DOI: 10.7860/JCDR/2021/46024.14806

Original Article

Nutrition Section

Effectiveness of a Nutritional Education Intervention Focussed on Iron among School Children in National Capital Region and Mumbai

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ABSTRACT

Introduction: Anaemia is a major health problem in India. Various studies mention poor nutrition knowledge and education as main factors of malnutrition.

Aim: This study aims at assessing the effect of nutritional education on iron among school children.

Materials and Methods: A cross-sectional interventional study was undertaken to improve nutrition literacy in schools from April 2018 to February 2019. The outreach platform used was Eat Right School program by Food Safety and Standards Authority of India (FSSAI). A study tool employed was data collection using self-developed questionnaire for pre and post-intervention knowledge assessment. School children from Delhi NCR and Mumbai participated in this study. Knowledge intervention was done on 5 key elements related to iron including role, sources, iron deficiency anaemia, iron absorption and knowledge of fortification. Chi-square test was applied for comparison.

Results: It was found that 54% (n=18,626) of school children studied were in the age group 11-14 years. From 27355 participants who reported the gender, 58.1% (n=15899) were males and 41.9% (n=11456) were females. Comparison of pre and post-intervention assessment revealed that percentage of students knowing importance/role of iron increased from 27.30% to 59.50%, iron deficiency anaemia from 34.03% to 59.85%, sources of iron from 25.20% to 51.70%, iron absorption from 36.00% to 61.2% and knowledge of fortification from 55.4% to 76.9%. Thus, significant shift ($p \leq 0.001$) in all the parameters was observed; improvement in scores ranged from 21.5% to 32.20% with highest increase seen in understanding the role of iron.

Conclusion: Results of the study reject the null hypothesis leading to acceptance of alternate hypothesis. The alternate hypothesis highlights the role of nutrition education in improving the nutritional literacy of school children in the area of iron and iron deficiency anaemia. Results of the current study increased the knowledge of children on all parameters related to iron education module. Thus, nutritional literacy is imperative in improving nutritional status and adolescent age-group is the window of opportunity to correct it.

Keywords: Eat right school, Food safety and standards authority of India, Nutrition education, Safe and nutritious food

INTRODUCTION

According to a United Nations International Children's Emergency Fund (UNICEF) estimate of year 2019, globally, 2 in 3 children are not fed the minimum recommended diverse diet for healthy growth and development [1]. Millions of children living in developing nations are at a risk of malnutrition and iron deficiency is one of the major contributing factors. The late indicator of this iron deficiency is anaemia. As published by World Health Organisation (WHO) in strategies to prevent anaemia: Recommendations from an Expert Group Consultation [2], "globally, two billion people are anaemic, which includes 315 million in the South-East Asia Region". According to WHO guidelines for control of Iron Deficiency Anaemia, nutritional anaemia is a major public health problem in India and is primarily due to iron deficiency [3,4]. Presently, in Indian population 53% women and 22% men are suffering from iron deficiency [3-5].

Another WHO technical report series no. 916 of 2003 [6] mentions; current food setting as one of the causes for malnutrition and anaemia in children. The current food setting does not encourage children to develop preferences for nutrient rich sources like fruits and vegetables [7,8]. It is thought that food preferences established in early ages of life assist young children in becoming more acceptable to new nutritious foods as they grow older [9]. Developing personal taste for these food items in early age is important because of their known long-term benefits in maintaining healthy status. Hence, nutrition education in schools becomes significant to teach children the importance of consuming nutrient rich food, create awareness about the risks associated with its inadequate intake and help students in making informed food choices [10]. Various studies [11,12] stated that poor nutrition knowledge and education as main factors in development of malnutrition. A pilot study by Wilna H et al., shows that food insecurity and hunger are leading causes of malnutrition and poor health in many African countries [13]. However, these are not the only causes of malnutrition, as other factors such as ignorance and illiteracy may also play a significant role. Research has demonstrated that a focused approach to change behaviour by applying active methods, including food-based activities, boost the effectiveness of nutrition education programmes and, thus, the nutrition knowledge of children [14].

Thus, it becomes noteworthy that introduction of nutrition education in schools can be a very effective technique in reducing the gap in nutrition literacy. Considering the Indian statistics of malnutrition leading to iron deficiency anaemia in children, an effort has been made to reduce this public health problem to improve the health status of the upcoming generation, Government of India has taken different initiatives like "Anaemia Mukta Bharat and Poshan Abhiyan" [15,16]. Another approach is 'Eat Right School' program,

a nation-wide campaign to help school children inculcate the habit of eating safe and eating right. Project Eat Right School is based on a three-pronged approach, at the school, state and national level. This is being done through curricular or co-curricular activities. At school level, this activity is performed through Health Coordinators and Health Teams [17].

It is found that children in the age group 8-14 years are engaged in frequent physical and mental activities. Also, being in a commencement of transition period [18]; body demands for nutrition changes exhibiting greater requirement of iron [19]. Lack of adequate quality and quantity of food can lead to anaemia and malnutrition. Further, anaemia can also lead to poor psychological and physical development of a child along with reduced capacity to perform work. According to the article published by Prathibha "if children are well nourished and can make optimal use of their skills, talents and energies today [20], they can become healthy and responsible citizens and parents of healthy babies' tomorrow. A balanced nutritional outlook is important for good health and healthy routine". Also, these young children can act as change agents and help in spreading awareness amongst their friends and families.

PepsiCo India has effectively implemented FSSAI's Eat Right School (Safe and Nutritious Food School) (SNF) program) [21], aligning with company's vision towards generating awareness about safe food, healthy and sustainable diets amongst the student community in our country. PepsiCo India has proposed Safe and Nutritious Food Fellowship program wherein, PepsiCo India Nutrition Sciences team trains students from Nutrition colleges and Non-governmental Organisation (NGO) representatives to take this education forward to government and private school children. The learning modules created by FSSAI [22] have been adopted for orientation of Nutrition college students as SNF Fellows through this program. PepsiCo has thus come forward with an effective intervention strategy to improve nutrition literacy in schools with the support of Nutrition Colleges and NGOs. As a part of this education program, Nutrition college students and NGO health workers have conducted nutrition educational programs in schools of Delhi, Gurgaon, Faridabad and Mumbai to make children aware about the importance of iron nutrition. This study was designed with an objective of assessing the effect of nutrition education on nutrition literacy in the area of iron and iron deficiency anaemia in school children. There are limited research studies available stating positive impact of nutrition education in improving the understanding of iron nutrition in school children [19,23,24], we hypothesised that there would be no effect of knowledge intervention on the understanding about iron in school children. Hence, the purpose of present study was pre and posteducation intervention assessment.

MATERIALS AND METHODS

This cross-sectional interventional study was conducted in various schools of Delhi, Gurgaon, Faridabad and Mumbai from April 2018 to February 2019. The study population were males and females children of class 4th and above in the age range of 8-14 years. As mentioned in the introduction, nutrition requirements in adolescent age group increases and therefore nutrition education at this age will provide right direction to children in making correct food choices and thus help in reducing health issues in later stages of life. A target of 0.4 million school children was set for this awareness program. This target was based on the reach of PepsiCo and its partners to around 200 schools in Delhi NCR and Mumbai regions.

The impact assessment study of nutrition education was done through a pre and post-survey for a statistically acceptable sample size of 10% of the decided target [25]. A total number of 34,773 students got enrolled after their schools agreed to participate in this educational program. Participating schools then registered [26] on Eat Right School portal created by FSSAI. Since this study was a part of Eat Right School, a program by FSSAI which is a government organisation no separate ethical approval was sought for this study. Also, school registration on FSSAI portal was considered as a consent and no individual consent was taken from parents and students.

Inclusion criteria: Both male and female children in class 4th-9th (age range of 8-14 years) from the school willing to participate in both pre and post-nutrition education intervention were included in the study.

Exclusion criteria: Male and female children below and above the selected age range were excluded from the study.

Data collection tool employed in this survey was a self-developed questionnaire. This questionnaire covered information on demographic parameters like age and gender along with questions to assess knowledge and awareness of a children in 5 key elements related to iron including- role, sources, iron deficiency anaemia, iron absorption, and knowledge of fortification. This questionnaire was designed on the basis of questionnaires used in similar surveys conducted by other researchers [5,19,20,27] and by the experts of PepsiCo India Pvt., Ltd. The validity and reliability of the questionnaire was verified by the panel of professionals consisting of Nutritionists, Dieticians and Academicians in nutrition field. It was found to be acceptable by this panel based on their vast experience in the nutrition research. All the questions designed were closed ended. Sample questionnaire is given in [Table/Fig-1]. Students were asked to complete this questionnaire in maximum 30 minutes as a part of pre-intervention assessment to obtain the baseline data.

Following this pre-intervention assessment a training session was conducted for the SNF Fellows by FSSAI on Safe and Nutritious Food (SNF) program and SNF portal navigation and by PepsiCo Nutrition Sciences team on the nutrition topic "Importance of Iron". SNF Fellows visited the schools and briefed the children about the program. This was followed by an awareness session on importance of iron using techniques like, interactive activities and quizzes [28] developed by PepsiCo and FSSAI. Session also included presentation on sources and inclusion of iron rich foods in daily diet, inhibitors of iron absorption, symptoms of iron deficiency, etc., followed by a video covering the same topics. Calendars and classroom posters delivering the key messages of the session were distributed to students for reinforcing the importance of iron in diet [Table/Fig-2].

After a minimum gap of seven-days, the children were asked to complete the same questionnaire in maximum 30 minutes as a part of post-intervention assessment. Pre and post-training assessment were done by scoring method which involved use of mean, standard deviation and percentage as described by Nimbalkar P et al., [29].

STATISTICAL ANALYSIS

Both pre and post-education questionnaire results were analysed using SPSS statistical software, version 10. A chi-square test [27] with 0.001 as level of significance was applied for pre and post-intervention comparison.

RESULTS

A total of 34,773 students participated in this survey. However, by the end of study, there were 223 dropouts due to absenteeism and 34,550 (99.3%) students completed the survey successfully by undertaking both pre and post-intervention assessments. Age group considered for this survey was between 8 to 14 years. On statistical evaluation, it was found that 54.0% of the children were in the age group 11-14 years followed by 35.7% of 10 years of age and 10.2% of 9 years of age. [Table/Fig-3] below highlights the age wise distribution of students.

On analysis of gender distribution, it was observed that only 27,355 students (79.4%) opted to answer this question, out of which 58.1% (n=15899) of the children were males and 41.9% (n=11456) of the children were females.

QUESTIONNAIRE

Dear Students,
Thank you for your enthusiastic participation in the Safe and Nutritious Food (SNF) School Program. Please help us in improving the program by filling out this short questionnaire. Please answer all the questions. It will take only 5-10 minutes and we are here to help if you have any questions.
Thanks,
SNF Program Team

GENERAL INFORMATION
Name: _____ Gender: Male/Female:
Class and Section: _____ Date of birth (DD/MM/YY):
Today's Date (DD/MM/YY):
School Name:
For Office use only
_____ Student ID

Please answer each question very carefully and choose only one option unless a question asks for more than one option.

Q1. Iron is an essential trace mineral required for:
a) Building strong bones
b) Formation of Haemoglobin
c) Good eyesight
d) All of the above

Q2. Iron Deficiency Anaemia is defined as:
a) High level of glucose in the blood
b) Low level of Haemoglobin in blood
c) High level of Cholesterol in blood
d) None of the above

Q3. Iron Deficiency Anaemia is caused due to:
a) Inadequate consumption of iron rich foods
b) Loss of blood
c) Poor absorption of iron in the body
d) All of the above

Q4. Deficiency of Iron in the body can result in:
a) Decreased academic performance
b) Tiredness and weakness
c) Breathlessness
d) All of the above

Q5. Which of the following foods is a source of iron?
a) Green Leafy Vegetables
b) Chana/Rajma/Egg/Fish
c) Fortified Food
d) All of the above

Q6. Which of these nutrients enhances the absorption of iron?
a) Vitamin A
b) Calcium
c) Vitamin C
d) Carbohydrates

Q7. Consuming tea/coffee along with or after a meal:
a) Decreases iron absorption
b) Increases iron absorption
c) Has no effect on iron absorption
d) Not sure

Q8. Which of these methods directly or indirectly helps in the prevention of Iron Deficiency Anaemia?
a) Fortification
b) Germination
c) Fermentation
d) All of the above

Q9. Which of the following combination of food preparations should NOT be consumed?
a) Chicken sandwich with a cup of coffee
b) Chana dal cheela with amla chutney
c) Omelette with toast and glass of orange juice
d) Not sure

Q10. Fortification is a process of adding essential nutrients (e.g. iron) in foods:
a) Yes
b) No
c) Don't know

Register your school at http://snfportal.inisnf/jsp/schooljsp

[Table/Fig-1]: Questionnaire for survey.

[Table/Fig-2]: Awareness session conducted in schools.

Age (Years)	No. of cases #(N=34437) (n)	Percentage (%)
8	21	0.1
9	3496	10.2
10	12294	35.7
11	6401	18.6
12	6385	18.5
13	5513	16.0
14	327	0.9

[Table/Fig-3]: Age distribution among study students.
Out of 34,550 only 34437 answered the question on age

The self-developed questionnaire used for this study was designed to assess the preliminary knowledge of children about iron and iron deficiency anaemia [Table/Fig-1]. These questions were multiple choice based and students had to select correct answer. Since, it was not mandatory to answer all the questions, analysis was performed on the basis of the number of students answering particular question. All the questionnaires which presented answers to both pre and post-intervention assessment attempted were considered as completed questionnaires. Questionnaires were not rejected on the basis of unmarked questions. The results of pre-interventional survey in 5 identified areas are shown in [Table/Fig-4].

The results for first two areas of importance/role of iron and iron deficiency anaemia highlight that students were aware about what is anaemia and what are its causes. However, percentage of participants knowing the sources of iron rich food, concept of fortified food was comparatively less. The results of sources of iron, iron absorption and knowledge of fortification clearly reveal that there was lack of awareness about importance of iron in many students which could be the major contributing factor for negative attitude and lack of good eating practices for preventing iron deficiency anaemia. Pre-intervention study was followed by a session which was designed to create awareness about 'importance of iron'.

After the initial assessment and educational intervention; post-assessment was performed to evaluate the impact on the awareness of the study participants about importance of iron and iron deficiency and significant improvement in knowledge (p-value <0.001) was seen. [Table/Fig-4,5] indicates that in the post-intervention assessment; students showed statistically significant increase in knowledge when analysed for responses to the questions based on five key elements namely importance/role of iron (32.2% increase), iron deficiency anaemia (25.82% increase), sources of iron in food (26.5% increase), nutrients that enhance iron absorption (25.20% increase), and concept of fortification (21.5% increase).

DISCUSSION

According to United Nations International Children's Emergency Fund (UNICEF), child hunger is a very significant issue today and approximately 149 million children world-wide are malnourished [1]. Malnourishment can be the result of non-availability of food or lack of knowledge about nutrition. One step to contribute towards reduction of malnourished cases is to impart knowledge to the young children. Research evidence suggests that nutrition education in schools is more likely to bring about positive behaviour changes in terms of adapting nutritious eating habits [8,30-32]. In a survey published by Tuuri G et al., "The Smart Bodies research program demonstrated that a short-term school-based intervention could successfully improve knowledge of healthy nutritional practices and self-efficacy to consume fruits and vegetables [8]. With guidance from program leaders, cooperation from teachers, classroom activities, and school lunch foods, children can increase their preferences for fruits and vegetables and begin making behavioural changes to improve their diets". The key findings of University of California Cal Fresh Nutrition Education Program [30] likewise emphasise that along with a focus on direct nutrition education, an emphasis on enhancing foods

Area of assessment	Questionnaire	Parameters	No. of cases N#	Pre-intervention N (%)	Post-intervention N (%)	p-value
Importance/ Role of iron	Profile of iron as essential trace mineral	Correct (Formation of haemoglobin)	34550	9448 (27.3)	20545* (59.5)	≤0.001
		Incorrect		25102 (72.7)	14005 (40.5)	
Iron deficiency anaemia	Knowledge of iron deficiency and anaemia	Correct (Low level of haemoglobin in blood)	34548	18692 (54.1)	25133* (72.7)	≤0.001
		Incorrect		15856 (45.9)	9415 (27.3)	
	Deficiency of iron in the body	Correct (All of the above)	34424	11286 (32.8)	19831* (57.6)	≤0.001
		Incorrect		23138 (67.2)	14593 (42.4)	
	Causes of iron deficiency anaemia	Correct (All of the above)	34477	8835 (25.6)	16984* (49.3)	≤0.001
		Incorrect		25642 (74.4)	17493 (50.7)	
	Methods for preventing iron deficiency anaemia	Correct (All of the above)	34194	8061 (23.6)	20464* (59.8)	≤0.001
		Incorrect		26133 (76.4)	13730 (40.2)	
Sources of iron	Sources of iron in foods	Correct (All of the above)	34465	8686 (25.2)	17816* (51.7)	≤0.001
		Incorrect		25779 (74.8)	16649 (48.3)	
Iron Absorption	Nutrients that enhances the absorption of iron	Correct (Vitamin C)	34427	11151 (32.4)	20669* (60.0)	≤0.001
		Incorrect		23276 (67.6)	13758 (40.0)	
	Impact of tea/coffee on iron absorption	Correct (Decreases iron absorption)	34383	12589 (36.6)	20555* (59.8)	≤0.001
		Incorrect		21794 (63.4)	13828 (10.2)	
	Combination foods not to be consumed	Correct (Chicken sandwich with a cup of coffee)	34264	13358 (39.0)	21850* (63.8)	≤0.001
		Incorrect		20906 (61.0)	12414 (36.2)	
Knowledge of fortification	Fortification is a process of adding essential nutrients (e.g., iron) in foods	Correct (Yes)	34290	18993 (55.4)	26359* (76.9)	≤0.001
		Incorrect		15297 (44.6)	7931 (23.1)	

[Table/Fig-4]: Responses of the students pre and post-intervention.
*p-value ≤0.001 (Significant) obtained by Chi-square test
#Since, it was not mandatory to answer all the questions, analysis was performed on the basis of the number of students answering particular question. Hence, N differs for each question

Areas for knowledge assessment	Average % Pre-assessment	Average % Post-assessment	Average % increase
Importance/Role of iron	27.30	59.50	32.20
Iron deficiency anaemia	34.03	59.85	25.82
Sources of iron in food	25.20	51.70	26.50
Iron absorption	36.00	61.2	25.20
Knowledge of fortification	55.4	76.9	21.5

[Table/Fig-5]: Percentage increase in knowledge assessment.

available on the school campus, establishing family and community partnerships, and empowering school stakeholders to implement the school district's wellness policies will improve nutrition practices in children. It will also improve the healthy eating practices in children. Research by Passmore S and Donovan M, suggests that children who attend schools with well-developed food education programs (cooking and growing) have better knowledge about making healthy food choices and creates a positive impact on pupils' healthy lifestyle behaviour [31].

The fundamental ideology of school education having a high success rate in community related issues than education offered on individual basis at home gets verified by a UNICEF report released in Oct 2012 on School Water, Sanitation and hygiene Knowledge, attitudes and Practices Survey [32]. Nutrition education should include all the educational activities that engage students, not only through direct classroom education but also through other venues throughout the school campus during the school day that are designed to motivate students and facilitate adoption of healthful food choices [14,33,34]. A comprehensive nutrition program run in schools in United States of America (USA) by The Academy of Nutrition and Dietetics, the Society for Nutrition Education and Behavior and School Nutrition Association [33] reveals that a promotion of healthful choices at school through nutrition standards, snack guidelines, and nutrition education can guide students to make life long healthful decisions in terms of food and nutrition.

Based on the above observations and findings from various researchers and published evidence [14,31-35], this study was designed with the objective of imparting education to school children on the importance of iron and iron deficiency anaemia in cities of India. A significant improvement was seen in the post-interventional results of this survey and indicates that the objective of this study is fulfilled. The age group 8-14 years was selected due to its high likelihood to suffer from anaemia due to various reasons [36]. It was decided to undertake this study in various schools of Delhi NCR and Mumbai region. In this way, maximum population could be educated in lesser time. For the purpose of this study, it was necessary to understand the baseline knowledge of children in the area of iron nutrition. Critical analysis of the data was performed to assess the level of knowledge children had. Findings were found to be consistent to a previous study stating that iron deficiency anaemia typically results from insufficient or wrong dietary intake [37]. The results for first two areas of importance/role of iron and iron deficiency anaemia are similar to a study conducted by Angadi N and Sanjitha A, where participants were aware about what is anaemia and what are its causes [38].

However, pre-interventional assessment also revealed a finding that matched to another study by Patimah S et al., about poor knowledge regarding diet associated with iron deficiency anaemia [39]. Based on the analysis as described in results above; weaker areas can be identified, and future intervention programs can be designed to educate children. It is necessary to assess the change in knowledge of participant's post-educational intervention to study the impact of awareness program. In this population group, evidence suggests that nutrition education intervention was effective, as it improved the knowledge scores attained. Significant increase in knowledge on food-based strategies promoting consumption of iron-rich foods and foods that increase absorption of iron (vitamin C rich foods) was also observed in the study performed by Kapur D et al., [25].

Other findings of the study regarding nutrients enhancing iron absorption, concept of fortification, wrong combination of foods affecting iron absorption were found to be parallel to a similar study conducted by Jalambo M et al., [40]. Though statistically significant increase in percentage to responses in post-intervention

phase in comparison to pre-intervention phase was seen, it was evident that conducting continuous sessions will help in improving not only knowledge but also attitude of children towards healthy nutritional habits. Guiding children on various aspects of iron, iron deficiency and problems associated with it and role of nutrition in preventing these problems can be of great use to improve eating habits in children. The findings of the present study match the findings of another study performed by Bandyopadhyay L et al., which highlights that knowledge of anaemia, knowledge regarding aetiology and harmful effect of anaemia, vegetable and animal source of iron, Vitamin C -rich fruits, and food preventing iron absorption considerably improved in post-test phase [27].

It can be inferred from this study that nutritional health education sessions driven by educational institutions can be a stepping stone to increase nutritional literacy in developing countries. Including such sessions in school curriculum with the help of expert nutritionists and health professionals can be advantageous for improving attitude of children towards healthy eating habits. Improvement in knowledge and attitude towards healthy eating will ensure increased healthy eating practices and improved nutritional status [41]. To strengthen this drive further and to reduce the gap existing in health and nutrition-related knowledge, few sessions can also be conducted for parents and children together [42]. It is evident in a study conducted by Shah P et al., that it is important to start early and sustain health education efforts throughout a child's school experience. These efforts should appropriately include participation by parents as well as teachers in pre-school, elementary, and secondary schools [43]. Additional sessions can be conducted for adolescent girls [19,27] considering the supplementary demand for iron in young age.

Thus, results of the study with large sample size and multi-centric nature, rejected the null hypothesis. Hence, the alternate hypothesis highlighting the role of nutrition education in improving the nutrition literacy of school children in the area of iron and iron deficiency anaemia holds true.

Limitation(s)

The authors carried out knowledge intervention which was followed by end line testing after a gap of a minimum of 7 days. Repeated interventions would be required to sustainably enhance the knowledge about iron. Further in this study, the age wise analysis for each element, change in attitude or in the prevalence of anaemia as a result of the knowledge intervention were not studied.

CONCLUSION(S)

Rejection of null hypothesis and thus acceptance of alternate hypothesis makes it evident that conducting nutrition education session in schools increased the knowledge of children with respect to role of iron as trace element in physiological function, iron deficiency and anaemia, nutrients that enhance iron absorption, methods of preventing iron deficiency anaemia, combination of foods not to be consumed, concept of fortification and food-based strategies promoting consumption of iron-rich foods. Continuous implementation of nutrition education programs on wider scale is very important to visualise the marked improvement in nutritional status of school children in the entire nation. Future studies in nutrition education with assessment of prevalence of anaemia before and after the intervention, as well as the changes in attitude and practice as a result of the intervention are thus required. This can be also supplemented with study assessing the knowledge level at different age groups and study of the changes in dietary pattern of children, haemoglobin assessment, changes in energy levels, improvement in concentration levels and increase in the consumption of iron rich foods.

Disclosure: Richa Bharti, Ankita Marwaha, Teena Badshah are employed by PepsiCo R&D. The views expressed in this manuscript are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc. This is a self-funded study by PepsiCo R&D.

Since this study was a part of Eight Right School, a program by FSSAI which is a government organisation no separate ethical approval was sought for this study. Also, school registration on FSSAI portal was considered as a consent and no individual consent was taken from parents and students.

Acknowledgement

We acknowledge, Namrata Khannna- Food Safety and Standards Authority of India for reviewing all the education material and supporting the SNF fellowship program as a key partner from FSSAI, CND and PGDSSFN students of Dr. BMN college, Suman and Dr. Vishwas from Swashrit NGO for collecting data. Our sincere thanks to Dr. Roshan along with B.Sc. Food Technology students from Bhaskaracharya College for data collection, coordinators of the study Ms. Ruby Sound and Dr. Anuradha Ramesh and the entire batch of students of Masters in Specialised Dietetics from Sir Vithaldas Thackersey College of Home Science (Autonomous) SNDTWU, Mumbai for the collection and compilation of the Mumbai data, Kailas Gandewar- for data analysis, Jehangir Clinical Development Centre (JCDC), Pune and Dr. Arati Ranade, Medical writer, JCDC for providing technical writing service. The authors acknowledge Nishi Sharma (PepsiCo India) for extensive manuscript review and valuable feedback which enabled in strengthening the manuscript.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 01, 2020
- Manual Googling: Jan 22, 2021
- iThenticate Software: Feb 08, 2021 (10%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: As declared above
- Was Ethics Committee Approval obtained for this study? NA
- Was informed consent obtained from the subjects involved in the study? NA
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jul 31, 2020**
Date of Peer Review: **Sep 15, 2020**
Date of Acceptance: **Jan 22, 2021**
Date of Publishing: **Apr 01, 2021**