with a low level of education [6]. It remains an important public health risk on a global basis. Iron insufficiency is acknowledged as the most frequent dietary deficit globally, affecting both poor and developed countries [7]. Iron, a vital micronutrient, is essential for the transportation of oxygen [8]. Anemia can affect cognitive and physical functions, resulting in lower economic production [9]. Maternal iron insufficiency has serious consequences, including stillbirth, poor birth weight, and infant mortality [10]. The World Health Organization (WHO) estimates that anemia affects 2 billion people worldwide, including half a billion women of reproductive age [11]. According to the World Health Organization, 29.9% of women aged from 15 to 45 suffer from anemia [11]. Iron deficiency is the major cause of anemia worldwide, impacting around 1.24 billion people. [12]. Menstrual blood loss, parasite infections, thalassemia, and sickle cell disease are among factors that can have an impact on hemoglobin levels [13]. Age, gender, height of habitation, smoking habits, and pregnancy can all impact hemoglobin concentration [13]. According to the National Family Health Survey-4 (NFHS-4) in Tamil Nadu, the prevalence of anemia among non-pregnant women and pregnant women was 55.4% and 44%, respectively [14]. Anemia among women of reproductive age is caused by a variety of causes, including an improper diet, micronutrient deficiencies such as iron, vitamin B12, and folate, as well as chronic illnesses [15,16]. Other risk factors include typical physiological changes during pregnancy, hemoglobinopathies, malaria, HIV, and hookworm infestations [16, 17]. The World Health Organization (WHO) classifies anemia in non-pregnant adult women according to hemoglobin levels: Mild anemia is defined as a hemoglobin level of 10 to less than 12 g/dl, Moderate anemia is defined as hemoglobin levels ranging from 7 to less than 10 g/dl, while severe anemia is characterized by hemoglobin levels below 7 g/dl [18]. Iron deficiency can be divided into three stages: Mild deficiency, which involves depleted iron stores but normal hemoglobin and iron-dependent protein production; marginal deficiency, characterized by depleted iron stores and reduced iron-dependent protein production but normal hemoglobin levels; and iron deficiency anemia, marked by a reduced number of circulating red blood cells (RBCs), leading to lower hemoglobin levels and impaired oxygen transport to tissues due to further depleted iron stores, and decreased levels of iron-dependent oxidative enzymes [19]. For women, anemia increases the risk of low birth weight or prematurity, perinatal and neonatal death, insufficient iron storage for babies, higher morbidity and mortality rates, and decreased physical activity, mental concentration, and productivity [20, 21, 22]. A healthy person maintains nutritional balance when the amount of food ingested fulfills the body's nutrient needs [23]. However, this equilibrium can be upset by variables such as poor diet, increased nutrient losses, increased requirements, impaired absorption, and reduced utilization, which frequently leads to iron insufficiency. Women with moderate anemia may report weariness and reduced job capability [24]. Among younger women, the prevalence of iron deficiency anemia is 2.4%, compared to 5.5% in older women [25]. Iron distribution in body – 70% of the iron in the human body attaches to hemoglobin, the pigment found in red blood cells (RBCs) that gives blood its red hue, the remaining iron either binds to other proteins such as myoglobin, transferrin, and ferritin, or it is stored within cells. The reticuloendothelial system, which clears damaged RBCs via macrophages in the spleen, liver, and bone marrow, contributes to iron homeostasis [59]. Enterocyte cells located in the duodenum and upper jejunum of the small intestine are tasked with the absorption of dietary iron. Because humans lack an active iron excretion system, intestinal iron absorption is crucial to maintaining iron balance in the body.[58]. Iron in the diet is present in two chemical forms: heme and nonheme. Haeme iron is present in haemoglobin, myoglobin and some enzymes. Non-haeme iron is found in plant foods, non-haeme enzymes and ferritin. Haeme iron is only found in animal products like meat, fish, and poultry, whereas nonheme iron can be found in fruits, vegetables, dry beans, nuts, grains products, and meat [60]. Heme iron is absorbed by the gut with greater effectiveness than nonheme iron [61].Iron absorption rates have been recorded as 25-30% from organ meats, 7-9% from green leafy vegetables, 4% from grains, and 2% from dry legumes, implying that food categories or other dietary factors may alter iron bioavailability [74]. Only 1-2 mg of iron are absorbed daily from a typical Western diet of 7 mg per 1000 kcal [62].

Ascorbic acid aids in iron absorption by binding with ferric iron (Fe^{3+}) in the acidic pH of the stomach, creating a soluble chelate that remains stable in the alkaline environment of the duodenum, the first part of the small intestine. Furthermore, ascorbate, or ascorbic acid salt, provides an electron, functioning as a free radical scavenger and decreasing iron oxidation states to Fe^{2+} , the only accessible form for enterocyte cells. [65]. Various animal tissues, including beef, chicken, fish, hog, and lamb, are beneficial to dietary non-haeme absorption. [67]. Ascorbic acid enhances iron absorption by creating a chelate with ferric iron (Fe^{3+}) in the acidic environment of the stomach, which stays soluble when transitioning to the alkaline pH of the duodenum, which is the initial segment of the small intestine [66]. Ascorbate, the salt of ascorbic acid, also donates an electron, serving as an antioxidant by scavenging free radicals and reducing iron oxidation states to Fe^{2+} , which is the sole accessible form for enterocytes. In plant-based diets, phytate and polyphenols decrease iron absorption by forming complexes with dietary iron in the gastrointestinal system [64, 65]. The lack of endophytases in the small intestine prevents the human body from digesting and absorbing phytate. Polyphenols are commonly present in the human diet, particularly in vegetables, cereals, spices, tea, coffee, red wine, and chocolate. [69, 70]. Polyphenols are recognized as inhibitors of iron bioavailability, functioning akin to phytate by binding with iron to form a complex molecule. [71]. Proteins have been reported to impede or improve iron absorption, depending on their source. While meat proteins have been demonstrated to enhance iron absorption [72, 68, 72], other proteins, like those found in eggs, were identified as inhibitors. [73].

Nutritional anemia is caused by a lack of important hematological elements such as iron, vitamin A, vitamin B12 (riboflavin), or folic acid, all of which are required for hemoglobin and red blood cell formation [3, 38]. Riboflavin (Vitamin B 2) deficiency promotes the development of anemia. Its effects on iron metabolism include reduced iron mobilization from storage, decreased iron absorption, and increased iron loss [39]. Similarly, vitamin C deficiency causes anemia by inducing hemolysis, which damages and destroys erythrocytes, as well as increasing non-heme iron absorption [39]. Beyond dietary inadequacies, several factors lead to anemia. Non-nutritional factors contribute significantly to the development of anemia. These include parasite infections, genetically determined hemoglobinopathies, and menstrual blood loss.

Anemia is a concern for all demographics, but female medical students are especially vulnerable due to their rigorous schedules, inconsistent eating times, and long working hours [26]. According to research, anemia has a considerable negative impact on occupational performance, and iron therapy can dramatically boost productivity. This is especially important in healthcare fields, where women are disproportionately affected. Healthcare personnel, including doctors, nurses, pharmacists, technicians, therapists, and associated professionals, encounter specific problems such as irregular schedules, unexpected working hours, and heavy workloads, making them more susceptible to anemia. Young working women, especially those who are physically active, are more likely to develop anemia and iron deficiency. [28]. This increased risk is frequently caused by a combination of menstrual iron loss, higher physical demands, and insufficient dietary iron consumption. Iron deficiency can lead to symptoms such as fatigue, depression, and restless legs syndrome, all of which can diminish both quality of life and work performance [29]. Human studies have extensively demonstrated the relationship between hemoglobin levels and work production [30]. Similar relationships between iron status and labour performance have been found in research on Sri Lankan tea estate workers and Kenyan road construction workers [31,32]. The economic benefits of increased job productivity with iron therapy are especially substantial in underdeveloped countries. Several investigations have revealed that people with iron-deficiency anemia frequently experience fatigue and weakness. According to research on premenopausal working women, menstrual or recently pregnant women are more likely to have iron deficiency [33]. Educated young working women have a better understanding of anemia, its causes, and implications than illiterate women, who are generally from rural areas [34]. Anemia is the most common nutritional deficit in the world, accounting for 95% of cases due to inadequate diet [35]. Iron deficiency anemia manifests when there's a lack of dietary iron intake, insufficient absorption, heightened physical demands, or significant blood loss [36, 37]. Certain populations have a particularly high rate of underweight, anemia, and low iron status. For example, young, nulliparous female garment workers in Cambodia are at a higher risk of nutritional inadequacies [41].

METHODOLOGY

A cross-sectional observational study of 115 female healthcare workers working in SRM Institute for Medical Science, SIMS Hospital, Chennai representing a diverse range of departments within the hospital setting, ages range from 18 to 62, which represents the wide variety of ages among the female healthcare workers in the institution. The sample for the study was obtained by getting permission from concerned authorities. After obtaining ethical clearance from the institute's Ethics Committee and permission from the HR department of SIMS Hospital and other relevant department heads, participants will be selected based on the inclusion and exclusion criteria. Informed consent was obtained from every participant.

Inclusion criteria

- All female healthcare workers
- Age above 18 years to 65 years

Exclusion criteria

- All male healthcare workers
- Age below 18 years
- Pregnant and lactating women
- Female healthcare workers who are already taking medications for anemia
- Female health care workers not having Indian citizenship
- Female health care workers who are not willing to participate

Knowledge, Attitude and Practices (KAP):

K – Knowledge: Shows the level of awareness of the risks linked to iron deficiency anemia to healthcare workers. Questions to assess understanding of anemia, its causes, symptoms, prevention, and treatment. Female healthcare personnel, who play an important role in patient care, require extensive knowledge to appropriately handle anemia.

A – Attitude: Questions to assess information of the female healthcare worker's perspectives, beliefs and feelings that are perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-confidence, food preferences towards iron deficiency anemia and its management. Their attitudes toward anemia have a substantial impact on their interactions with patients, influencing the overall quality of healthcare delivery.

P – Practice: Questions to understand the actual behaviors and practices related to anemia, the dietary management of consumption of specific iron rich foods and its frequency. Identifying prevalence Practices will assist in identifying gaps and adopting solutions to improve the standard of care, that is the dietary habits they practice in day to day life.

Data collection

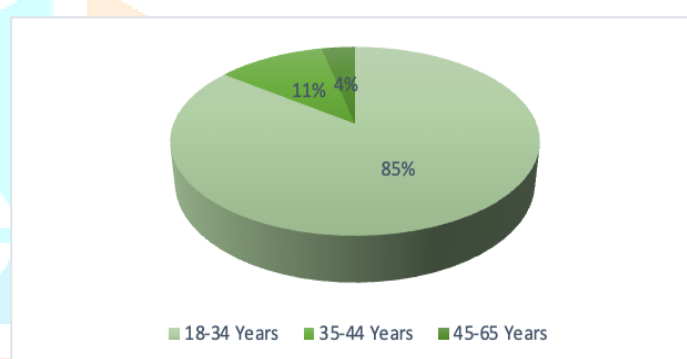
Data will be collected through face-to-face interviews using a validated questionnaire obtained from the Food and Agriculture Organization (FAO). The questionnaire consists of two sections. Section A includes demographic information such as age, educational qualification and occupation. background variables like type of family, dietary pattern, number of meals per day, history of previous anemia, skipping of meals, and details about the menstrual cycle. Section B consists of a total of 17 questions: 8 questions on knowledge, 6 questions on attitudes, and 3 questions on practices regarding anemia. The scoring for knowledge, the correct answer was scored (two points), the incomplete answer was scored (one point) and for those who don't know was scored (zero). 3-point Likert scale is used for attitude, where for a positive or desired response score of 3, neutral response score of 2 and for negative response score of 1 is given. In practice, it consists of closed ended questions, each item score of 1 for yes and zero for no.

RESULTS

Table 1: Age group of respondents

Age	Frequen cy	Percentage (%)
18-34 Years	98	85.2
35-44 Years	13	11
45-65 Years	4	4
TOTAL	115	100

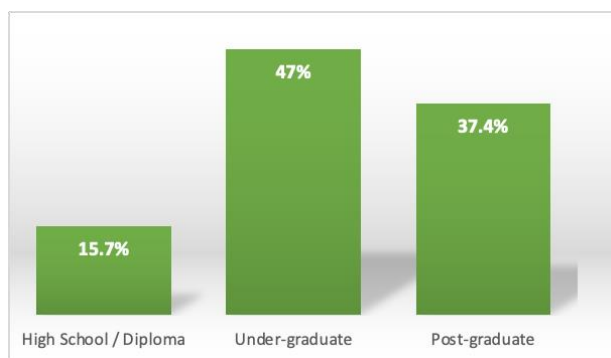
Figure 1: Age group of respondents



Inference: Most respondents (85.2%) are in the 18-34 age group, showing that younger female healthcare workers are the main participants in this study. The 35-44 age group comprises 11%, while those aged 45-65 years make up only 4%, indicating lesser participation from older age groups.

Table 2: Educational qualification of respondents

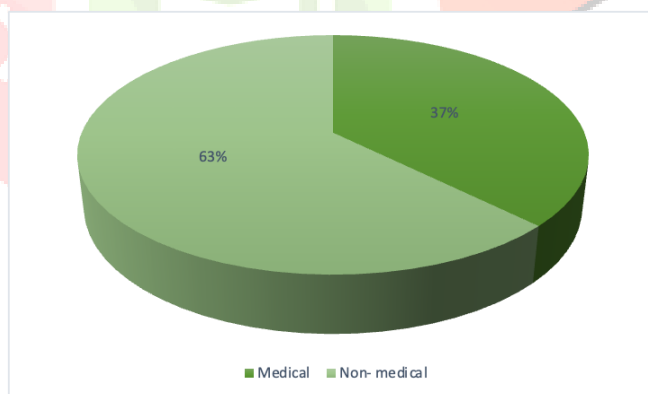
Qualification	Frequenc y	Percentage (%)
High School / Diploma	18	15.7
Under-graduate	54	47
Post-graduate	43	37.4
TOTAL	115	100

Figure 2: Educational qualification of respondents

Inference: The data on the educational qualifications of respondents indicates that nearly half (47%) are undergraduates, while 37.4% have postgraduate qualifications. A smaller portion, 15.7%, have a high school diploma or equivalent. This suggests that the majority of the female healthcare workers surveyed have attained higher education levels, with a significant number having advanced degrees.

Table 3: Occupation of respondents

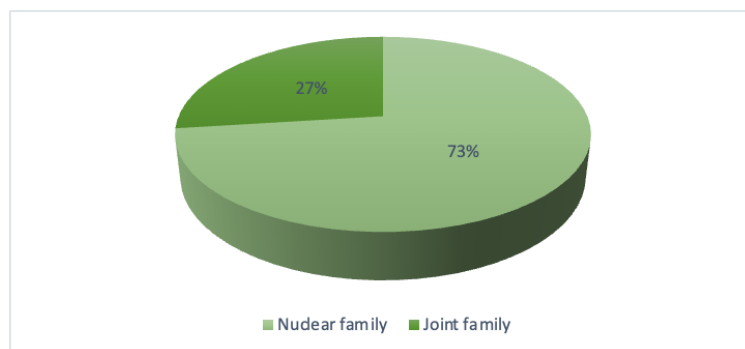
Occupation	Frequency	Percentage (%)
Medical	43	37.4
Non-medical	72	62.6
TOTAL	115	100

Figure 3: Occupation of respondents

Inference: The majority of respondents (62.6%) are in non-medical roles, while 37.4% are in medical roles. This indicates that non-medical positions comprise the majority of the respondents in the study.

Table 4: Type of family

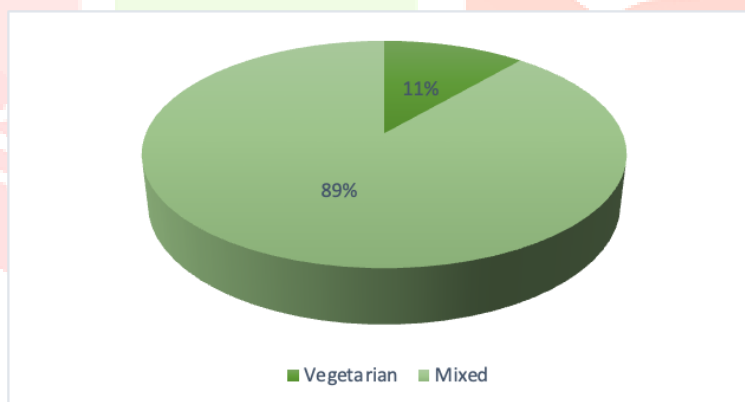
Family	Frequency	Percentage (%)
Nuclear family	84	73.0
Joint family	31	27.0
TOTAL	115	100

Figure 4: Type of family

Inference: The majority of respondents of 73% live in nuclear families, while 27% reside in joint families. This suggests that nuclear families are more prevalent among the surveyed individuals compared to joint families.

Table 5: Dietary pattern

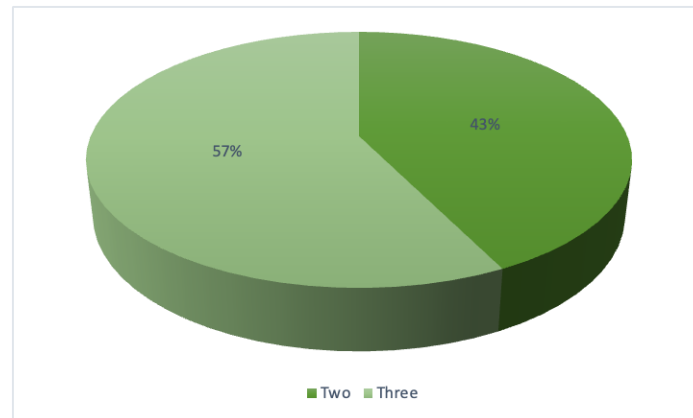
Dietary pattern	Frequency	Percentage (%)
Vegetarian	13	11.3
Mixed	102	88.7
TOTAL	115	100

Figure 5: Dietary pattern

Inference: The data on dietary patterns shows that the majority of respondents, at 88.7%, follow a mixed diet, while only 11.3% adhere to a vegetarian diet. This suggests that the preference for a mixed diet is significantly higher among the respondents compared to vegetarianism. Overall, the data indicates a preference for dietary variety among the surveyed individuals.

Table 6: Meals per day

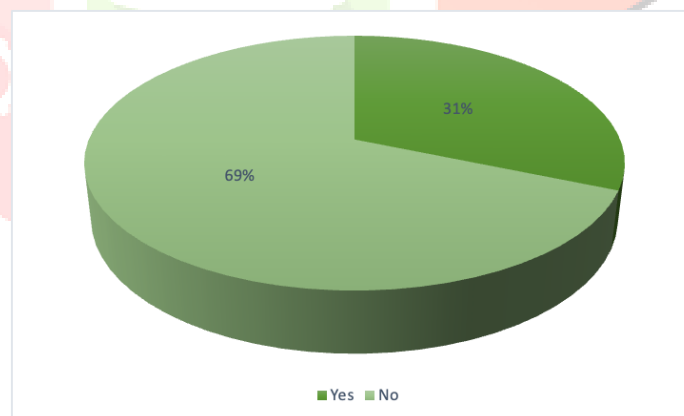
Meals	Frequency	Percentage (%)
Two	49	42.6
Three	66	57.3
TOTAL	115	100

Figure 6: Number of meals per day

Inference: The data shows that while 57.3% of the sample population prefers consuming three meals a day, a significant portion, 42.6%, opts for only two meals. This suggests a mixed preference within the population regarding meal frequency, with a notable proportion favoring a two-meal daily routine.

Table 7: History of previous anemia

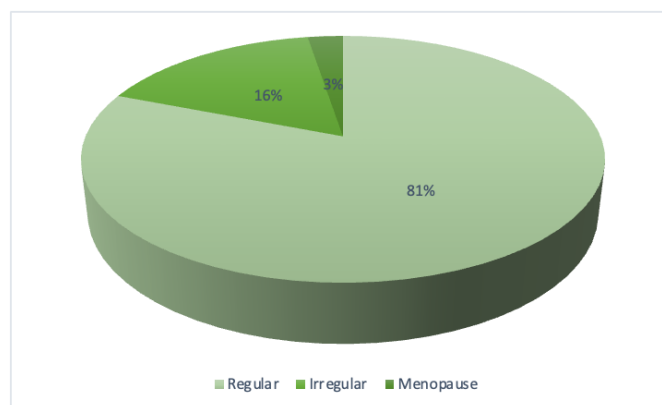
History of Anemia	Frequency	Percentage (%)
Yes	36	31.3
No	79	68.7
TOTAL	115	100

Figure 7: History of previous anemia

Inference: The data indicates that 31.3% of respondents have a history of previous anemia, while the majority, 68.7%, do not. This suggests that a significant portion of respondents have experienced anemia in the past.

Table 8: Menstrual cycle

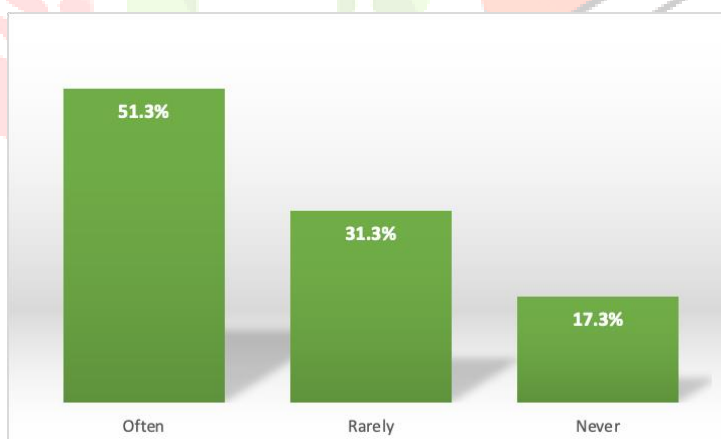
Menstrual cycle	Frequency	Percentage (%)
Regular	93	80.9
Irregular	19	16.5
Menopause	3	2.6
TOTAL	115	100

Figure 8: Menstrual cycle

Inference: The data shows that 80.9% of respondents have a regular menstrual cycle, while 16.5% experience irregular cycles. Additionally, 2.6% of respondents are in menopause. This suggests that the majority of respondents have regular menstrual cycles.

Table 9: Skipping of meals

Meal	Frequency	Percentage (%)
Often	59	51.3
Rarely	36	31.3
Never	20	17.3
TOTAL	115	100

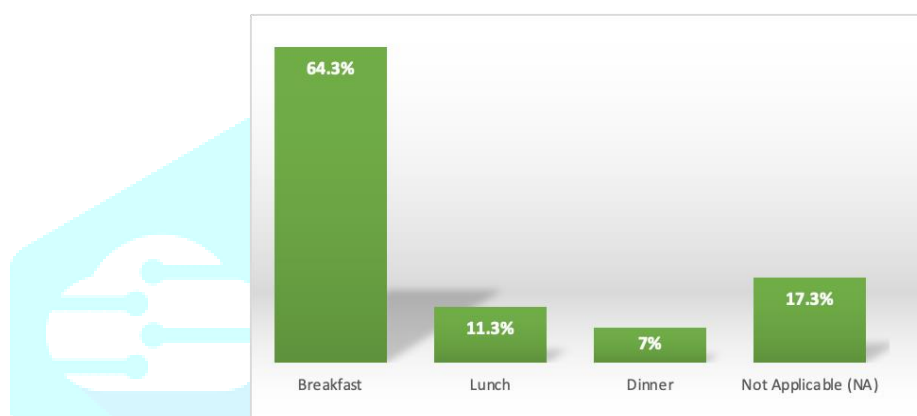
Figure 9: Skipping of meals

Inference: The majority of the sample population (51.3%) often skip meals, indicating irregular eating habits. A smaller portion (31.3%) rarely skip meals, suggesting more consistent meal patterns. The smallest group (17.3%) never skips meals, indicating the most regular eating habits. This distribution shows that a significant portion of the population frequently skips meals, while a minority consistently maintains regular meal consumption.

Table 10: Type of meal skipped

Meal	Frequency	Percentage (%)
Breakfast	74	64.3
Lunch	13	11.3
Dinner	8	7.0
Not Applicable (NA)	20	17.3
TOTAL	115	100

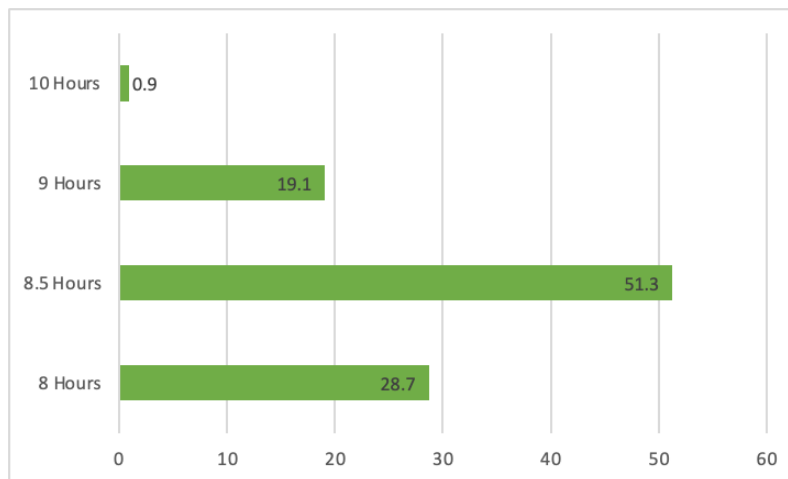
Figure 10: Type of meal skipped



Inference: The majority of the sample population (64.3%) skips breakfast, followed by a smaller percentage who skip lunch (11.3%) and dinner (7.0%). Notably, 17.3% of individuals never skip meals, indicating they may have irregular eating habits. This distribution shows that a significant portion of the population frequently skips meals, while a minority consistently maintains regular meal consumption.

Table 11: Total number of working hours per day

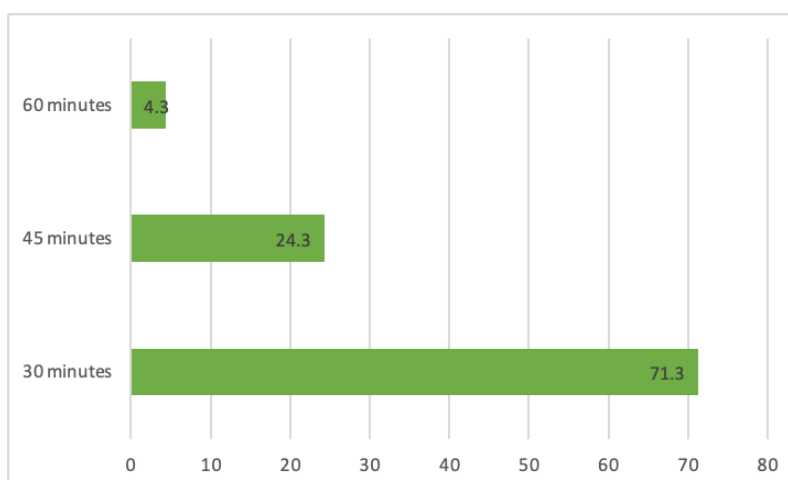
Time	Frequency	Percentage (%)
8 Hours	33	28.7
8.5 Hours	59	51.3
9 Hours	22	19.1
10 Hours	1	0.9
TOTAL	115	100

Figure 11: Total number of working hours

Inference: Based on the data provided, it seems that the majority of people work either 8.5 hours or 8 hours a day, with 51.3% and 28.7% respectively. A smaller portion works 9 hours, comprising 19.1% of the total. Very few, just 0.86%, work for 10 hours. This suggests that the most common workday length is between 8 and 9 hours.

Table 12: Total number of rest hour per day

Time	Frequency	Percentage (%)
30 min	82	71.3
45 min	28	24.3
60 min	5	4.3
TOTAL	115	100

Figure 12: Total number of rest hour per day

Inference: Most respondents (71.3%) rest for 30 minutes per day, while 24.3% rest for 45 minutes, and only 4.3% rest for 1 hour. This distribution highlights that the majority of respondents have shorter breaks or rest periods during their working and indicates that the majority have limited rest periods, suggesting a potential area for improving work-life balance among healthcare workers.

Table 13: Correlation between knowledge, attitude and practice

N=115

		Knowledge	Attitude	Practice
Knowledge	Correlation coefficient	1.000	0.183	-0.067
Attitude	Correlation coefficient	0.183	1.000	0.080
Practice	Correlation coefficient	-0.067	0.080	1.000

Significant at $P \leq 0.05$

Correlation Between Knowledge and Attitude

There is a weak positive correlation between knowledge and attitude among female health care workers, with a Spearman's rho correlation coefficient

Correlation Between Attitude and Practice

The correlation between attitude and practice among female health care workers is very weakly positive, with a Spearman's rho correlation coefficient of 0.080. However, this relationship is not statistically significant, as indicated by a significance level of 0.395.

Correlation Between Practice and Knowledge

The correlation between practice and knowledge among female health care workers shows a very weak negative correlation, with a Spearman's rho correlation coefficient of -0.067. Therefore, this relationship is not statistically significant, as indicated by a significance level of 0.475.

Table 14: Association of occupation with knowledge, attitude and practice

	Occupation	N	Mean & Standard deviation
Knowledge	Medical	43	10.79±2.6
	Non-medical	72	11.63±2.5
Attitude	Medical	43	13.74±1.7
	Non-medical	72	14.04±1.6
Practice	Medical	43	19.67±5.8
	Non-medical	72	19.74±7.1

Significant at $P \leq 0.05$

Association between occupation and knowledge

The above table shows, there is no significant difference between occupation and knowledge towards anemia among female healthcare workers, with a significance level of 0.985 as per T-Test.

Association between occupation and attitude

There is no significant difference between occupation and attitude towards anemia among female healthcare workers, with a significance level of 0.723 as per T-Test.

Association between occupation and practice

There is no significant difference between occupation and practice towards anemia among female healthcare workers, with a significance level of 0.105 as per T-Test.

DISCUSSION

Knowledge towards anemia among female healthcare workers

Nearly 93% of female healthcare workers are aware of anemia, according to a study. Similarly, another study found that 73% of participants had heard about anemia ([54]. However, detailed knowledge about anemia varies significantly among healthcare workers. Only 11.3% could correctly identify the symptoms of anemia, while 81% provided incomplete answers. This level of detailed knowledge is lower than findings from other studies, where 44.2% and 38% of participants could correctly identify symptoms [78, 79]. In terms of understanding the consequences of anemia, 82% of healthcare workers are aware of its effects on young children, but only 23% understand its impact on pregnant women. Furthermore, 65.2% provided incomplete answers regarding the consequences of anemia. Knowledge about the causes of anemia is relatively low, with only 12.1% answering correctly, and 83% providing incomplete answers. This indicates a lack of awareness among healthcare workers about how anemia is caused. Similarly, only 9.5% of participants knew how to prevent anemia, 84.3% gave incomplete answers. Regarding dietary factors, 78.2% of healthcare workers correctly identified foods that increase iron absorption, such as Vitamin C. Conversely, 42% correctly identified that tea and coffee consumption decrease iron absorption. This finding is higher than another study where only 37.3% correctly identified this fact [78]. Awareness of iron-rich foods that are easily absorbed is also low, with only 40% of participants answering correctly, and 47% not knowing.

Attitude towards anemia among female healthcare workers

Approximately 18.2% of female healthcare workers expressed uncertainty regarding whether they had been diagnosed with anemia, 33% think they're not likely while 49% believed they were likely to develop anemia. These figures are consistent with similar observations but lower than those reported in other studies [80]. Despite this, a positive attitude toward anemia was evident, with 68% considering it a serious health problem. Moreover, a significant majority of healthcare workers 95% believed that preparing meals with iron-rich foods was beneficial for themselves and their families. Interestingly, none considered it to be not beneficial, while only 5.2% were unsure. However, despite this awareness, some challenges were identified. Approximately 15% found cooking with iron-rich foods difficult, with an additional 4.3% finding it somewhat challenging due to pre-preparation work and time constraints, particularly on working days. Nevertheless, the majority 80% did not find it difficult to cook with such foods, and 83% felt confident in cooking with them. Although organ meats are known to be a rich source of iron, opinions on their taste varied among healthcare workers. Approximately 38.2% disliked the strong iron taste, while 14% were unsure, and 48% liked the taste.

Practice towards anemia among female healthcare workers

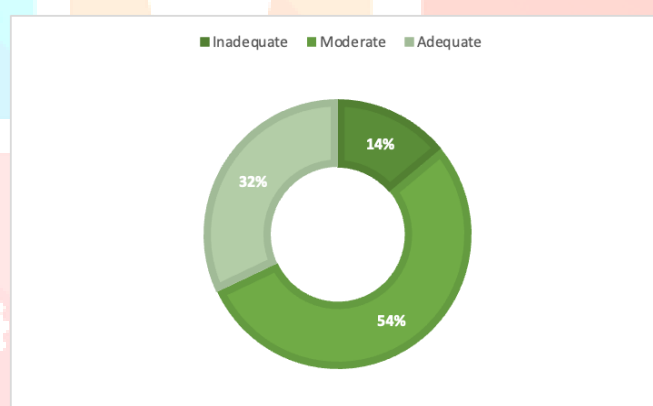
Despite being aware that tea and coffee consumption decreases iron absorption, nearly 71.3% of female healthcare workers habitually consume these beverages, with 56.5% drinking them daily. Among them, 29% do not drink tea or coffee at all. Interestingly, tea and coffee consumption immediately after a meal, which can reduce iron absorption, is practiced by 12% of respondents, while 44.3% drink these beverages two hours or more before a meal. Notably, tea consumption of more than four cups per day was associated with a higher prevalence of iron deficiency anemia (IDA), primarily due to the presence of iron absorption inhibitors such as polyphenols and calcium [81]. Regarding vitamin C intake, nearly 94% of female healthcare workers habitually include it in their diet. However, only 32% consume it daily, while 62% do not. A relatively low vitamin C intake was observed. Vitamin C plays a crucial role in non-heme iron absorption. Interestingly, 56% consume vitamin C after meals, indicating an understanding of its role in enhancing iron absorption. The highest consumption rate for Moringa leaves 28.5%, followed by Gogu leaves 23%. The lowest consumption rate is for Amaranth 12.8%. Generally, Moringa leaves and Gogu leaves have higher consumption rates compared to other green leafy vegetables, indicating their popularity or better accessibility. In terms of organ meat consumption among female healthcare workers, distinct trends were observed. Liver emerged as the most favored, with 43% of respondents indicating consumption, compared to 28.81% who do not. This suggests a relatively higher acceptance of liver in their diet. In contrast, the heart is less popular, with only 29.35% consuming it and 35.16% opting not to. Kidney follows a similar pattern, with 27.52% consuming it and a higher 36.01% not including it in their diet. These results indicate that while there is some level of acceptance for liver, the overall preference for

consuming organ meats such as heart and kidney is low among the sample population. Among flesh meats, chicken stands out as the most popular choice, with 47.66% indicating consumption, followed by goat meat at 27.97%. However, lamb, duck, and red meat show lower consumption rates, with only 7.25%, 3.62%, and 13.47% respectively. These differences likely reflect individual taste preferences, cultural influences, and the availability of meats. Fresh fish emerges as the most frequently consumed option, with 29% of respondents indicating its consumption, followed by prawns 23.66%, seafood 15.64%, dried fish 20.61%, and shrimps 11.06%. These percentages reflect distinct preferences and consumption habits among individuals, highlighting a potential area for nutritional education and awareness regarding the benefits and preparation of these iron-rich foods.

Table: 15 KAP score percentage of respondents

S.no	KAP SCORE		
	Classification	Frequency(n)	Percentage(%)
1	Inadequate	16	14
2	Moderate	62	54
3	Adequate	37	32
	TOTAL	115	100

Figure: 15 KAP score percentage of respondents



The KAP is about Knowledge Attitude Practice and it is categorized into three levels in the study which is Inadequate, Moderate & Adequate. Inadequate (0 to 26), Moderate (26 to 50) and Adequate (> 50)

Association of Knowledge, Attitude and Practice

Good knowledge and change in attitude can help achieve the necessary shift in behaviour towards healthy foods to prevent IDA [82]. The one study shows high level knowledge about anemia is associated with the positive attitude towards its prevention and management, this shows a positive correlation between knowledge and attitude indicating individuals for more knowledgeable about anemia to have more positive attitude towards adopting preventive measures and healthy behaviour to combat anemia ($p=0.005$) [83]. The present study showed a statistically significant correlation with a weak positive correlation ($p=0.006$), between knowledge and attitude. This means that individuals with higher knowledge about anemia also tend to have a more positive attitude towards its prevention. Hence, Positive attitude regarding anaemia influences the high level of knowledge and good practice concerning this condition. A study observed that the attitude was higher among working subjects, but this did not result in a significant correlation in practice ($p > 0.05$) [84]. Similarly, the present study attitude may be positive but shows no significant correlation between attitude and practice ($p = 0.395$), indicating that changes in attitude do not significantly influence practice. Therefore, these findings suggest that while female healthcare workers may have good attitudes, this does not necessarily translate to better practices. A study observed knowledge level did not correlate with practice with ($p>0.05$) [84], The present study shows that there is no significant correlation between the knowledge and practice (0.475) among healthcare workers.

Key Findings:

Occupation and KAP: No significant difference is found between occupational roles and KAP, suggesting that job roles do not significantly influence anemia-related knowledge, attitudes, or practices.

KAP Correlations: There was a positive correlation between knowledge and attitude toward anemia prevention. However, no significant correlation was observed between attitude and practice, indicating that positive attitudes do not consistently lead to healthy practices.

Meal Skipping: Approximately 51.3% of female healthcare workers reported skipping meals, with breakfast being the most commonly skipped meal. Similar trends were observed among medical students, where 88% admitted to skipping meals [51]. Numerous studies consistently show a higher prevalence of anemia among individuals who frequently skip meals [77].

Rest Hours: Less rest periods (71.3% rest for only 30 minutes per day) may impact the ability to consume regular meals, increasing the risk of IDA

Dietary Awareness and Habits: While 78.2% correctly identified foods that increase iron absorption, only 40% were aware of easily absorbed iron-rich foods. Vitamin C consumption was high, but daily intake was low. High tea and coffee consumption was noted despite its negative impact on iron absorption.

Uncertainty and Perceived Risk: 18.2% were uncertain about their anemia diagnosis, 33% perceived a high risk of developing anemia, and 68% considered anemia a serious health problem.

Challenges in Food Preparation: Healthcare workers find cooking with iron-rich foods difficult the reason behind is pre-preparation methods, lack of time especially on working days.

Meat and Fish Consumption: Chicken (47.66%) and fresh fish (29%) are the most consumed meats and seafood.

Implications

Positive attitudes and knowledge towards IDA prevention do not consistently lead to healthy practices. These findings highlight the importance of not just improving knowledge and attitudes but also ensuring that there are effective strategies and interventions in place that can translate this knowledge and attitude into practical actions among healthcare workers. This might involve more targeted training programs, practical workshops, or institutional support to bridge the gap between knowledge, attitude, and practice to improve dietary habits and prevent IDA among female healthcare workers.

Conclusion

Research highlights the pre-menopausal working women, particularly those menstruating or recently pregnant, are more susceptible to iron deficiency. [33] Anemia poses significant health and socioeconomic challenges globally, with women being particularly vulnerable. [43] Nutritional deficiencies, especially iron deficiency, are common among women, including female healthcare workers. [76]. The study concludes that while female healthcare workers in a tertiary care hospital may possess knowledge and positive attitudes towards anemia prevention, these do not necessarily translate into healthy practices. No significant differences in KAP were found based on occupational roles, indicating that job type does not significantly impact anemia-related perceptions or behaviors. The study highlights meal skipping, irregular eating habits, high tea and coffee consumption, and low rest hours as key contributors to the risk of iron deficiency anemia (IDA). To effectively address IDA, the study emphasizes the need for targeted training programs, practical workshops, and institutional support to bridge the gap between knowledge, attitudes, and practical actions among healthcare workers. By applying knowledge and fostering positive attitudes, better practices can be achieved over time.

Limitations

- The number of respondents is limited to 115.
- The study was completed within a relatively short duration.
- The study solely focuses only on iron deficiency anemia.
- The study does not encompass all the healthcare workers in tertiary care hospitals.

Recommendations

By enhancing the knowledge and attitudes of female healthcare workers regarding IDA prevention, and by providing them with the necessary resources and support, it's reasonable to expect that their practices related to IDA management may improve, ultimately leading to better patient care outcomes, the overall health of themselves will be enhanced, reduces absenteeism and regularity in work. So, applying knowledge and fostering positive attitudes can contribute to better practices over time.

Replication of the present study on larger samples, and different settings.

REFERENCES

- [1] Badireddy KM, Baradhi MM, Wihite A (Hughes). 2023. Chronic anemia (Nursing). PMID: 33760549.
- [2] Chaparro CM, Suchdev PS. 2019. Anemia epidemiology, pathophysiology, and etiology in low- and middle-income countries. *Ann N Y Acad Sci*, 1450(1): 15–31.
- [3] World Health Organization. 2001. The World Health Report 2001 - Mental disorders affect one in four people. Available from: <https://www.who.int/news/item/28-09-2001-the-world-health-report-2001-mental-disorders-affect-one-in-four-people>
- [4] Mollmann M. 1990. The Effects of Anemia. *Oxygen Transport in the Critically Ill Patient*, pages 29–31.
- [5] Bhadra P, Deb A. 2020. A Review on Nutritional Anemia.
- [6] Marx JJ. 1997. Prevalence of iron deficiency in developed nations, impact of lifestyle factors, and risks associated with prevention strategies. *Eur J Clin Nutr*, 51(8): 491–494.
- [7] Milman N. 2011. Anemia remains a significant health concern in numerous regions. *Ann Hematol*, 90: 369.
- [8] Hagler L, Askew EW, Neville JR, Mellick PW, Coppes RI Jr, Lowder JF Jr. 1981. Effects of dietary iron deficiency on hemoglobin, myoglobin, their corresponding reductases, and skeletal muscle mitochondrial respiration. *Am J Clin Nutr*, 34(10): 2169–2177.
- [9] Haas JD, Brownlie T. 2001. Investigating how iron deficiency impacts work capacity through thorough research review. *J Nutr*, 131: 676S–690S.
- [10] Smith ER, et al. 2017. Modifiers affecting the impact of maternal multiple micronutrient supplementation on stillbirth, birth outcomes, and infant mortality: a meta-analysis of individual patient data from 17 randomized trials in low- and middle-income countries. *Lancet Glob Health*, 5: e1100.
- [11] World Health Organization. 2019. Anaemia. Available from: <https://www.who.int/news-room/fact-sheets/detail/anaemia>
- [12] Seo H, Yoon SY, Ul-Haq A, et al. 2023. The effects of iron deficiency on the gut microbiota in women of childbearing age. *Nutrients*, 15: 691. doi:10.3390/nu15030691.
- [13] Gillespie S. 1998. Key Challenges in Managing Iron Deficiency. The Micronutrient Initiative–UNICEF.
- [14] Beck KL, Kruger R, Conlon CA, Heath AL, Matthys C, Coad J, Stonehouse W. 2013. Suboptimal iron status and associated dietary patterns and practices in premenopausal women living in Auckland, New Zealand. *Eur J Nutr*, 52: 467–476. doi:10.1007/s00394-012-0348-y.
- [15] Rodgers J, Kim R, Subramanian SV. 2015. Explaining within- vs between-population variation in child anthropometry and haemoglobin measures in India: A multilevel analysis of the National Family Health Survey. Japan Epidemiological Association.

- [16] Zhang SM, Willett WC, Selhub J, Hunter DJ, Giovannucci EL, Holmes MD, et al. 2003. Risk of breast cancer in relation to plasma folate, vitamin B6, vitamin B12, and homocysteine levels. *J Natl Cancer Inst*, 95: 373–380.
- [17] Velikkakam T, Fiuza JA, Gaze ST. 2017. An overview of hookworm infection in humans within the context of neglected tropical diseases in South Asia. Springer; p. 121–135.
- [18] Anchang-Kimbi JK, Nkweti VN, Ntonifor HN, Apinjoh TO, Chi HF, Tata RB, et al. 2017. The study provides a detailed analysis of red blood cell morphologies and identifies the causes of anemia among pregnant women during their initial clinic visit in the Mount Cameroon area. It follows a prospective cross-sectional design. *BMC Res Notes*, 10: 645.
- [19] World Health Organization. 1989. The reference for the WHO (1989) anemia grading system can be found on the World Health Organization's website. Available from: <https://www.who.int/data/nutrition/nlis/info/anaemia>
- [20] Coad J, Conlon C. 2011. Iron deficiency in women: assessment, causes and consequences. *Curr Opin Clin Nutr Metab Care*, 14: 625–634.
- [21] Gillespie S, Johnston J. 1998. Expert Consultation on Anemia Determinants and Interventions. Ottawa: The Micronutrient Initiative.
- [22] Stoltzfus RJ. 2001. Defining Iron-Deficiency Anemia in Public Health Terms: A Time for Reflection. *J Nutr*, 131(2): 565S–567S.
- [23] Allen L. 1997. Pregnancy and iron deficiency: unresolved issues. *Nutr Rev*, 55(4).
- [24] Hercberg S, Rouaud C. 1981. Nutritional anaemia. 133: 1–36. PMID: 1226458.
- [25] Gillespie S. 1998. Major Issues in the Control of Iron Deficiency. The Micronutrient Initiative–UNICEF.
- [26] Stevens GA. 2013. A systematic analysis of population representative data examining global, regional, and national trends in hemoglobin concentration and the prevalence of total and severe anemia in children, pregnant women, and non-pregnant women from 1995 to 2011. *Lancet Glob Health*, 1(1): 16–25.
- [27] Vibhute NA, Shah U, Belgaumi U, Kadashetti V, Bommanavar S, Kamate W. 2019. Prevalence and awareness of nutritional anemia among female medical students in Karad, Maharashtra, India: A cross-sectional study. *J Family Med Prim Care*, 8: 2369–2372.
- [28] Kalasuramath S, VinodKumar CS, Malay K, Ginnavaram V, Deshpande DV. Impact of anemia, iron deficiency on physical and cardio respiratory fitness among young working women in India
- [29] Kolarš B, Mijatović Jovin V, Živanović N, Minaković I, Gvozdenović N, Dickov Kokeza I, Lesjak M. Iron Deficiency and Iron Deficiency Anemia: A Comprehensive Overview of Established and Emerging Concepts.
- [30] Marcus H, et al. 2021. A systematic narrative synthesis explored the impact of anemia on work productivity in both labor- and non-labor-intensive occupations. *Food Nutr Bull*.
- [31] Edgerton VR, Gardner GW, Ohira Y, Gunawardena KA, Senewiratne B. 1979. The impact of iron-deficiency anemia on worker productivity and activity patterns. *Br Med J*, 2(6204): 1546–1549.
- [32] Schuepbach RA, Bestmann L, Bechir M, Fehr J, Bachli EB. 2011. Educated hospital employees in Switzerland exhibit a high prevalence of iron deficiency. 7(2): 150–157. PMCID: PMC3614822. PMID: 23675232.
- [33] Ohira K, Koziol BJ, Edgerton VR, Brooks GA. Oxygen consumption and work capacity in iron-deficient anemic rats.

- [34] Husaini M, Karyadi D, Gunadi H. 1983. Evaluation of nutritional anemia intervention among anaemic female workers on a tea plantation. Washington DC: The Nutrition Foundation.
- [35] Wolgemuth JC, Latham MC, Hall A, Chesher A, Crompton DW. 1982. How iron-deficiency anemia affects both productivity and activity patterns in workers. *Am J Clin Nutr*, 36(1): 68–78.
- [36] Wolmarans P, Dhansay MA, Mansvelt EP, Laubscher JA, Benade AJ. 2003. Iron status of South African women working in a fruit-packing factory. *Public Health Nutr*, 6: 439–445. doi:10.1079/PHN2003460.
- [37] Kanak K, Busch-Hallen J, Cavalli-Sforza T, Crape B, Smitasiri S. 2005. The process and outcomes of social marketing and community mobilization of weekly iron-folic acid supplements to prevent anemia among Cambodian women in three different settings. *Nutr Rev*, 63.
- [38] World Health Organization. 2009. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993–2005. *Public Health Nutr*, 12(4): 444–454.
- [39] Bhandari S, Sayami JT, Thapa P, Sayami M, Kandel BP, Banjara MR. 2016. Dietary intake patterns and nutritional status of women of reproductive age in Nepal: A health survey. *Arch Public Health*, 74: 2. doi:10.1186/s13690-016-0114-3.
- [40] Gereklioglu C, Asma S, Korur A, Erdogan F, Kut A. 2016. Medication adherence to oral iron therapy among patients diagnosed with iron deficiency anemia. *Pak J Med Sci*, 32(3): 604–607. doi:10.12669/pjms.323.9799.
- [41] Koury MJ, Ponka P. 2004. Fresh perspectives on erythropoiesis: Exploring the functions of folate, vitamin B12, and iron. *Annu Rev Nutr*, 24: 105–131.
- [42] Fishman SM, Christian P, West KP. 2000. The role of vitamins in the prevention and control of anemia. *Public Health Nutr*, 3(2): 125–150.
- [43] Charles CV, Summerlee AJ, Dewey CE. 2012. Anemia in Cambodia: Examining prevalence, causes, and areas for further research. *Asia Pac J Clin Nutr*, 21: 171–181.
- [44] Makurat J, Friedrich H, Kuong K, Wieringa FT, Chamnan C, Krawinkel MB. 2016. Nutritional and micronutrient status of female workers in a garment factory in Cambodia.
- [45] Shah SA, Soomro U, Ali O, Tariq Y, Waleed MS, Guntipalli P, Younus N. 2023. The Prevalence of Anemia Among Working Women. *Cureus*, 15(8).
- [46] Christopher VS, Jayaraj G. 2020. Prevalence of Anemia Among Home-Makers and Working Women.
- [47] Bentley ME, Griffiths PL. 2002. The burden of anemia among women in India.
- [48] Saydam BK, Genc RE, Sarac F, Turfan EC. 2017. Prevalence of anemia and associated factors among women in Turkey.
- [49] Mawani M, Ali SA, Bano G, Ali SA. 2016. Iron Deficiency Anemia among Women of Reproductive Age, an Important Public Health Problem: Situation Analysis.
- [50] Diaz M, Rosado JL, Allen LH, Abrams S, García OP. 2002. The efficacy of a local ascorbic acid-rich food in improving iron absorption from Mexican diets: a field study using stable isotopes.
- [51] Abdulail K, et al. 2023. Knowledge, Attitudes, and Practices Regarding Anemia Among Pregnant Women Attending Antenatal Clinic at the University of Cape Coast Hospital in the Cape Coast Metropolis, Ghana.
- [52] Kalasuramath S, VinodKumar CS, Malay K, Ginnavaram V, Deshpande DV. 2015. Impact of anemia, iron deficiency on physical and cardio respiratory fitness among young working women in India.

- [53] Darmawati D, Siregar TN, Kamil H, Tahlil T. 2020. Obstacles faced by health workers in preventing iron deficiency anemia among pregnant women in Indonesia.
- [54] Huong C, Chua JL, Ng RY, Panse DK, Misra S, Sumera A. 2022. A cross-sectional survey examined the knowledge, attitudes, and practices (KAP) regarding anemia among female university students in Malaysia. *Malays J Nutr*, 28(2).
- [55] Pandey S, Singh A. 2013. A cross-sectional study of nutritional anemia among medical students in a medical college, at Bilaspur, Chhattisgarh. *Natl J Med Res*, 3: 143–146. Agustina R, et al. 2021. Associations of Knowledge, Attitude, and Practices toward Anemia with Anemia Prevalence and Height-for-Age Z-Score among Indonesian Adolescent Girls. PMID: 34282657.
- [56] Angadi N, Ranjitha A. 2016. Knowledge, attitude, and practice regarding anemia among adolescent girls in the urban slums of Davangere City, Karnataka.
- [57] Heshmat R, et al. 2009. Comparison of Knowledge, Attitude and Practice of Urban and Rural Households toward Iron Deficiency Anemia in three Provinces of Iran.
- [58] Abu-Baker NN, et al. 2011. The impact of nutrition education on knowledge, attitude, and practice regarding iron deficiency anemia among female adolescent students in Jordan.
- [59] Aboud SA, El Sayed HA, Ibrahim HAF. 2019. Exploring the knowledge, attitude, and practice concerning the prevention of iron deficiency anemia among pregnant women in the Tabuk Region.
- [60] Gulec S, Anderson GJ, Collins JF. 2014. Understanding the mechanistic and regulatory aspects of intestinal iron absorption. *Am J Physiol Gastrointest Liver Physiol*, 307(4): 397–409.
- [61] Gupta CP. 2014. Role of Iron (Fe) in Body. *IOSR J Appl Chem*, 7(11): 38–46.
- [62] Hurrell RF. 1997. Preventing Iron Deficiency Through Food Fortification. *Nutr Rev*, 55(6): 210–222.
- [63] Johnson-Wimbley TD, Graham DY. 2011. Modern Approaches to Diagnosing and Managing Iron Deficiency Anemia. *Ther Adv Gastroenterol*, 4(3): 177–184. doi:10.1177/1756283X11398736.
- [64] Lonnerdal B. 2010. Examining the mechanisms and public health significance of calcium and iron absorption. *Int J Vitam Nutr Res*, 80(4–5): 293–299. doi:10.1024/0300-9831/a000036.
- [65] Smirnoff N. 2018. Ascorbic Acid Metabolism and Functions: A Comparison of Plants and Mammals. *Free Radic Biol Med*, 122: 116–129. doi:10.1016/j.freeradbiomed.2018.03.034.
- [66] Lynch SR, Cook JD. 1980. Interaction of vitamin C and iron. *Ann N Y Acad Sci*, 355: 32–44. doi:10.1111/j.1749-6632.1980.tb21325.x.
- [67] Cook JD, Monsen ER. 1976. Food Iron Absorption in Human Subjects. III. Factors influencing nonheme iron absorption. *Am J Clin Nutr*, 29(8): 859–867. doi:10.1093/ajcn/29.8.859.
- [68] Hurrell RF, Reddy MB, Juillerat M, Cook JD. 2006. Meat protein fractions enhance nonheme iron absorption in humans. *J Nutr*, 136(11): 2808–2812. doi:10.1093/jn/136.11.2808.
- [69] Hurrell RF, Reddy M, Cook JD. 1999. Polyphenolic-containing beverages inhibit non-heme iron absorption in human subjects. *Br J Nutr*, 81(4): 289–295. doi:10.1017/S0007114599000537.
- [70] Petry N, Egli I, Zeder C, Walczyk T, Hurrell R. 2010. Polyphenols and phytic acid contribute to the low iron bioavailability from common beans in young women. *J Nutr*, 140: 1977–1982. doi:10.3945/jn.110.125369.
- [71] Hart JJ, Tako E, Kochian LV, Glahn RP. 2015. Identification of black bean (*Phaseolus vulgaris* L.) polyphenols that inhibit and promote iron uptake by Caco-2 cells. *J Agric Food Chem*, 63(25): 5950–5956. doi:10.1021/acs.jafc.5b00531.

- [72] Lee M, Lee DT, Lee YS. 1995. Iron absorption and intestinal solubility in rats are influenced by dietary proteins. *Nutr Res*, 15(11): 1705–1716. doi:10.1016/0271-5317(95)02041-0.
- [73] Ishikawa S-I, Tamaki S, Arihara K, Itoh M. 2007. Egg yolk protein and egg yolk phosphatidylcholine inhibit calcium, magnesium, and iron absorptions in rats. *J Food Sci*, 72(6): 412–419. doi:10.1111/j.1750-3841.2007.00417.x.
- [74] Bjorn-Rasmussen E, Hallberg L. 2004. The Impact of Animal Proteins on Food Iron Absorption in Humans. *Ann Nutr Metab*, 23(3): 192–202. doi:10.1159/000176256.
- [75] Zijp IM, Korver O, Tijburg LB. 2000. Effect of tea and other dietary factors on iron absorption. *Crit Rev Food Sci Nutr*, 40(5): 371–398. doi:10.1080/10408690091189194.
- [76] Malay KK. 2018. Awareness regarding anaemia among 1st year dental undergraduate students. *Drug Invention Today*, 10: 10.
- [77] Shill KB, Karmakar P, Kibria MdG, Das A, Rahman MA, Hossain MS. 2014. Prevalence of iron deficiency anemia among university students in the Noakhali region, Bangladesh. *J Health Popul Nutr*, 32(1): 103–110.
- [78] Kotecha PV, Karkar P, Nirupam S. 2001. Summary Report on the Adolescent Girls Anemia Control Program by the Government of Gujarat (Departments of Health and Education). Vadodara: Medical College Vadodara/UNICEF.
- [79] Chakma T, Rao PV, Meshram PK. 2012. Assessing the Feasibility of Iron-Folic Acid Supplementation Among Tribal Adolescent Girls in Mandla District, Madhya Pradesh. *Public Health Nutrition*, 16(2): 377–380.
- [80] Singh M, Rajoura OP, Honnakamble RA. Anemia-related knowledge, attitude, and practices in adolescent schoolgirls of Delhi: A cross-sectional study.
- [81] Sung ES, Choi CK, Kim NR, Kim SA, Shin MH. 2018. Relationship between coffee and tea consumption and ferritin levels using data from the Korean National Health and Nutrition Examination Survey - IV and V. *Chonnam Med J*, 54(3): 178–183.
- [82] Shahzad S, Islam K, Azhar S, Fiza S, Ahmed W, Murtaza Z. 2017. The influence of knowledge, attitude, and practice on the status of iron deficiency anemia among females in the reproductive age group (20–21-year-olds) enrolled at Government Home Economics College Lahore, Pakistan. *Int Arch Biomed Clin Res*.
- [83] Adznam SH, Sedek R, Kasim MZ. 2018. Evaluation of knowledge, attitude, and practice levels concerning anemia among pregnant women in Putrajaya, Malaysia. *Pak J Nutr*, 17(11): 578–585.
- [84] Imunticha FT, Achen RK, Quadras R, D’Souza MV, D’Souza PJ, Sankar A. 2015. Understanding of knowledge and self-reported practices regarding the prevention of iron deficiency anemia among women of reproductive age in rural areas. *Int J Adv Sci Res*, 1(7): 289–292.
- [85] Food and Agriculture Organization of the United Nations. 2014. Guidelines for assessing nutrition-related Knowledge, Attitudes and Practices.