

Micronutrient Awareness Among Adolescent Girls: A Study on Knowledge, Attitudes and Practices

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ABSTRACT

Knowledge, Attitudes and Practices (KAP) studies offer valuable insights into determinants of nutrition like socio-cultural, psychological and behavioral. This study specifically aimed to assess the KAP of micronutrients like iron, vitamin A, zinc and iodine among adolescent college going girls. Deficiencies of these micronutrients are more common among adolescents. A cross-sectional KAP survey was conducted with 163 college going girls by using structured questionnaire. Participants were from both rural and urban background and were predominantly vegetarian. While many were aware of the term 'micronutrients,' their understanding of various aspects of micronutrients was limited. Most participants were unfamiliar with the concept of food fortification, including fortification logos and specific fortified foods. There was mixed response with regard to cooking practices to preserve micronutrients. Some of the practices followed by the participants helped to retain the micronutrients while others led to loss of micronutrients. Fifty per cent participants followed diet diversification though they were not fully aware of its concept. For most of the participants, the diet was cereal and pulse based with some dairy products. A nutritionally insufficient diet may contribute to the continued prevalence of malnutrition among adolescents. Overall, there is a need for interventions like nutrition education to inform participants about effective strategies for enhancing their micronutrient status.

Keywords : Micronutrients, Fortification, Adolescents, Malnutrition

THE World Health Organization (WHO) defines adolescence as the age group of 10 to 19 years (Divya et al., 2022). Adolescence is a unique stage of human development accompanied by growth spurt, hormonal changes and increased cognitive demands (Latha et al., 2024). During this stage of development good nutrition plays a significant role to maintain overall health (Ayal et al., 2022). Adolescents have higher nutritional needs than adults because they gain about 40 per cent of their adult weight and 15 per cent of their adult height in this phase. Among the essential nutrients, micronutrients comprising of vitamins and minerals have a crucial role in healthy development, growth, disease prevention and well-being. They are required for production of

enzymes, hormones and other essential components to enhance immunity. Vitamin B complex plays an important role in neural communication and their deficiency can lead to neurological disorders like depression. Iron is essential for maintaining neurotransmitter homeostasis, myelin production, synaptogenesis and basal ganglia function (Pivina et al., 2019). Its deficiency causes cognitive decline, memory loss and impaired motor development (Gingoyon et al., 2022). Iodine is an essential micronutrient required for production of thyroid hormone that is crucial in development, growth and metabolism. Its deficiency can cause iodine deficiency disorders (Sorrenti et al., 2021). The most severe consequences of iodine deficiency include mental

retardation which makes it major contributor for cognitive decline. Zinc helps the cells to grow and divide and is required for the activity of enzymes, proteins and DNA. Zinc promotes immune functions and helps people resist several infectious diseases including diarrhea and pneumonia. Its deficiency is linked to impaired attention, learning and memory and development of neuro psychological diseases. The retinal form of vitamin A has role in the activation of signaling processes in the retina that initiate vision. It is also required in the synthesis of RNA and glycoproteins involved in corneal and conjunctival epithelial maintenance (Ohanenye *et al.*, 2021).

Dietary diversity means consumption of various food groups within the specified reference period (Alam *et al.*, 2010). Diverse diets include adequate combination of macronutrients and micronutrients and other important food-based substances such as dietary fiber to ensure nutrient adequacy. Lack of diversity in diets leads to higher incidence of micronutrient deficiencies. Diet diversity holds special significance for adolescent girls as they require varied nutrients for physiological development and biological maturation. Nutritional deficiencies at this time have far reaching consequences.

However, in this challenging phase of life many adolescents are not aware of importance of micronutrients and neglect them in their diet. As a consequence, they develop symptoms like chronic fatigue, weak immunity, cognitive decline and health risks. Deficiencies of iron, Vitamin A, zinc and iodine are common among adolescents. This occurs due to limited dietary diversity, increased fast food consumption and lack of proper nutrition education. Micronutrient deficiencies affect about one-third of the world's population (Han *et al.*, 2022). As per the data of National Family Health Survey 2019-2021 (NFHS-5), the prevalence of anemia was 59.1 per cent in adolescent girls. About one third adolescent population was found to be zinc deficient and 16 per cent of them were vitamin A deficient (Pareek *et al.*, 2024). Most of the deficiencies are preventable by creating awareness

about micronutrient importance. Food fortification is an effective strategy that can be helpful in addressing micronutrient deficiencies, especially in areas having less access to diverse foods. Lack of nutrition information can also be a contributory factor for low nutritional knowledge on health (Khwairakpam Beembem *et al.*, 2012). Creating awareness about micronutrients in adolescents can help lay foundation for healthy future and reduce risk of chronic diseases. With this backdrop the study was taken up to assess the awareness of micronutrients in the adolescent girls.

METHODOLOGY

The study was conducted in Aditi Mahavidyalaya, University of Delhi with a sample of 163 adolescent girls. These girls willingly gave their consent to participate in the study as subjects. A structured questionnaire having questions related to knowledge, attitudes and practices was designed to gather information about knowledge, attitudes and practices regarding micronutrient consumption of the participants. There were both open-ended and close-ended questions in the survey. The recorded information was tabulated in the excel sheet and responses were expressed in percentage.

RESULTS AND DISCUSSION

Demographic Profile of the Respondents

The demographic profile of the participants is shown in the Table 1. The age group of the participants was divided into two categories 18-19 years and 20-21 years. The number of participants were almost similar in each age group. The majority of the participants were vegetarian (71.2%). Only 6.7 per cent of the participants were staying as paying guest, rest were at their home. Urban participants (62%) were more than rural participants (38%).

Knowledge about Examples, Sources and Functions of Micronutrients

Knowledge of participants about sources and functions of micronutrients is depicted in Table 2. Though the majority of participants (95.1%) were

TABLE 1
Demographic profile of the respondents (n=163)

Characteristics	Category	Respondents					
		Urban (n=101)		Rural (n=62)		Total (n=163)	
		No.	%	No.	%	No.	%
Age group (years)	18-19	50	49.5	26	41.9	77	47.2
	20-21	51	50.5	36	58.1	86	52.8
Food Habits	Vegetarian	73	72.3	43	69.4	116	71.2
	Non-vegetarian	28	27.7	19	30.6	47	28.2
Accommodation	Home	96	95	56	90.3	152	93.3
	Paying Guest	5	5	6	9.7	11	6.7

TABLE 2
Knowledge about sources and functions of micronutrients (n=163)

Statement	No.	%
Awareness about micronutrients?		
Yes	155	95.1
No	8	4.9
Micronutrients examples		
Fat	15	9.2
Sugar	8	4.9
Calcium	68	41.7
Protein	35	21.5
Zinc	128	78.5
Vitamin C	103	63.2
Carbohydrates	25	15.3
Vitamin D	94	57.7
Source of information about micronutrients		
Health care professionals	45	27.6
Social media	105	64.4
Books and magazines	80	49.1
Family and friends	62	38.0
Seminars	1	0.06
Awareness about role of micronutrients		
Iron	141	86.5
Vitamin A	123	75.5
Sodium	93	57.1
Iodine	115	70.6
Vitamin C	131	80.4
Vitamin D	124	76.1

familiar with the term, 'micronutrients'. However, they were uncertain about specific examples of the micronutrients and included protein (21.5%), carbohydrates (15.3%) and fat (9.2%) in micronutrient category. This indicated that participants were not having in depth knowledge of the micronutrients. Also, they could not differentiate between macro and micronutrients examples.

Social media has become an important source of information for our young generation. In the study, social media (64.4%) was the most popular source of information of micronutrients followed by books and magazine (49.1%), family and friends (38%) and healthcare professionals (27.6%). Iron as micronutrient was best known among the participants. The awareness about individual micronutrients in decreasing order was iron (86.5%), vitamin C (80.4%), vitamin D (76.1%), vitamin A (75.5%), iodine (70.6%) and sodium (57.1%). Specific responses by the participants included role of iron in hemoglobin synthesis, importance of vitamin A in eye health and vision, involvement of sodium in blood pressure, iodine role in thyroid function, zinc contribution in immunity enhancement and importance of vitamin D in bone development.

Knowledge About Fortification of Micronutrients

Results obtained regarding knowledge about fortification of micronutrients are presented in Table 3. About 34 per cent participants were aware about fortification of micronutrients. These

TABLE 3
Knowledge about fortification of micronutrients
(n = 163)

Statement	No.	%
Awareness of importance of food fortification		
Yes	56	34.4
No	107	65.6
Awareness of food fortification logo		
Yes	45	27.6
No	118	72.4
Information about fortified foods		
Read it on package	63	38.7
Advertisement	25	15.3
Read in an article	19	11.7
Friends	12	7.4
Others (social media)	11	6.7
Have not bought such foods	31	19.0
Information about fortification on the food label		
A statement on the front	8	4.9
Nutrition information panel	80	49.1
Ingredient list	71	43.6
Elsewhere on package	8	4.9
Have not seen such statements	2	1.2

participants knew that by fortification nutrient content is increased and it provides health benefit. It can address micronutrient deficiency in various age groups. Fortification logo on the food label was familiar to only 27.6 per cent participants. Another study conducted in Urban Delhi on 150 women, depicted that 48 per cent of the respondents were aware about the fortification logo on pre packed foods (Ahuja and Sheth, 2021). Information about fortified foods was more commonly read on package of the food products (38.7%) by the participants. Other source of information included advertisements (15.3%), articles (11.7%), friends (7.4%) and social media (6.7%). Nineteen per cent participants never bought fortified foods. This shows they were never aware of the existence of such products. The results revealed that the majority participants were able to read information regarding fortification on the

nutritional information panel (49.1%) and in the ingredient list (43.6%).

Awareness about fortification of few commonly used food items was assessed for participants. According to the responses received 24.5 per cent participants knew oil is fortified with vitamin A and D and 25.8 per cent knew wheat flour is fortified with iron, zinc and folic acid. About 36 per cent participants mentioned about milk fortification with Vitamin A, D, Calcium and Iron and 42.9 per cent were aware of salt fortification with iodine and iron. Participants listed some functions of micronutrients like role in immune system (78.5%), energy production (54.6%), bone (47.2%) and skin health (46.6%). The overall knowledge of fortified foods was low among the participants which is consistent with results were reported in previous studies (Battalwar & Chavan, 2017 and Kasankala *et al.*, 2018). The level of awareness about fortified food among the participants could impact the consumption of fortified food. Fortified foods would be one of the convenient ways to address micronutrient deficiency in developing countries like India where vegetarianism predominates among population. Studies had revealed that daily consumption of fortified food could be instrumental in alleviating micronutrient deficiencies (Larson *et al.*, 2021).

Practices Regarding Micronutrient Consumption

Consumption of fortified foods among the participants was dependent on the type of food product being consumed. (Table 4). Fortified flour was the most popular food to be consumed by the participants (82.8%). Fortified breakfast cereals (52.8%), noodles (75.5%), dairy products (74.2%), oils (79.1%), salt (85.9%) and fruit juices (65.6%) were also consumed by majority participants. Fortified margarine (8.6%) and flavored water (25.8%) were not so popular choice of the participants. The results depicted the participants were consuming the fortified foods which were commonly available in the market. There was less consumption of uncommon fortified foods.

TABLE 4
Frequency of fortified food or drinks consumed by the respondents (n=163)

Fortified Food	No No. (%)	Yes No. (%)	Frequency				
			Daily No. (%)	Several times in a week No. (%)	Weekly No. (%)	Occasionally No. (%)	Rarely No. (%)
Flour	28 (17.2)	135 (82.8)	117 (86.7)	6 (4.4)	8 (5.9)	2 (1.5)	2 (1.5)
Breakfast cereals	77 (47.2)	86 (52.8)	37 (43.0)	21 (24.4)	7 (8.1)	12 (14.0)	9 (10.5)
Noodles	40 (24.5)	123 (75.5)	16 (13.0)	14 (11.4)	27 (22.0)	33 (26.8)	33 (26.8)
Margarine	149 (91.4)	14 (8.6)	0 (0.0)	2 (14.3)	3 (21.4)	3 (21.4)	6 (42.9)
Dairy Products	42 (25.8)	121 (74.2)	96 (79.3)	18 (14.9)	5 (4.1)	2 (1.7)	0 (0.0)
Oils	34 (20.9)	129 (79.1)	108 (83.7)	14 (10.9)	7 (5.4)	0 (0.0)	0 (0.0)
Salt	23 (14.11)	140 (85.9)	135 (96.5)	2 (1.4)	2 (1.4)	1 (0.7)	0 (0.0)
Fruit juices	56 (34.4)	107 (65.6)	28 (26.2)	32 (29.9)	22 (20.6)	18 (16.8)	7 (6.5)
Flavoured water	121 (74.2)	42 (25.8)	8 (19.0)	8 (19.0)	1 (2.4)	12 (28.6)	13 (31.0)

Cooking Practices to Preserve Micronutrients

Participants were assessed on the cooking practices to preserve the micronutrients. The responses are tabulated in the Table 5. Responses for throwing (45.4%) or not throwing extra water (54.6%) after boiling rice was almost equal. The majority participants (78.0%) washed the vegetables after cutting, peeled the vegetables thinly (72.4%), used baking soda while cooking (67.5%) and kept milk exposed to light (81.0%). Half of the participants threw extra water after boiling rice and half preferred it not to throw. There were both good and bad cooking practices followed by the participants. This indicates they were not aware of the ways to preserve the micronutrients while cooking.

Strategies to Increase your Micronutrient Intake :

Participants followed these measures to increase their micronutrients in descending order - diet diversification (52.7%), inclusion of fortified foods (30.1%), use of supplements (17.2%). The results are tabulated in the Table 6.

Diet diversification is inclusion of number of different foods or food groups over a given reference period. It is regarded as an important element of a high-quality diet and found to be essential for optimal growth and development as well as long-term health (Larson *et al.*, 2021). Inclusion of fortified foods and use of supplements are the approaches which are followed across the world to combat deficiencies. However,

TABLE 5
Cooking practices to preserve the micronutrients (n=163)

Practice	Yes No. (%)	No No. (%)
Do you throw extra water after boiling rice?	74 (45.4)	89 (54.6)
Do you wash vegetables after cutting?	127 (78.0)	36 (22.0)
Do you peel the vegetables thinly?	118 (72.4)	45 (27.6)
Do you use baking soda while cooking?	53 (32.5)	110 (67.5)
Do you keep milk exposed to light?	31 (19.0)	132 (81.0)

TABLE 6
Strategies to increase your micronutrient intake (n=163)

Strategies to increase your micronutrient intake	No. (%)
Diet diversification	86 (52.7%)
Inclusion of fortified foods	49 (30.1%)
Use of supplements	28 (17.2%)

there are experts who suggest that use of supplements and food fortification are not the ultimate measures for controlling deficiencies, rather food-based approaches like diet diversification should be considered on the long-term basis (Nair *et al.*, 2016).

Assessments of Participants about Diet Diversity : According to 47.1 per cent participants diet diversification meant inclusion of variety of different foods in individual's diet, whereas 52.9 per cent respondents did not have understanding of diet diversification. The frequency of different food items consumed by the respondents are given in the Table 7. Cereals and their products (87.7%), pulses and their products (60.7%) were consumed by majority participants on the daily basis. Fruits (47.9%), roots and tubers (46%) and other vegetables (45.4%) were also part of daily diet of participants

but in less number. Almost fifty percent of the participants preferred to take sweets daily. Dark green vegetables, nuts and oilseeds, egg and flesh foods were not included in majority participant's daily diet. It was observed diets of the participants was predominantly cereal and pulse based and diet diversity aspect was missing in many participants' diets. Dark green vegetables, nuts and oilseeds and non-vegetarian food items were not daily choice of majority participants. Studies suggest diet diversity is associated with more likelihood of meeting micronutrient requirements (Lachat *et al.*, 2018) and lower rates of noncommunicable diseases (Hanley-Cook *et al.*, 2021).

This study assessed adolescents' awareness of micronutrients and their role in a healthy diet. While most were familiar with the term 'micronutrient,' they lacked knowledge about specific examples and their functions. Social media strongly influenced their food choices. Many were unaware of fortification logos and had limited knowledge of food fortification, although they commonly consumed fortified cereals, dairy, salt and oil. There was mixed knowledge about preserving micronutrients during cooking. Adolescents used strategies like diet diversification, fortified foods and supplements to boost micronutrient intake. However, many still omitted key food groups,

TABLE 7
Assessments of participants about diet diversity (n=163)

Name of the food item	Daily No. (%)	Several times in a week No. (%)	Weekly No. (%)	Occasionally No. (%)	Rarely No. (%)
Cereals and their products	143 (87.7)	14 (8.6)	6 (3.7)	0 (0.0)	0 (0.0)
Pulses and their product	99 (60.7)	50 (30.7)	14 (8.6)	0 (0.0)	0 (0.0)
Root and tubers	75 (46.0)	56 (34.4)	20 (12.3)	7 (4.3)	5 (3.0)
Fruits	78 (47.9)	64 (39.3)	16 (9.8)	5 (3.0)	0 (0.0)
Dark green leafy vegetables	41 (25.2)	82 (50.3)	30 (18.4)	9 (5.5)	1 (0.6)
Other vegetables	74 (45.4)	57 (35.0)	25 (15.3)	5 (3.1)	2 (1.2)
Nuts and oilseeds	31 (19.0)	63 (38.7)	29 (17.8)	31 (19.0)	9 (5.5)
Eggs	8 (4.9)	19 (11.7)	46 (28.2)	42 (25.8)	48 ((29.4)
Flesh foods	15 (9.2)	7 (4.3)	40 (24.5)	52 (31.9)	49 (30.1)
Sweets and sugars	77 (47.2)	42 (25.8)	15 (9.2)	22 (13.5)	7 (4.3)

leading to nutritionally inadequate diets. The study suggests that nutrition education is necessary to improve adolescents' understanding of dietary diversity.

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