

UNDERSTANDING DIETARY IRON INHIBITORS: A QUALITATIVE INVESTIGATION OF DIETARY PATTERNS, BEHAVIOURS, AND PERCEPTIONS AFFECTING IRON ABSORPTION AMONG WOMEN OF REPRODUCTIVE AGE IN AN URBAN HEALTH CENTRE, SOUTH INDIA

Praveen Kumar I¹, Farida Fahhima A², Renjana S.R³, Balabaskaran S⁴

¹Assistant Professor, Department of Community Medicine, Saveetha Medical College, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, Tamil Nadu 602105.

Email: Pravinvip14@gmail.com

²Post graduate, Department of Community Medicine, Saveetha Medical College, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai, Tamil Nadu

³Epidemiologist, Block Public Health Unit, Agali block, NHM Palakkad

⁴Associate Professor, Sri Venkateshwara Medical College Hospital & Research Centre, Puducherry

Corresponding Author: Dr Praveen Kumar I

ABSTRACT

Iron deficiency is one of the most common nutritional disorders worldwide and is a significant cause of anaemia in females of reproductive age. While numerous efforts have been made to promote iron-rich foods and iron supplementation, dietary factors that hinder iron absorption have received less attention. Iron bioavailability can be significantly affected by common inhibitors like phytates, tannins, polyphenols, and calcium, especially among those who eat mostly a plant-based diet. To create effective nutrition education programs and enhance iron status, it is important to understand community perceptions, dietary habits, and people's iron awareness.

Objective

To find out the dietary pattern, dietary practices, perception and sociocultural determinants affecting iron absorption among women of reproductive age visiting an Urban Health Centre of a Tertiary care teaching hospital in Tamil Nadu, India.

Materials and Methods

A qualitative study was carried out from February to May 2025 at an Urban Health Centre in Tiruvallur district, Tamil Nadu. The number of twenty-five women aged 15-49 years) was determined through purposive sampling. The data was gathered using a semi-structured interview guide and in-depth interviews. The dietary habits, knowledge of iron-rich foods, awareness of dietary inhibitors and factors influencing dietary choices were discussed during the interviews. All interviews were audio-recorded, transcribed and analysed using NVivo software. Thematic analysis was used to detect themes and patterns.

Results

The analysis identified six main themes: dietary practices, sources of iron-rich foods, awareness of iron-rich foods, access to iron-absorption inhibitors, perceptions/awareness and cultural and social factors. The general awareness among the participants was good regarding iron-rich foods: green leafy vegetables, eggs, fish, meat, dates and jaggery. There was, however, limited information about dietary inhibitors: tea, coffee, milk, phytates, tannins and the calcium-rich foods. Important barriers to good iron absorption were identified as frequent tea and coffee consumption and cultural dietary habits. Family members, health professionals, and social media were identified as important sources of nutrition information and nutrition-related behaviours.

Conclusion

Although there is good awareness of iron-rich foods, there are still significant gaps in knowledge about dietary inhibitors of iron absorption among women of reproductive age. A more robust nutrition education

program that provides concrete details of the bioavailability of iron, meal planning and a balanced diet could improve dietary habits and help reduce the incidence of iron deficiency anaemia. There should also be a focus on incorporating cultural beliefs as well as family and health care systems to achieve sustainable behaviour change in community-based interventions.

Keywords: Iron deficiency, Iron absorption, Iron inhibitors, Women of reproductive age, Qualitative research, Nutrition education.

INTRODUCTION

Iron is a micronutrient that is vital for many physiological functions such as oxygen transport, cellular respiration, DNA synthesis, immunity and energy metabolism. Women of reproductive age are of particular interest due to the increased physiological demands for iron during menstruation, pregnancy and lactation¹. Although efforts have been made to improve nutritional status, iron deficiency is the most frequent micronutrient deficiency globally and a major public health problem, particularly in low and middle-income countries (LMICs)².

Iron deficiency is the most common cause of anaemia, and a significant portion of anaemia in women of reproductive age. The World Health Organisation (WHO) reported that about 30% of all women in the world aged between 15 and 49 years are afflicted with anaemia, which is disproportionately high in South Asian countries². Even though nutritional interventions address this public health concern in India, the National Family Health Survey-5 (NFHS-5) indicates that more than half of women aged 15–49 years are anaemic³. Traditionally, efforts to prevent iron deficiency have been directed towards consuming more iron-rich foods and enhancing the availability of iron supplements. There is, however, emerging evidence that dietary iron intake might not be enough to maintain adequate iron status because iron bioavailability depends on several dietary factors⁴. Iron in foods exists in two forms, haem iron and non-haem iron, the latter being more readily inhibited by other foods. Phenols (in tea and coffee), phytates (in cereals and legumes), tannins, and calcium-rich foods all have the capacity to interfere with the absorption of iron when taken at the same time as a meal containing iron.^{5,6}

Other dietary measures can, on the other hand, increase iron absorption. Foods containing Vitamin C, such as citrus fruits, tomatoes and guavas, have been found to enhance the absorption of non-haem iron by reducing it to the more absorbable ferrous form of iron⁷. Thus, it is important that the consumption of iron-rich foods, as well as any dietary practices that affect iron bioavailability, be effective in anaemia prevention and control.

Factors such as cultural beliefs, family influences, social norms, level of education and access to health information can influence dietary practices. Prior research has shown that whilst awareness of iron-rich foods might be reasonably high, awareness of the inhibitors and facilitators of iron absorption is comparatively low amongst women in many communities⁸. There are some misconceptions about foods and traditional dietary practices that can interfere with iron absorption, potentially leading to iron deficiency.

Although quantitative studies have thoroughly documented the prevalence and determinants of anaemia, few studies have examined how individuals think, feel, and experience dietary practices related to iron absorption and the sociocultural factors impacting these practices. Qualitative research provides important insights into the contextual factors shaping food choices and foodways, which can be used to develop culturally relevant health education interventions.

Hence, this study was designed to assess the dietary habits, practices, perceptions and socio-cultural factors influencing iron absorption among women of reproductive age attending Urban Health Centre of a tertiary care teaching hospital in Tamil Nadu, India. The study aims to explore participants' knowledge about iron-rich foods and dietary inhibitors, thereby understanding the knowledge gaps and opportunities to support nutrition education efforts that enhance iron bioavailability to reduce iron deficiency anaemia.

MATERIALS AND METHODS

Study Design

A qualitative study employing in-depth interviews was conducted.

Study Setting

The study was carried out at an Urban Health Centre attached to a tertiary care teaching hospital in Tiruvallur District, Tamil Nadu, India.

Study Period

February 2025 to May 2025.

Study Participants

Women aged 15–49 years visiting the Urban Health Centre.

Inclusion Criteria

- Women aged 15–49 years.
- Willing to participate and provide informed consent

Exclusion Criteria

- Women with chronic illnesses, including diabetes mellitus, hypertension, and asthma

Sampling Technique

Purposive sampling was employed to recruit participants with diverse socioeconomic and dietary backgrounds.

Sample Size

Twenty-five participants were interviewed. Data collection continued until thematic saturation was achieved.

Data Collection

Data were collected using a semi-structured interview guide containing open-ended questions focusing on: daily dietary habits, awareness of iron-rich foods, knowledge of factors affecting iron absorption, cultural and social influences on food choices, perceptions regarding anaemia and iron deficiency. Interviews were conducted in the local language, audio-recorded with permission, and transcribed verbatim. The average duration of the interview was 30 minutes. The IDI was audio recorded with the consent of the participants. At the end of the interview, the summary points were informed to the participant for validating the information summarized.

Data Analysis

The interviews were transcribed into the language of record (Tamil) and then translated to English. Notes were taken while listening to the audio recording of the IDI. Manual descriptive content analysis was used to analyze the transcripts. Transcripts were reviewed by another person to decrease bias and increase interpretive credibility. Also Transcripts were analyzed using Braun and Clarke's six-step thematic analysis approach in NVivo software¹³. Decisions on coding rules and theme generation were done using standard procedure and consensus. Codes, themes, and categories were generated based on the grounded theory approach. Inferences were drawn and meaning was derived based on the objectives of the study. The conceptual framework was derived based on the codes, themes, and categories generated from the participants statements.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee of Saveetha Medical College. Written informed consent was obtained from all participants.

RESULTS

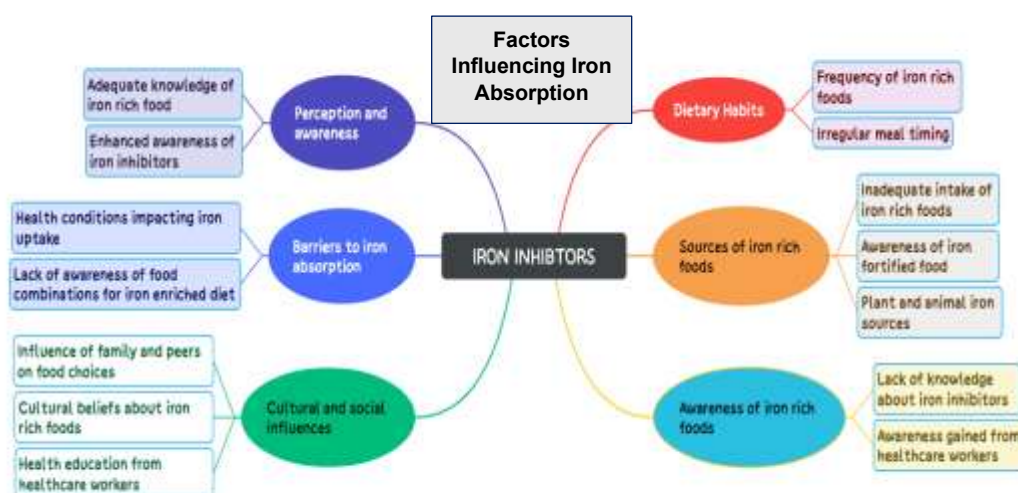
Twenty-five women of reproductive age (15–49 years) participated in the study. Participants had a wide range of educational, occupational and socioeconomic backgrounds. The criterion of saturation was met when the 25 in-depth interviews were conducted, and no new themes arose during the analysis of subsequent interviews. The results of thematical analysis revealed six main themes and eighteen codes associated with each of these themes that explained the dietary practices, knowledge, perceptions and sociocultural factors affecting iron absorption among the participants. The themes and codes are listed in Table 1.

Table 1: Thematic Framework of Dietary Practices, Awareness, Perceptions, and Sociocultural Factors Affecting Iron Absorption (N=25)

Themes	Codes
Dietary habits	Frequency of iron rich foods consumed Irregular meal timing and skipping meals

Sources of Iron-Rich Foods	Inadequate intake of iron rich foods Awareness of iron fortification foods Adequate knowledge on plant/animal iron sources
Awareness on iron-rich foods	Awareness gained from health care workers Cultural influences on iron rich foods Good awareness of the food combinations for an iron-enriched diet
Barriers to Iron Absorption	Health Conditions Impacting Iron intake Factors Affecting Iron Bioavailability (e.g., Phytates, Tannins) Lack of awareness of the food combinations for an iron-enriched diet
Perceptions and Awareness	Adequate knowledge of iron importance Lack of awareness of Iron Inhibitors Enhanced awareness of Iron Inhibitors
Cultural and Social Influences	Influence of Family and Peers on Food Choices Cultural Beliefs About Iron-Rich Foods Health education from Health care workers

Figure 1. Thematic map showing major themes and subthemes related to awareness of dietary iron inhibitors and factors influencing iron absorption among women of reproductive age (N=25)



Theme 1: Dietary Habits

The participants reported diets mostly comprising traditional South Indian foods like idli, dosa, rice-based food and chapati. Some of the respondents noted eating iron-rich foods such as green leafy vegetables, eggs, fish and meat, but it was not a consistent practice and not everyone eating them did so consistently. Irregular meal timing and meal skipping, especially by women who were multitasking between household duties and work, were a common theme. Time constraints were reported by many participants as a reason for consuming whatever food was available.

“I have whatever is available in the morning; it's always rush hour at that time, and I don't have time to eat.” Some participants indicated that they had started eating fruits like Pomegranate, Banana, Guava and Date after seeking guidance from health care professionals.

Theme 2: Sources of Iron-Rich Foods

A high proportion of participants were aware of the foods commonly available that they could consume for iron. Sources of iron in the diet that were often mentioned were green leafy vegetables, eggs, fish, meat, Genetics and Molecular Research 25 (8s): 2026

dates, beetroot and jaggery. Some misconceptions about iron-rich foods were noted, however. There was a lack of nutritional knowledge with milk and curd being perceived as important sources of iron. Several people thought that their diet provided them with enough iron despite being diagnosed with anaemia.

“I think I have an iron-rich diet, and I have always eaten healthy food. I don't know how the doctor said I have anaemia.”

It has also been reported that healthcare professionals gave participants some dietary recommendations, such as eating more dates, pomegranates, spinach, and animal-source foods, which participants changed their eating habits in response to.

Theme 3: Awareness of Iron-Rich Foods and Enhancers of Iron Absorption

Healthcare workers, particularly after the use of health services for diagnosis or treatment of anaemia, were the primary source of awareness on iron-rich foods. Doctors and health professionals were a frequent source of nutritional information for participants. Some of the respondents reported knowledge of foods that promote iron absorption, including vitamin C rich foods (e.g., lemon, tomatoes, and citrus fruits).

One participant reported:

“After my transfusion, the doctor advised me to have sour fruits, like lemon juice, sweet lime, and tomatoes, to increase iron absorption.”

Even with this knowledge, it is observed that participants were still not certain about the scientific basis for these recommendations, and they also highly relied on the advice from healthcare providers, family members, and their social network.

Theme 4: Barriers to Iron Absorption

The issue of barriers to optimal iron absorption came to the fore. Several factors impacting diet were identified by the participants, such as dietary constraints, chronic health issues, food preferences, and lack of awareness regarding food interaction. One of the most important discoveries was the extent to which tea and coffee were drunk with food. Some participants indicated that they consumed tea and/or coffee several times during the day, but did not keep any time between drinking and eating.

“I used to drink tea or coffee 6–7 times a day, and I don't follow any time gap between tea and meals.”

The participants also reported difficulties in taking iron tablets because of gastrointestinal side effects (such as nausea and an unpleasant taste). Secondly, there were widespread false beliefs about the role of milk and other foods in anaemia. Information about dietary inhibitors like phytates, tannins, calcium and polyphenols was relatively sparse. Tea and coffee were known by some participants as inhibitors, and other inhibitory factors were not well known.

Theme 5: Perceptions and Awareness Regarding Iron and Iron Inhibitors

The majority of the participants were aware of the role of iron in the formation of blood and overall health. However, specific information on the requirements for iron, iron metabolism and iron absorption mechanisms was still scarce. Participants frequently described weakness and fatigue as the first and foremost symptom of iron deficiency, but had different levels of awareness about other health effects. There was some variation in awareness of dietary inhibitors. The most frequently recognised inhibitors were tea and coffee, while information on the phytate content of foods and calcium interactions and on tannins was limited.

“Tamarind is the only one I heard of; my mother told me about it, and I have heard it on the radio too.”

Healthcare consultations tended to be more about iron-rich foods, rather than about diet factors that affect iron absorption, many of the respondents indicated.

Theme 6: Cultural and Social Influences

Family members, friends, health care professionals and social media were important influences on food habits. Spouses, parents, siblings, and community members provided dietary advice to participants, often. Social media and online videos turned out to be significant sources of nutrition information, especially for those who didn't have high levels of formal education.

“My sister watch YouTube videos about food habits; they tell me about them.”

Food selection and attitudes towards health were affected by traditional beliefs and cultural practices. Some participants noted making dietary changes such as eating foods rich in iron or changing eating patterns as suggested by the elders, family traditions, or experiences within the community. But these factors sometimes led to false information about nutrient sources and absorption.

DISCUSSION

A qualitative study was conducted to gain insight into the dietary practices, perceptions, and awareness of the women of reproductive age regarding iron absorption at an Urban Health Centre (UHC) in Tamil Nadu. The findings showed that the participants generally had good knowledge about iron-rich foods, but there was limited knowledge on dietary inhibitors of iron absorption. The idea of cultural beliefs, habit of food consumption and family influences, as well as lack of health education, were noted as important factors that affect iron absorption dietary behaviours.

One of the important findings of this study was the awareness about the available iron-rich foods like green leafy vegetables, eggs, fish, meat, dates, and jaggery. These foods were often cited as a source of iron, and the foods were reported to have been eaten more after a health talk. The low to moderate level of awareness regarding iron-enriched foods has been reported in low and middle-income countries, including Ethiopia, Nepal, and Bangladesh, where public health campaigns and antenatal nutrition counselling have contributed to awareness⁹. But just having knowledge does not always result in good food habits. However, several of the participants in the present study indicated that they experienced irregular meal patterns, skipped meals, and did not always eat items that are rich in iron, indicating that real-world practical constraints might obstruct the use of nutrition knowledge.

The study also uncovered the common misconceptions about iron food sources. Some of the participants thought that foods like milk and curd were the significant sources of dietary iron although their iron content was low. This is similar to what was found in previous qualitative studies on nutritional knowledge among women/caregivers. These may lead to misplaced dietary priorities and a lack of iron consumption despite a healthy diet.

A very significant result of this study was the low knowledge about Fe inhibitors in the diet. Some participants knew that tea and coffee could inhibit iron absorption, but few had heard about other inhibitors like phytates, tannins and calcium-rich foods. This discovery is especially noteworthy because the composition of meals greatly affects dietary iron bioavailability. Hurrell and Egli (2010) showed that phytates in cereals and legumes are one of the most powerful inhibitors of non-haem iron absorption, and polyphenols in tea and coffee significantly decrease iron absorption with meals⁴. Similarly, Benkhedda et al. (2010) found that calcium was a negative factor in the absorption of iron, especially among women who had low iron stores⁶. The small number of such interactions that were detected in the current study indicates a need for community nutrition education.

Tea and coffee drinking were common among the participants. A few women said that they drink several cups of tea or coffee per day, particularly before or after eating. Consumption of tea is reported to cause iron deficiency in various studies showed that tea polyphenols have a great inhibitory effect on the absorption of non-haem iron even when dietary enhancers like ascorbic acid are added^{5,10}. The high prevalence of tea and coffee consumption at mealtimes found in this study, therefore, could be a large, modifiable risk factor for poor iron status.

The other key finding was that healthcare workers are a leading source of nutrition-related information. A significant number of participants reported having been advised on diet after being diagnosed or treated for anaemia. The results indicate that, however, nutritional counselling frequently targeted the increase of iron-rich foods without providing information on factors that affect the bioavailability of iron. There are similar concerns about nutritional interventions in previous public health studies, which focused mainly on iron supplementation and offered insufficient iron absorption education on dietary enhancers and inhibitors¹. Newly developed counselling messages may contribute to the effectiveness of current anaemia prevention programmes by being expanded to incorporate information on food combinations, meal timing and dietary inhibitors.

Throughout the interviews, cultural and social influences were apparent. Food and nutrition choices and health behaviours were identified as being influenced by family members, friends, social media and traditional beliefs. Sometimes, information from family members, neighbours, and Internet research was used to determine food selections. The results are in line with past studies that showed that food-related behaviours are grounded in social and cultural contexts¹¹. In many communities, diet is not simply a result of nutritional knowledge, but also cultural norms, availability, family taste and social norms. Therefore, the contextual factors need to be taken into account when developing interventions to promote dietary behaviours and involve family members, in addition to women.

The result of this study can also be analysed using the framework of the Health Belief Model (HBM). The participants who had previously been diagnosed with anaemia or treated for it seemed to feel that they were

more likely to become iron-deficient and were more inclined to change dietary habits. Healthcare workers were important cues to action, by providing dietary counselling to induce behaviour change. But perceived barriers (such as drinking tea regularly, preferences, cost and lack of understanding about iron inhibitors) often hindered adoption of optimal food choices for iron. Some of the same applications of HBM have been found in studies that investigated nutritional behaviours and anaemia prevention in women of reproductive age¹².

Strength of the study

The qualitative study design was one of the strengths of the study, as it allowed for a detailed exploration of food iron absorption experiences, perceptions and dietary behaviours among participants. In-depth interviews yielded detailed descriptions of beliefs, attitudes, and social influences, which was mostly concerned with the measurement of knowledge or prevalence. The six primary themes and various subthemes enabled a thorough evaluation of diet, awareness, barriers, and sociocultural factors related to iron absorption. Studies of the prevalence of anaemia and iron deficiency have been done, but fewer studies have investigated community awareness of the inhibitors of iron absorption in the diet.

Limitations of the study

One of the limitations of the study is that it was carried out at one Urban Health Centre in a Tertiary Care Teaching Hospital in Tamil Nadu. The results cannot necessarily be applied to women living in rural areas, in other parts of India or among women with other cultural or socioeconomic backgrounds. Findings would be more generalizable and transferable to other populations and sites if more sites and more diverse populations were studied. Further, all dietary behaviours and perceptions were self-reported and may be subject to recall and social desirability bias. The participants might have inadvertently over- or underestimated their food behaviours, or given answers they thought might fit in with society. In addition, the study was mainly based on perception and awareness without collecting objective data on dietary intake, iron status and indicators of anaemia. More detailed knowledge of the relationship between knowledge, diet and iron status can be gained from future mixed methods studies that incorporate biochemical assessment and dietary analysis. Nevertheless, the study has some limitations and provides useful information about the gap in knowledge and behaviours that affect the absorption of Fe among women of reproductive age and a basis for planning future research and developing interventions.

CONCLUSION

The results showed that the knowledge of the food sources of iron among the participants was adequate, but there were significant gaps in their knowledge about dietary factors affecting iron bioavailability. Foods like green leafy vegetables, eggs, fish, meat, dates and jaggery were commonly recognised as an important source of iron, but there was a low level of knowledge about inhibitors of iron absorption like tea, coffee, calcium-rich foods, phytates and tannins. The results suggest that there is a gap between knowledge of iron-rich foods and knowledge of how effective the foods are for iron utilisation in the body. The study also found that personal values, cultural traditions, family routines, social support networks and health care messages all play a role in dietary behaviours. Familiarity with nutrition and nutrition-related behaviours was influenced by family members, health professionals and social media. But there were still a lot of misunderstandings about food combinations and meal timing, which may have been responsible for some cases of poor iron absorption even with adequate iron intake. Coffee and tea, which are consumed around mealtimes, came up as a specific barrier to optimal iron bioavailability. The results overall confirm the importance of a broad approach to nutrition education, beyond merely encouraging people to eat iron-rich foods and supplements. Dietary enhancers and inhibitors of iron absorption, culturally appropriate meal planning, and locally available food sources should be integrated into public health interventions. Improved nutrition counselling in communities and embedding iron bioavailability messages into existing anaemia prevention programmes may help to improve dietary behaviours and support existing work on the prevention of iron deficiency anaemia in women of reproductive age.

REFERENCES

1. Pasricha, S.R., Tye-Din, J., Muckenthaler, M.U. and Swinkels, D.W., 2021. Iron deficiency. *The Lancet*, 397(10270), pp.233–248.
2. World Health Organization (WHO), 2024. Anaemia Fact Sheet. Geneva: World Health Organization

3. IIPS, I.C.F., 2021. National family health survey (NFHS-5): 2019-21 India. Mumbai: International Institute for Population Sciences (IIPS).
4. Hurrell, R. and Egli, I., 2010. Iron bioavailability and dietary reference values. *American Journal of Clinical Nutrition*, 91(5), pp.1461S–1467S.
5. Zijp, I.M., Korver, O. and Tijburg, L.B., 2000. Effect of tea and other dietary factors on iron absorption. *Critical reviews in food science and nutrition*, 40(5), pp.371-398
6. Benkhedda, K., L'abbé, M.R. and Cockell, K.A., 2010. Effect of calcium on iron absorption in women with marginal iron status. *British journal of nutrition*, 103(5), pp.742-748.
7. Lynch, S.R. and Cook, J.D., 1980. Interaction of vitamin C and iron. *Ann NY Acad Sci*, 355(1), pp.32-44.
8. Balarajan, Y., Ramakrishnan, U., Özaltin, E., Shankar, A.H. and Subramanian, S.V., 2011. Anaemia in low-income and middle-income countries. *The Lancet*, 378(9809), pp.2123–2135.
9. Khanna, P., Kaur, M., Varma, N., Sharma, S., Sehgal, R., Singh, T., Srivastava, R., Kushwaha, S. and Jain, R., 2023. Impact of community based nutrition intervention in the prevention and control of anaemia among reproductive aged women of India. *Maternal and Child Health Journal*, 27(7), pp.1247-1253.
10. Thankachan P, Walczyk T, Muthayya S, Kurpad AV, Hurrell RF. Iron absorption in young Indian women: the interaction of iron status with the influence of tea and ascorbic acid. *Am J Clin Nutr*. 2008 Apr;87(4):881-6. doi: 10.1093/ajcn/87.4.881. PMID: 18400710
11. Contento, I.R., 2016. *Nutrition Education: Linking Research, Theory and Practice*. 3rd ed. Burlington, MA: Jones & Bartlett Learning
12. Jones, C.L., Jensen, J.D., Scherr, C.L., Brown, N.R., Christy, K. and Weaver, J., 2015. The Health Belief Model as an explanatory framework in communication research. *Health Communication*, 30(6), pp.566–576
13. Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp.77–101.