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Knowledge, Attitudes, and Practices Regarding Iron Deficiency Anemia Among Young Female Adults in Mumbai and Development of Culturally Relevant Iron-Rich Recipes

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Abstract: ***Background: Iron Deficiency Anemia (IDA) remains one of the most widespread micronutrient deficiencies globally, disproportionately affecting women of reproductive age due to factors like menstruation, dietary patterns, and lack of awareness. In India, nearly 57% of non-pregnant women aged 15–49 are anemic (NFHS-5, 2021), highlighting a critical public health concern. Despite formal education, young urban women often lack practical knowledge about iron bioavailability and dietary strategies to enhance iron intake. Given the dual burden of malnutrition (undernutrition and overnutrition), culturally relevant and accessible dietary interventions are urgently needed.***

Methods: A cross-sectional study was conducted among 100 young female adults aged 18–25 years in Mumbai. Participants were selected using convenience sampling. Data collection involved anthropometric assessments (self-reported weight, height, BMI), a 24-hour dietary recall, a semi-quantitative food frequency questionnaire (FFQ), and a validated Knowledge, Attitude, and Practice (KAP) questionnaire on IDA. Data were analyzed using descriptive and inferential statistics via SPSS Version 21. Additionally, five iron-rich recipes were developed and standardized using traditional Indian ingredients and evaluated through sensory assessment.

Results: The mean dietary iron intake among participants was 8.83 ± 4.03 mg/day, significantly lower than the recommended dietary allowance of 27 mg/day for menstruating women. A majority 91% of participants consumed less than 50% of the RDA. Despite 93% having completed graduate or postgraduate education, knowledge and practices regarding iron-rich food consumption and absorption enhancers (e.g., vitamin C) were suboptimal. Vegetarianism (59%) and common consumption of inhibitors (e.g., tea with meals) further contributed to poor iron bioavailability. Anthropometric data revealed that 19% were underweight and 23% were overweight or obese, indicating the presence of the double burden of malnutrition. Standardized iron-rich recipes using garden cress seeds, jaggery, ragi, and amaranth were well accepted, achieving moderate sensory scores.

Conclusion: Despite educational attainment, young women in urban Mumbai exhibit poor iron intake and limited practical knowledge regarding Iron Deficiency Anemia prevention. This disconnect between knowledge and practice highlights the need for targeted educational interventions and culturally appropriate dietary solutions. The study demonstrates that standardized, iron-rich recipes can serve as effective tools for improving iron intake. Integrating nutritional education with practical, locally adapted dietary interventions could significantly contribute to reducing the burden of IDA among young women.

Keywords: Iron Deficiency Anemia, Young Adult Females, Knowledge Attitude Practice (KAP), Dietary Intervention, Iron-Rich Foods, Nutrition Education, Mumbai, India

I. INTRODUCTION

Iron Deficiency Anemia (IDA) is a major public health challenge, especially among women of reproductive age due to factors such as menstruation, inadequate dietary intake, frequent infections, and poor access to healthcare services (World Health Organization [WHO], 2021). IDA not only affects physical growth and cognitive development but also has broader implications on productivity, immunity, and maternal health outcomes (National Family Health Survey [NFHS]-5, 2021). Globally, anemia affects nearly 1.2 billion individuals, and iron deficiency accounts for over half of these cases. In India, the burden is especially alarming, with approximately 57% of non-pregnant women aged 15–49 years classified as anemic, despite decades of public health efforts and supplementation programs (MoHFW, 2021).

Young adulthood, particularly the age group between 18 and 25 years, is a critical period during which long-term dietary habits and health behaviors are shaped. However, even among well-educated urban populations, there remains a considerable gap in the practical understanding of nutrition, especially micronutrients like iron. Iron is essential for oxygen transport, energy production, and immune function, and its deficiency can lead to fatigue, poor concentration, and decreased work performance. Despite being preventable and treatable, iron deficiency continues to persist due to dietary practices such as high dependence on plant-based foods, low intake of heme iron sources, and the consumption of iron absorption inhibitors like tea and coffee alongside meals (Mehta, 2016; ICMR, 2020).

Moreover, the coexistence of undernutrition and rising overweight/obesity rates in India reflects a double burden of malnutrition, complicating the landscape of nutritional interventions. Among young women, body image concerns, restrictive dieting behaviors, and fast-paced urban lifestyles contribute to inconsistent meal patterns and inadequate nutrient intake (Gopalan et al., 2016). Government initiatives like the Anemia Mukt Bharat (AMB) campaign have attempted to reduce anemia prevalence, but behavior change remains limited without complementary efforts in education and food-based solutions (MoHFW, 2018).

Hence, there is a pressing need to assess the knowledge, attitudes, and practices (KAP) regarding iron intake among young urban females and to develop culturally relevant, acceptable, and nutritionally rich dietary interventions. Such targeted efforts can potentially bridge the gap between awareness and practice, making nutrition education more actionable and impactful. The current study focuses on the KAP regarding IDA in young adult females in Mumbai and proposes recipe-based interventions that utilize commonly available ingredients to improve iron intake in a sustainable manner.

II. LITERATURE REVIEW / BACKGROUND

Iron Deficiency Anemia (IDA) remains a persistent public health issue despite the implementation of various supplementation and fortification programs in India. Several recent studies have investigated the underlying knowledge, attitudes, and dietary behaviors that contribute to its prevalence, particularly among adolescent and young adult females. Kumar and Roy et al., 2018 emphasized that poor awareness regarding iron-rich dietary sources, especially among college-going women, leads to inadequate iron intake and subsequent deficiency. This is compounded by the misconception that mere consumption of vegetables fulfills the daily iron requirement, disregarding issues related to non-heme iron absorption. Similarly, Sinha et al. 2020 reported that even among educated females, iron-related knowledge was not reflected in dietary practices, often due to cultural food patterns, time constraints, or reliance on convenience foods.

Another significant finding across recent literature is the role of vegetarian diets and meal combinations in influencing iron absorption. Jain and Jain et al., 2022 highlighted that while iron is present in many plant-based foods, its bioavailability is low when consumed with iron inhibitors such as tannins in tea, phytates in whole grains, or calcium-rich foods. The study also noted a lack of understanding about enhancers such as vitamin C, which can significantly improve non-heme iron absorption. In a similar vein, Zende et al. 2022 found that the consumption of iron-rich foods did not necessarily correlate with optimal hemoglobin levels, indicating that poor meal planning and inadequate knowledge about nutrient interactions play a critical role.

From a behavioral perspective, multiple studies have underscored the disconnect between theoretical knowledge and practical implementation. For instance, Patil et al. 2020 reported that while awareness campaigns improved general knowledge, there was little change in actual dietary behavior unless supported by ongoing interventions such as recipe demonstrations or community workshops. This gap is further exacerbated by the lack of tailored interventions that address local food habits and availability. Furthermore, Gole and Dighe et al., 2023 highlighted the success of sensory-evaluated, iron-rich recipe interventions in enhancing both nutritional intake and acceptance among young females, particularly when prepared with familiar ingredients like jaggery, garden cress seeds, and ragi. These recent studies collectively suggest that while there has been progress in raising awareness about anemia, young women continue to face barriers in translating knowledge into practice. The evidence supports a shift toward integrated strategies that combine KAP-based assessments with culturally relevant dietary interventions. Developing simple, acceptable recipes using affordable and locally available ingredients appears to be a promising approach for improving dietary iron intake and reducing anemia prevalence in the young female population of India.

III. METHODOLOGY

This study followed a descriptive, cross-sectional design and was conducted over a period of four months in Mumbai, India, targeting young female adults aged 18 to 25 years. The primary objective was to assess their knowledge, attitudes, and practices (KAP) regarding Iron Deficiency Anemia (IDA) and subsequently develop culturally relevant dietary interventions. A convenience sampling technique was employed to recruit a total of 100 participants, primarily college-going students residing in urban areas.

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Informed consent was obtained from each participant prior to data collection, and ethical approval was secured from the concerned institutional review board. Data collection was carried out through a structured, pre-tested questionnaire divided into four main sections. The first section gathered demographic and anthropometric data including age, education level, dietary pattern, and self-reported height and weight, which were used to calculate Body Mass Index (BMI). The second section comprised a 24-hour dietary recall to assess actual food intake on the previous day, followed by a semi-quantitative Food Frequency Questionnaire (FFQ) adapted to include 98 commonly consumed food items in India, with a focus on iron-rich sources. Portion sizes were standardized using local household measures and cross-verified during the interview. The third section of the questionnaire was a validated KAP tool designed to evaluate participants' knowledge about iron-rich foods, symptoms of IDA, absorption enhancers and inhibitors, and attitudes toward dietary choices and supplementation. The practice component captured real-life behavior such as meal combinations, frequency of consuming green leafy vegetables, and use of iron supplements. The final section included questions related to awareness of national programs addressing anemia, such as Anemia Mukt Bharat. For the intervention component, five iron-rich recipes were developed using locally available ingredients such as ragi, garden cress seeds, jaggery, amaranth, and dates. These were standardized through repeated trials for portion size, nutritional value, and sensory characteristics. Sensory evaluation was conducted using a 9-point hedonic scale assessing attributes such as appearance, texture, taste, aroma, and overall acceptability. All data were entered and analyzed using IBM SPSS Statistics for Windows, Version 21.0. Descriptive statistics, including means, standard deviations, and percentages, were used to summarize the data. Chi-square tests and cross-tabulations were applied to determine associations between KAP scores and demographic variables. The findings from both the assessment and intervention phases were synthesized to draw conclusions and propose actionable recommendations for improving iron intake and awareness among young adult females in urban India.

IV. RESULTS

The study enrolled 100 young adult females aged 18 to 25 years residing in urban Mumbai. The mean age of participants was 22.09 ± 1.93 years. All participants identified as female. Regarding educational background, 59% were pursuing postgraduate studies, 34% were graduates, and 7% had completed only secondary school. Dietary pattern analysis revealed that 59% of participants followed a vegetarian diet, 39% were non-vegetarians, and 2% followed an eggetarian diet. This high proportion of vegetarianism could have implications for iron intake, considering the low bioavailability of non-heme iron from plant-based sources.

Anthropometric data indicated that 58% of the participants had a normal BMI, while 23% were overweight or obese, and 19% were underweight. These results suggest the presence of a double burden of malnutrition in the study group. Additionally, most participants (75%) were not taking any form of iron supplements, and only 16% reported taking them occasionally. A notable 83% had no family history of anemia, although this may reflect limited awareness or undiagnosed cases.

Table 4.1 Anthropometric measurements of the study participants

Anthropometric measurements	Participants (N = 100), Mean (SD)
Height, cm	158.66 (5.885)
Weight, kg	56.937 (13.9112)
BMI, kg/m^2	22.4430 (4.80688)

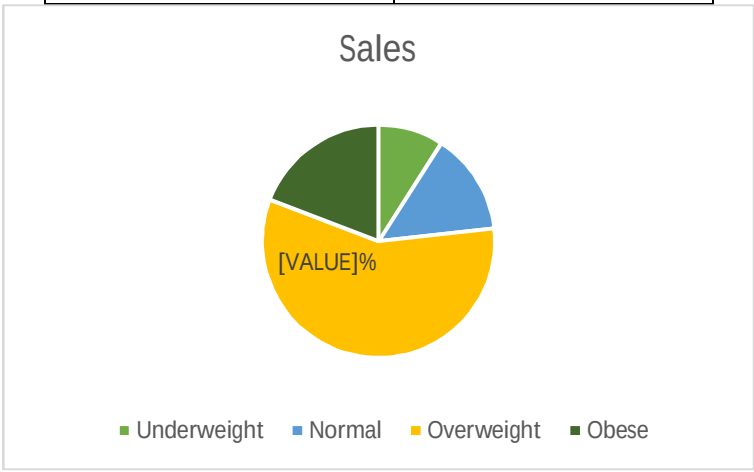

Figure 4.1 BMI status of the study participants

The 24-hour dietary recall revealed that the mean daily dietary iron intake was 8.83 ± 4.03 mg, substantially lower than the Indian Council of Medical Research's (2020) Recommended Dietary Allowance (RDA) of 27 mg/day for menstruating women. A staggering 91% of participants consumed less than 50% of the RDA, with only 1% meeting the full requirement. Furthermore, 68% of the participants consumed green leafy vegetables less than four times per week, while the intake of iron-enhancing foods such as citrus fruits was also found to be low. In contrast, a high percentage of participants reported consuming tea or coffee with meals, potentially inhibiting iron absorption.

Table 4.2 Iron intake of the study participants based on 24-hour recall

Variable	Mean (SD) (N = 100)
Iron intake from 24-hour recall	8.83 (4.03)

Table 4.3 Iron intake of the study participants based on 24-hour recall compared with RDA (2023)

Variable	Mean (SD) (N = 100)
Iron intake status, *n (%)*	
Less than 50% of RDA (Group A)	91 (91.0)
50 – 75% of RDA (Group B)	9 (9.0)
75 – 100% of RDA	0 (0.0)
More than 100% of RDA	0 (0.0)

The Food Frequency Questionnaire (FFQ) analysis provided additional insights into long-term dietary patterns. It was found that only 8% of the participants regularly consumed iron-fortified products, and 72% reported eating legumes and pulses daily. However, the intake of animal-based sources of heme iron—such as red meat, organ meat, and seafood—was negligible among vegetarians and infrequent even among non-vegetarians. This dietary behavior is indicative of low heme iron consumption, which is generally more efficiently absorbed than non-heme sources.

The Knowledge, Attitude, and Practice (KAP) assessment revealed a notable gap between theoretical knowledge and actual practices. While 88% of participants correctly identified iron-rich foods such as green leafy vegetables and jaggery, only 52% knew about iron absorption enhancers like vitamin C. Furthermore, only 34% were aware of iron inhibitors, including tannins in tea or calcium in dairy products. Despite the high educational status of participants, these results highlight gaps in functional nutrition literacy. Additionally, only 16% of the participants were aware of the Anemia Mukt Bharat program, indicating limited outreach of government initiatives even among educated youth.

In terms of attitudes, 72% of participants believed that their diet was sufficient in iron, while only 21% felt a need to improve their iron intake. This misperception could lead to complacency in dietary practices and delayed diagnosis or intervention. As for iron-related symptoms, 47% of participants reported experiencing fatigue, 41% noted headaches, and 25% experienced shortness of breath or dizziness—symptoms commonly associated with iron deficiency.

A detailed analysis of the association between dietary iron intake—categorized by percentage of the Recommended Dietary Allowance (RDA)—and key variables such as KAP scores, dietary preferences, and anthropometric status revealed significant trends. Among the participants, those consuming less than 50% of the RDA (which accounted for 91% of the sample) demonstrated notably lower KAP scores compared to those whose intake exceeded 50% of the RDA. Poor knowledge of iron-rich foods, inadequate understanding of absorption enhancers, and lack of awareness about inhibitory food combinations were more prevalent in the lower intake group. In contrast, participants meeting more than 50% of the RDA showed relatively higher knowledge and more favorable dietary practices, such as regular intake of citrus fruits and reduced tea consumption with meals. When analyzed by dietary preference, vegetarian participants were disproportionately represented in the <50% RDA group, with 65% of them displaying low iron intake. Their dietary habits, such as infrequent consumption of iron-fortified products and higher intake of phytate-rich grains and legumes, likely contributed to poorer bioavailability of iron. Anthropometric trends also reflected nutritional inadequacy, as 63.1% of underweight participants belonged to the <50% RDA group, suggesting a link between chronic low nutrient intake and body mass. Even among overweight participants, iron intake remained low, indicating that excess caloric consumption did not translate into improved micronutrient status. These associations reinforce the critical role of both nutrition literacy and dietary quality in addressing iron deficiency, and highlight the need for targeted education strategies customized to dietary patterns and nutritional status.

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Table 4.4 Comparison of Mean Anthropometric and Iron Intake of the study participants based on 24-hour recall compared with RDA (Variables between Group A and Group B)

Variable	Group A (n = 91)	Group B (n = 9)	Mean Difference	t	df	p-value	95% CI of Difference
Iron from 24hr Recall (mg)	8.03 ± 3.24	16.89 ± 1.69	-8.856	-8.065	98	0.000	[-11.035, -6.677]
Age (years)	22.05 ± 1.98	22.44 ± 1.24	-0.389	-0.574	98	0.567	[-1.735, 0.958]
Height (cm)	158.59 ± 5.81	159.33 ± 6.96	-0.740	-0.358	98	0.721	[-4.839, 3.359]
Weight (kg)	57.65 ± 14.30	49.72 ± 5.35	7.923	3.405	22.350	0.003	[2.607, 13.240]
BMI (kg/m²)	22.71 ± 4.90	19.71 ± 2.79	3.002	2.826	13.481	0.014	[0.7155, 5.2885]

Group A = Participants with <50% of iron intake compared with RDA
Group B = Participants with 50 – 75% of iron intake compared with RDA
Data presented as Mean ± Standard Deviation
Significance determined at $p < 0.05$

Table 4.5 Association of Iron intake of the study participants based on 24-hour recall compared with RDA with different dietary preferences of the participants

Dietary preference	Participants grouped as Iron intake compared with RDA		Total (%) (N)	χ^2, *p*
	Group A	Group B		
Vegetarian (%) (n)	59.3 (54)	55.6 (5)	59.0 (59)	
Non vegetarian (%) (n)	33.0 (30)	44.4 (4)	34.0 (34)	
Other (%) (n)	7.7 (7)	0.0 (0)	7.0 (7)	1.030, 0.598

Group A = Participants with <50% of iron intake compared with RDA
Group B = Participants with 50 – 75% of iron intake compared with RDA
Significance determined at $p < 0.05$

Table 4.6 Most iron rich food items consumed on an average by the participants & Association of Iron intake of the study participants based on 24-hour recall compared with RDA

Iron rich food items	n (%)	Iron intake compared with RDA (%) (n)		Total (%) (N)	χ^2, *p*
		Group A	Group B		
Ragi (30g)	2(2.0)	0.0 (0)	22.2 (2)	2.0 (2)	25.114, 0.000
Jowar (60g)	1(1.0)	1.1 (1)	0.0 (0)	1.0 (1)	3.383, 0.847
Wheat (90g)	9(9.0)	9.9 (9)	0.0 (0)	9.0 (9)	4.688, 0.698
Rice flakes (30g)	2(2.0)	2.2 (2)	0.0 (0)	2.0 (2)	5.443, 0.488
Oats (60g)	1(1.0)	0.0 (0)	11.1 (1)	1.0 (1)	13.512, 0.061
Green gram (dal) (30g)	8(8.0)	5.5 (5)	33.3 (3)	8.0 (8)	9.750, 0.136
Bengal gram (30g)	1(1.0)	1.1 (1)	0.0 (0)	1.0 (1)	2.737, 0.741
Lentil (dal) (30g)	4(4.0)	3.3 (3)	11.1 (1)	4.0 (4)	4.367, 0.627
Red gram (30g)	15(15.0)	13.2 (12)	33.3 (3)	15.0 (15)	5.273, 0.509
White sesame seeds (2.5g)	1(1.0)	1.1 (1)	11.1 (1)	2.0 (2)	9.500, 0.147
Black sesame seeds (2.5g)	2(2.0)	0.0 (0)	11.1 (1)	1.0 (1)	17.094, 0.009
Garden cress seeds (2.5g)	1(1.0)	1.1 (1)	0.0 (0)	1.0 (1)	5.127, 0.275
Chia seeds (2.5g)	9(9.0)	9.9 (9)	0.0 (0)	9.0 (9)	8.425, 0.209

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Almond (2.5g)	31(31.0)	30.8 (28)	33.3 (3)	31.0 (31)	3.377, 0.760
Cashew (2.5g)	6(6.0)	5.5 (5)	11.1 (1)	6.0 (6)	9.675, 0.139
Walnut (2.5g)	16(16.0)	16.5 (15)	11.1 (1)	16.0 (16)	14.952, 0.021
Dates (15g)	16(16.0)	14.3 (13)	33.3 (3)	16.0 (16)	2.927, 0.818
Black raisins (5g)	9(9.0)	6.6 (6)	33.3 (3)	9.0 (9)	9.123, 0.167
Jaggery (desi, dark brown) (10g)	1(1.0)	1.1 (1)	0.0 (0)	1.0 (1)	11.718, 0.110
Egg (50g)	4(4.0)	4.4 (4)	0.0 (0)	4.0 (4)	4.239, 0.516

Group A = Participants with <50% of iron intake compared with RDA
Group B = Participants with 50 – 75% of iron intake compared with RDA
Significance determined at $p < 0.05$

Table 4.7 Association of Knowledge, Attitude & Practices about awareness of IDA & Association of Iron intake of the study participants based on 24-hour recall compared with RDA

Variable	Iron intake compared with RDA (%) (n)		Total (%) (N)	χ^2, *p*
	Group A	Group B		
K.1 Have you heard about Iron deficiency anaemia?				
No	15.4 (14)	11.1 (1)	15.0 (15)	0.117, 0.732
Yes	84.6 (77)	88.9 (8)	85.0 (85)	
K.2 Can you recognize someone who has anaemia?				
No	56.0 (51)	33.3 (3)	54.0 (54)	1.701, 0.192
Yes	44.0 (40)	66.7 (6)	46.0 (46)	
K.3 Do you know consequences of iron deficiency anaemia for infants, young children & pregnant women?				
No	51.6 (47)	44.4 (4)	51.0 (51)	0.170, 0.680
Yes	48.4 (44)	55.6 (5)	49.0 (49)	
K.4 Do you know Causes of iron deficiency anaemia?				
No	46.2 (42)	33.3 (3)	45.0 (45)	0.544, 0.461
Yes	53.8 (49)	66.7 (6)	55.0 (55)	
K.5 Do you know Prevention of anaemia?				
No	50.5 (46)	22.2 (2)	48.0 (48)	2.633, 0.105
Yes	49.5 (45)	77.8 (7)	52.0 (52)	
K.6 Do you know about Iron rich foods?				
No	16.5 (15)	0.0 (0)	15.0 (15)	1.745, 0.186
Yes	83.5 (76)	100.0 (9)	85.0 (85)	
K.7 Do you know if Iron rich foods get easily absorbed in the body?				
No	46.2 (42)	22.2 (2)	44.0 (44)	1.904, 0.168
Yes	53.8 (49)	77.8 (7)	56.0 (56)	
K.8 Do you know foods that decrease iron absorption?				
No	58.2 (53)	22.2 (2)	55.0 (55)	4.293, 0.038
Yes	41.8 (38)	77.8 (7)	45.0 (45)	
K.9 Do you know foods that increase iron				

absorption?				
No	41.8 (38)	22.2 (2)	40.0 (40)	1.302, 0.254
Yes	58.2 (53)	77.8 (7)	60.0 (60)	
K.10 Do you think the disease anaemia denotes is - deficiency of blood in the body?				
No	44.0 (40)	44.4 (4)	44.0 (44)	0.001, 0.978
Yes	56.0 (51)	55.6 (5)	56.0 (56)	
K.11 Do you think the disease can occur at any age?				
No	12.1 (11)	0.0 (0)	11. 0 (11)	1.222, 0.269
Yes	87.9 (80)	100.0 (9)	89.0 (89)	
K.12 Do you think the disease is contagious?				
No	86.8 (79)	88.9 (8)	87.0 (87)	0.031, 0.860
Yes	13.2 (12)	11.1 (1)	13.0 (13)	
K.13 Do you think in nutrients deficiency - mainly iron deficiency is the cause of anaemia?				
No	28.6 (26)	11.1 (1)	27.0 (27)	1.267, 0.260
Yes	71.4 (65)	88.9 (8)	73.0 (73)	
K.14 Do you think excessive bleeding is also a cause of this disease?				
No	38.5 (35)	33.3 (3)	38.0 (38)	0.091, 0.762
Yes	61.5 (56)	66.7 (6)	62.0 (62)	
K.15 Do you think anaemia is more prevalent in female population as compared to male population?				
No	26.4 (24)	11.1 (1)	25.0 (25)	1.018, 0.313
Yes	73.6 (67)	88.9 (8)	75.0 (75)	
K.16 Do you think Anaemia mainly occurs during adolescent ages and pregnancy?				
No	47.3 (43)	22.2 (2)	45.0 (45)	2.073, 0.150
Yes	52.7 (48)	77.8 (7)	55.0 (55)	
K.17 Do you think light yellow or whitish discoloration is the main symptom of the disease?				
No	49.5 (45)	44.4 (4)	49.0 (49)	0.082, 0.774
Yes	50.5 (46)	55.6 (5)	51.0 (51)	
K.18 Do you think fatigue, weakness, dyspnea and headache are also seen in IDA?				
No	27.5 (25)	11.1 (1)	26.0 (26)	1.140, 0.286
Yes	72.5 (66)	88.9 (8)	74.0 (74)	
K.19 Do you think blood investigations show hemoglobin deficiency in IDA?				
No	29.7 (27)	11.1 (1)	28.0 (28)	1.399, 0.237
Yes	70.3 (64)	88.9 (8)	72.0 (72)	
K.20 Do you think the disease is curable?				
No	8.8 (8)	0.0 (0)	8.0 (8)	0.860, 0.354

Yes	91.2 (83)	100.0 (9)	92.0 (92)	
A.1 How likely do you think you are to be iron deficient/anemic?				
Not likely	23.1 (21)	66.7 (6)	27.0 (27)	7.921, 0.019
Likely	30.8 (28)	11.1 (1)	29.0 (29)	
Not sure	46.2 (42)	22.2 (2)	44.0 (44)	
A.2 How serious do you think iron deficiency anaemia is?				
Not serious	11.0 (10)	11.1 (1)	11.0 (11)	1.767, 0.413
Serious	57.1 (52)	77.8 (7)	59.0 (59)	
Not sure	31.9 (29)	11.1 (1)	30.0 (30)	
A.3 How good do you think it is to prepare meals with iron rich foods?				
Not good	2.2 (2)	0.0 (0)	2.0 (2)	0.211, 0.900
Good	87.9 (80)	88.9 (8)	88.0 (88)	
Not sure	9.9 (9)	11.1 (1)	10.0 (10)	
A.4 How difficult is it for you to prepare meals with iron rich foods?				
Difficult	20.9 (19)	0.0 (0)	19.0 (19)	4.054, 0.132
Not difficult	45.1 (41)	77.8 (7)	48.0 (48)	
So-so	34.1 (31)	22.2 (2)	33.0 (33)	
A.5 How confident do you feel in preparing meal with iron rich food?				
Not confident	20.9 (19)	11.1 (1)	20.0 (20)	2.930, 0.231
Confident	37.4 (34)	66.7 (6)	40.0 (40)	
Ok/So-so	41.8 (38)	22.2 (2)	40.0 (40)	
A.6 How much do you like the taste of iron rich food item if you have tasted any in particular?				
Dislike	3.3 (3)	0.0 (0)	3.0 (3)	1.536, 0.464
Like	57.1 (52)	77.8 (7)	59.0 (59)	
Not sure	39.6 (36)	22.2 (2)	38.0 (38)	
A.7 Intake of balanced diet, nutrients mainly iron containing food items with vitamin C are helpful for prevention and cure of IDA?				
No	1.1 (1)	0.0 (0)	1.0 (1)	0.751, 0.687
Yes	63.7 (58)	77.8 (7)	65.0 (65)	
Don't know	35.2 (32)	22.2 (2)	34.0 (34)	
A.8 Is it necessary to consult a physician if symptoms of IDA are seen?				
No	4.4 (4)	11.1 (1)	5.0 (5)	0.784, 0.676
Yes	84.6 (77)	77.8 (7)	84.0 (84)	
Don't know	11.0 (10)	11.1 (1)	11.0 (11)	
A.9 Have you ever felt the symptoms of IDA?				
No	34.1 (31)	33.3 (3)	34.0 (34)	0.537, 0.764
Yes	23.1 (21)	33.3 (3)	24.0 (24)	
Don't know	42.9 (39)	33.3 (3)	42.0 (42)	

P.1 Do you consume any Heme iron (animal) source foods?				
No	63.7 (58)	55.6 (5)	63.0 (63)	0.235, 0.628
Yes	36.3 (33)	44.4 (4)	37.0 (37)	
P.2 Do you consume vit-c rich fruits (citrus, amla, etc) usually?				
No	8.8 (8)	11.1 (1)	9.0 (9)	1.615, 0.446
Yes	75.8 (69)	88.9 (8)	77.0 (77)	
Don't know	15.4 (14)	0.0 (0)	14.0 (14)	
If yes in p.2 question P.2.1 Do you consume vit-c rich fruits daily?				
No	70.3 (64)	55.6 (5)	69.0 (69)	0.836, 0.361
Yes	29.7 (27)	44.4 (4)	31.0 (31)	
If yes in p.2.1 question P.2.2 When do you usually eat fresh citrus fruits?				
Before/ After meal	46.2 (42)	44.4 (4)	46.0 (46)	1.140, 0.565
During meal	9.9 (9)	0.0 (0)	9.0 (9)	
Other	44.0 (40)	55.6 (5)	45.0 (45)	
P.3 Do you add lemon juice to most of your meals daily?				
No	33.0 (30)	11.1 (1)	31.0 (31)	6.642, 0.036
Yes	34.1 (31)	77.8 (7)	38.0 (38)	
Not so often	33.0 (30)	11.1 (1)	31.0 (31)	
P.4 Do you consume tea/coffee usually?				
No	29.7 (27)	44.4 (4)	31.0 (31)	0.836, 0.361
Yes	70.3 (64)	55.6 (5)	69.0 (69)	
If yes in p.4 question P.4.1 Do you consume tea/coffee daily?				
No	44.0 (40)	77.8 (7)	47.0 (47)	3.761, 0.052
Yes	56.0 (51)	22.2 (2)	53.0 (53)	
If yes in p.4.1 question P.4.2 When do you usually drink tea/coffee?				
Direct before/ during/ after meal	16.5 (15)	22.2 (2)	17.0 (17)	1.051, 0.591
No time	44.0 (40)	55.6 (5)	45.0 (45)	
2hr before/ after meal	39.6 (36)	22.2 (2)	38.0 (38)	
P.5 Do you take balanced and nutritious diet regularly for prevention of the disease?				
No	23.1 (21)	0.0 (0)	21.0 (21)	7.468, 0.024
Yes	41.8 (38)	88.9 (8)	46.0 (46)	
Don't Know	35.2 (32)	11.1 (1)	33.0 (33)	
P.6 Do you discuss regarding IDA with people around you?				
No	70.3 (64)	55.6 (5)	69.0 (69)	0.836, 0.361
Yes	29.7 (27)	44.4 (4)	31.0 (31)	

For the intervention phase, five iron-rich recipes were developed using ingredients such as garden cress seeds, ragi, jaggery, dates, and amaranth.

The recipes included laddoos, chips, crackers, cookies formulations tailored to urban preferences which can even be made on large scale. Sensory evaluation using the 9-point hedonic scale showed that the majority of recipes received moderate to high scores in terms of taste, texture, and overall acceptability. This suggests a strong potential for incorporating such interventions into daily diets as a palatable and practical solution to improve iron intake.

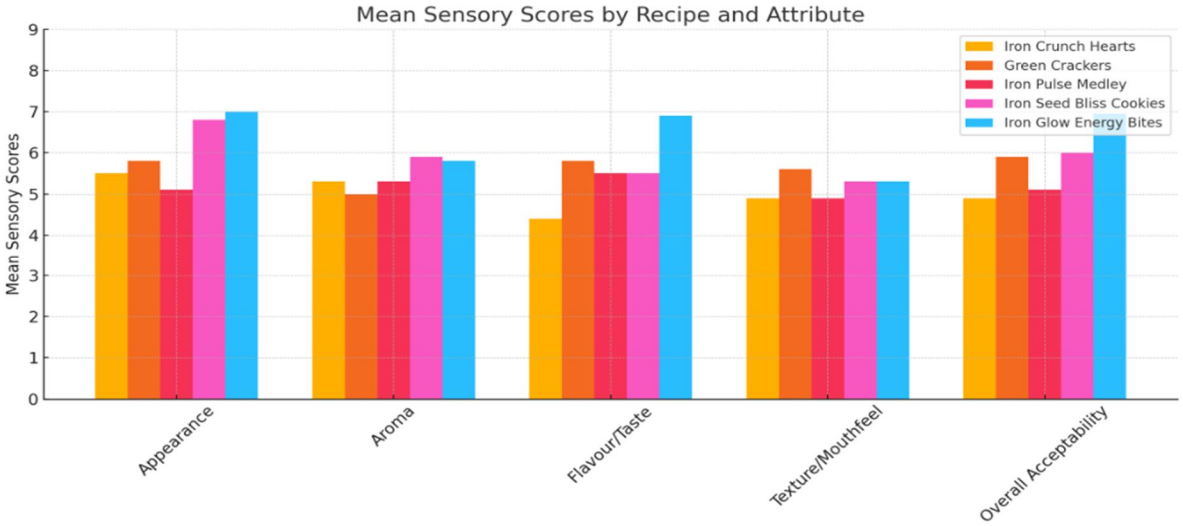

Fig 4.2 Mean Sensory Scores of Standardized Iron-Rich Recipes (N = 10 Experts)

V. DISCUSSION

This study revealed a significant gap between formal education and practical nutrition behavior among young urban women. Although 93% of participants were graduates or postgraduates, 91% consumed less than 50% of the recommended daily iron intake (ICMR, 2020), reflecting poor functional nutrition literacy. While basic knowledge of iron-rich foods like green leafy vegetables and jaggery was present, understanding of enhancers (e.g., vitamin C) and inhibitors (e.g., tea, calcium) was lacking, aligning with previous findings by Sinha et al. 2020. Vegetarian participants, who formed the majority, showed lower intake and KAP scores, likely due to limited bioavailability in plant-based diets (Jain & Jain, et al., 2022). The presence of both underweight (19%) and overweight (23%) individuals with poor iron intake supports the national trend of a double burden of malnutrition (NFHS-5, 2021), emphasizing that calorie sufficiency does not guarantee micronutrient adequacy (Gopalan et al., 2016).

Encouragingly, iron-rich recipes developed using locally available ingredients were moderately to highly accepted on sensory evaluation, suggesting that simple, culturally appropriate interventions can improve intake—a finding consistent with Gole and Dighe et al., 2023. However, low awareness of national programs like Anemia Mukt Bharat (only 16%) underscores the need for grassroots-level, behavior-driven education. Overall, the results advocate for integrated strategies that combine KAP assessment with practical dietary interventions to bridge the gap between knowledge and action in the prevention of IDA.

VI. CONCLUSION

This study highlights a significant disconnect between education and dietary iron adequacy among young urban women. Despite high literacy, most participants consumed less than half the recommended iron intake and lacked practical knowledge of iron absorption. Vegetarian diets, poor food combinations, and limited awareness of national programs further contributed to the deficiency. However, the positive acceptance of simple, iron-rich recipes suggests that culturally tailored dietary interventions can be effective. Bridging the gap between knowledge and practice through food-based, behavior-driven strategies is essential to reducing the burden of Iron Deficiency Anemia.

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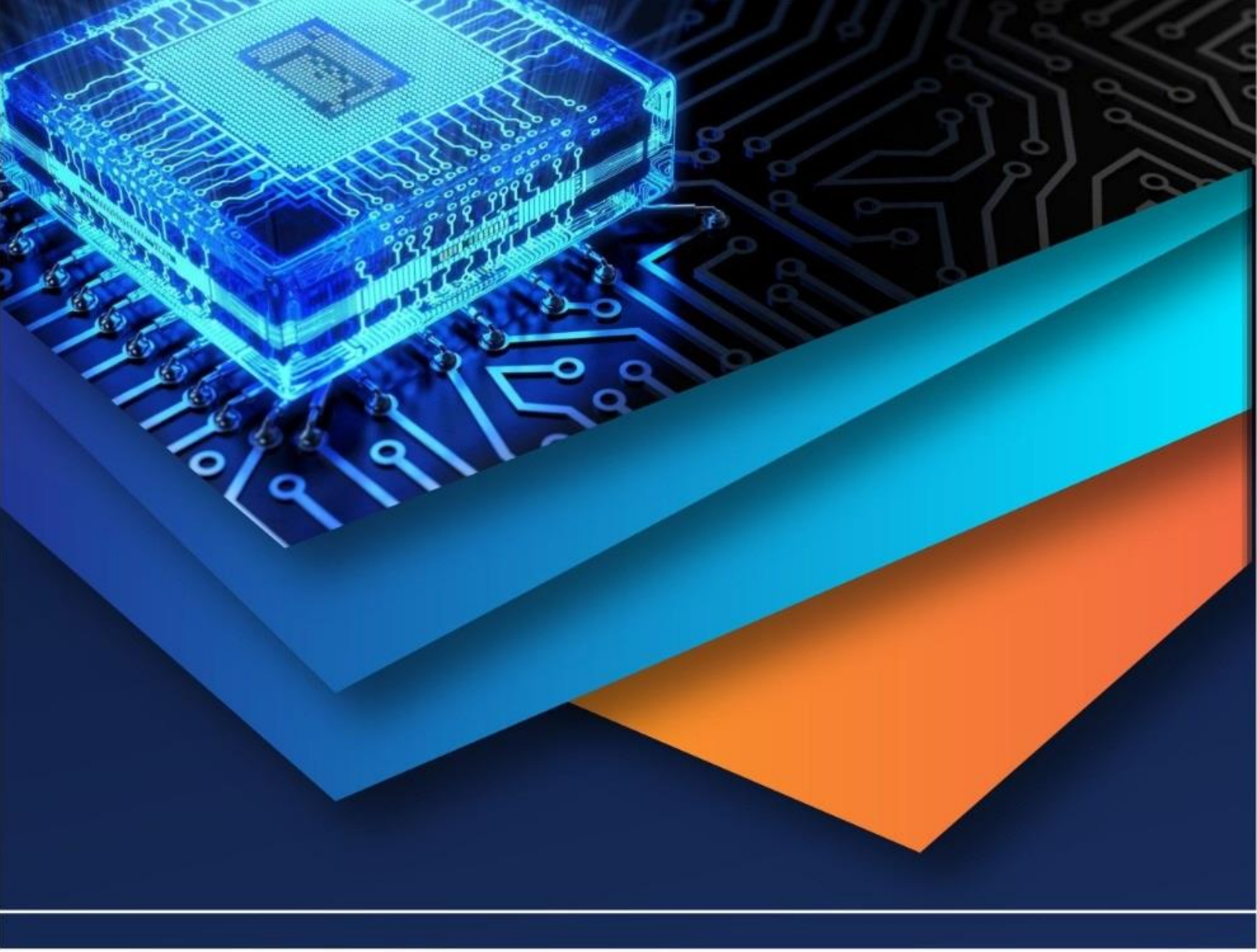

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