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Impact of Nutrition Education on Whole Grains Consumption amongst Primary and Middle School Children in Delhi

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Abstract Imparting nutrition education in schools is an effective tool for inculcating healthy eating behavior in early childhood, which will bestow lifelong positive health implications. Ignorance, illiteracy, lack of nutrition knowledge, and inappropriate nutritional practices and dietary traditions influence the nutritional status of children. This study assesses the existing knowledge, attitude, and practices prevalent amongst the school children (6-14 years) in the consumption of whole grains and examines the impact of nutritional intervention on them. 22% of participants were from primary school in the age group of 6-10 years, and 78% were from middle school between the ages of 11-14 years. Total percentage of girl students was 84% against boys, which was 16%. Nutrition education was imparted to the school children through visual presentation on the importance of consuming whole grains, structure and composition of whole grains, difference between refined and whole grains, food sources, nutritional importance, rich sources of dietary and soluble fibre, besides promoting digestive health and wellness. Self-designed fun nutrition games and food quizzes were employed to engage with the school students. In the pre-assessment survey, the middle school students showed significantly ($p \leq 0.05$) higher knowledge than primary school students. Although after implementing the nutrition education program in the post-assessment survey, an increase in knowledge about whole grains was observed both in primary as well as middle school students. However, no significant difference was seen in the knowledge acquisition between male and female students in pre or post-nutrition intervention assessment. The present study showed an incremental rise in the knowledge and attitude of primary and secondary school children in the age group of 6-14 years in all aspects of whole-grain education. Therefore, this intervention showed that in order to bridge the gap of nutrition literacy among school-going children, integrating nutrition education into the school curriculum can be an effective tool for inculcating healthy eating behavior in early childhood.

Keywords Whole Grains, Nutrition Education, FSSAI, Eat Right School

1. Introduction

Whole grains are a significant and vital energy source, complex carbohydrates, micronutrients, and phytochemicals. Regular intake of whole grains in the diet bestows many health benefits. The amount and type of carbohydrates play a significant role in maintaining health and significantly influence dietary disorders such as non -communicable diseases (NCDs). Rapid transition in India

has witnessed a shift in diets and lifestyle, which has led to an increase in overweight and obesity at a rate surpassing undernutrition prevalence, associated with non-communicable diseases (NCDs).

The Global Burden of Disease Study (GBD), (2017) has systematically analyzed and reported a rise in NCDs worldwide, particularly in developing countries like India. This is seen amongst all socio-economic strata, which significantly affects premature mortality [1-2]. The increased risk of weight gain and higher body mass index in children, adolescents, and adults [3] development of type-2 diabetes mellitus (T2DM) and non-communicable diseases (NCDs) and dental caries [4-5] is associated with an increased and regular intake of free sugars in their diet. Unfortunately, India has the second-highest diabetic population globally (77 million) and is projected to reach 101 million by 2030 [6-9]. According to the ICMR- INDIA study, the prevalence of diabetes is 7.3%, and that of prediabetes is 10.3% in the country [9]. It has been shown that lifestyle factors such as dietary intake, mainly cereal grains, and lack of physical activity affect obesity and influence insulin resistance in prediabetes and diabetes. Consumption of complex carbohydrates obtained from whole grains, legumes, vegetables, and whole fruits have been associated with reduced risk of type-2 diabetes mellitus (T2DM) and cardiovascular disease (CVD). These beneficial effects are due to the specific constituents present in the carbohydrates. Similarly, consumption of brown rice in the Asian population is associated with reduced risk of T2DM versus white rice with increased risk, particularly in Japan and China. Still, the evidence is limited [3].

The recommended dietary allowances (RDA) & estimated average requirements (EAR) for Indians (2020) have reported that the Indian diets derive most of the calories from dietary carbohydrates and more than 50% of calories by urban adults and 75% by rural adults are obtained by refined grains respectively. It is recommended to reduce the consumption of refined cereal grains and substitute them with intact whole grains, which should consist of more than half the daily intake [10]. Many investigators have stated the health benefits associated with the consumption of whole grains, vegetables, and fruits, which are minimally processed due to their low glycemic index [11].

Background

Eating habits established early in childhood can be traced back to adulthood. During the formative years, children develop their physical, mental, and social faculties. Therefore, imparting nutrition education in schools has been recognized as an effective tool for inculcating healthy eating behavior in children globally. Several studies have reported that ignorance, illiteracy, lack of nutrition knowledge, and inappropriate nutritional practices and dietary traditions influence the nutritional status of children. Malnutrition can be effectively addressed by imparting nutrition and health education in schools. Research has indicated that to increase the effectiveness of nutrition education programs, emphasis on a behavioral-based approach and active methods and food-based activities will improve children's cognitive ability and nutrition knowledge [12]. Shah & Misra [13] have reported inadequate health and nutrition-related information available amongst the urban Asian Indian population.

Children spend much time in school. Therefore, schools are ideally suited to promote healthy eating practices. School-based nutrition education programs will allow children to make informed food choices and engage in physical activities, which will further help strengthen the nutrition education messages. Moreover, children are the effective change agents, and they rapidly spread information they acquire from school to the communities they reside. Therefore, imparting nutrition education to children in schools is a meaningful engagement to overcome the nutritional public health problems over the short and long term [14]. In India, the government has taken various proactive initiatives such as "Poshan Abhiyan" to help spread awareness about the importance of eating a healthy and well-balanced diet. The problems associated with the procurement and consumption of whole grain products include limited availability, lack of consumer awareness, inability to identify whole grain versus whole wheat or dark bread, unacceptable taste, colour, and texture of whole grain foods [15]. Being-Hwan Lin [16] reported that reading food labels and practical nutrition education messages played a significant role in developing strategies to promote the consumption of whole grains among consumers. Therefore, in order to bridge the gap of nutrition literacy among school-going children, integrating nutrition education into the curriculum can be an effective tool.

Educational strategies should increase health awareness, communication, and skill-building [17]. School-based nutrition education programs targeted toward particular eating behaviors show promising results regarding behavior and attitude change of children and adolescents [18]. This study was designed to assess the existing knowledge, attitude, and practices prevalent amongst the school children (6-14 years) in the consumption of whole grains and examine the impact of nutritional intervention on them. The hypothesis stated that there would be no effect of nutritional intervention on the school children. Therefore, the study's objective was to assess the pre and post-nutrition education intervention.

2. Materials and Methods

2.1. Study Protocol

This cross-sectional intervention study was done in Delhi (India) schools under the ‘Eat Right School’

initiative of the Food Safety and Standards Authority of India (FSSAI) under the Ministry of Health and Family Welfare, Government of India. Under the 'Eat Right School' initiative, all schools were expected to promote safe and nutritious food (SNF) practices and ensure that the food served in the canteens/ cafeterias was wholesome and nutritious. Participating schools had to mandatorily register on the 'Eat Right School' portal created by FSSAI. A formal training session was conducted for the SNF Fellows (undergraduate students of the department of food technology) by the nutrition experts to empower them with the necessary knowledge and skills to impart nutrition education to the school children before the commencement of the study.

2.2. Participants

In this study, participants were students from primary and middle sections of government schools in Delhi, India. All the schools whose Principals or administrators were willing to participate in the study were included, and a prior time slot was fixed to conduct the session. Each school was asked to designate a teacher as a Health and Wellness Coordinator (HWC). The role of the HWC was to be the point of contact for the SNF Fellows (college students of food technology) who carried out the study on the school students. The critical nutrition messages on whole-grain consumption imparted during the training had to be reinforced to the scholars by discussing them time and again. The school did this by organizing different events/ competitions based on a balanced diet, healthy eating habits, types and variety of whole grains etc.

Further, the HWC had to regularly upload the information along with the pictures of the activities conducted with the students on the FSSAI portal for which they were awarded points. All the students who participated in the study were from classes II to VIII and were between 6-14 years. There was no gender selectivity, and students participated voluntarily. The students studying in the government schools essentially belonged to the low-income group.

2.3. Nutrition Education

Nutrition interventions on the importance of whole grains in the diet, their nutritional significance, and health benefits for this study were divided into different sessions and planned to accommodate the school schedule (Table 1). Morning assembly time and zero periods were used to impart nutrition education. On the first day of the study, students were briefed about the program and were then asked to fill out the pre-test questionnaire and demographic data on the existing knowledge, attitude, and practices pertaining to whole grains. After that, nutrition education was imparted to the school children through a visual presentation on the importance of consuming whole grains, structure and composition of whole grains, the difference between refined and whole grains, sources, nutritional importance of rich sources of complex carbohydrates such as dietary and soluble fibre, B complex vitamins besides promoting digestive health and wellness. Calendars to each student and classroom posters to the class teachers with the key messages were given for reinforcement and a constant reminder of the importance of whole grains in the individual's diet.

Table 1. Nutrition education methods according to the nutrition intervention technique

Days	Nutrition Education Method	Nutrition Topic covered
Day 1	• Registration of the school on the FSSAI portal. • Pre-test questionnaire was given to the students on whole grains. • Visual presentation • Classroom interaction	• Need for a balanced diet • Structure and composition • whole grain v/s refined grain • sources of whole grain food products. • Nutritional significance and serving size • health benefits of consuming whole grains.
	• Distribution of calendars to all children • classroom posters to teachers for displaying in classes	• Discussed the posters – balanced diet, structure and composition of whole grain and examples of good sources of whole grains in daily diet.
Day 2 (after a week)	• Classroom session • nutrition games (primary school children) • food quiz (middle school children)	• Reinforced the message of importance of healthy, well balanced meals, example of whole grains and servings per day. • More than half the intake of cereal grains must consist of whole grains.
Day 3 (after a fortnight)	• The post-test questionnaire was given.	• No further nutrition education was imparted

Table 2. Pre/ Post Test Questionnaire on Whole Grains

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

Q1. What does a whole grain consist of?

(a) Only Endosperm
(b) Endosperm and Germ
(c) Germ and Bran
(d) Bran, Endosperm and Germ

Q2. Which of the following is Whole Grain Food?

(a) While Rice
(b) Oats
(c) White Bread
(d) Cornflakes

Q3. Which of the following nutrients are present in whole grains?

(a) Complex Carbohydrates and Fibre?
(b) Vitamin B
(c) Antioxidants and Phytonutrients
(d) All of the above

Q4. Why should one prefer Whole Grains over refined grains?

(a) Whole grains keep the heart healthy.
(b) Whole grains help in maintaining a healthy body weight.
(c) Whole grains are rich in fibre, which keeps hunger satisfied for longer.
(d) All of the above.

Q5. Which part(s) of the whole grain is/ are removed to give a fine texture and improve shelf life in refined grain?

(a) Only Endosperm
(b) Endosperm and Germ
(c) Bran and Germ
(d) Bran and Endosperm

Q6. Breads which are brown in colour are always made up of whole grain?

(a) Yes
(b) No
(c) Don't know

Q7. Which of these cereals is a good source of soluble fibre?

(a) Oats
(b) Whole wheat
(c) White rice
(d) All of the above.

Q8. Which of the following meal options will provide the maximum whole grain?

(a) A bowl of oats + whole wheat sandwich
(b) A bowl of noodles + a glass of juice
(c) Stuffed whole wheat paratha + a bowl of curd
(d) A bowl of white rice pulao + mint chutney

Q9. Out of the total serving of cereals that you should consume in a day; how much is the recommended proportion of servings from whole grains?

(a) At least ½ of the servings should be from whole grains
(b) ¼ of the servings should be from whole grains
(c) Less than ½ of the servings should be from whole grains
(d) Don't know.

Q10. Which of the following makes oats good for your health?

(a) It is a whole grain
(b) Soluble fibre (βeta Glucan)
(c) Proteins
(d) All of the above

During the second visit to the school is after a week, the SNF fellows (college students) further reinforced the message of consuming a healthy balanced diet with adequate amounts of whole grains. In order to engage and excite the school children about the significance of nutrition education, some self-designed fun nutrition games (snakes and ladder, color wheel, etc.) and food quizzes were explicitly designed to engage with the middle school students. These were used to improve their knowledge on how to select the correct sources of whole grains which are locally available, regionally consumed, easily sourced, seasonal and cost-effective too, since this study included students primarily from government schools that were from very low and low-income strata of the society. Posters and placards were displayed in the classrooms, focusing on the importance of eating a healthy and balanced diet, emphasizing appropriate food habits for improved bioavailability of nutrients. A third follow-up visit was done for each school class-wise, but no further nutrition education was done, the post-test questionnaire was given. The second and third classroom sessions were planned two weeks apart to reduce the possibility that memorization of questions and answers was a factor from the pre-test to the post-test on nutrition knowledge or practices. The detailed questionnaire is given in Table 2.

2.4. Inclusion Criteria

Children from both the genders from classes II to VIII (age range of 6-14 years) who were willing to participate in pre and post-nutrition education intervention were included in the study.

2.5. Exclusion Criteria

Students who were absent on day 1 and those who were below and above the selected age range were excluded from the study.

2.6. Statistical Analysis

The statistical analysis was conducted using SPSS-25 ($p \leq 0.05$) for both the pre and post-assessment nutrition intervention survey. Pearson correlation coefficients were also measured by using SPSS. The results were expressed as means ± standard error of the mean (SEM).

3. Results

Thirty-five (35) government schools in Delhi took part in the study. A total of 3449students participated in this survey and successfully completed both pre and post-intervention assessments. The demographic data are presented in Figures 1a & 1b. Out of these, 752 (22%) were from primary school in the age group of 6-10 years and 2697 (78%) were from middle school in the age group of 11- 14 years. A total of 84% of females and 16% of males took part in the study. The results of pre-intervention and post-intervention of age group 6-10 years and 11-14 years are shown in Table 3. In pre-intervention assessment, 21.81% - 32.58% students of age group 6-10 years were found to have knowledge about different aspects of whole grains. Whereas in the age group of 11-14 years, this awareness was higher, ranging from 32.55% to 47.09%. After imparting nutrition education to the students in the post-intervention assessment; both primary and middle school students showed a statistically significant ($p \leq 0.05$) increase in knowledge transition with an average percent mean of 31.99 and 32.31 (Table 5 & Figure 2), respectively, when analyzed for responses to the questions based on composition, type, nutrients, importance, dietary recommendation of whole grains.

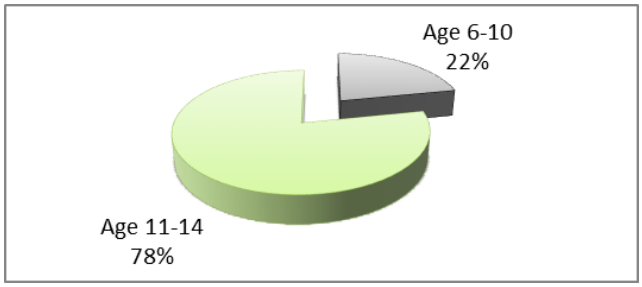


Figure 1a. Age wise distribution of students

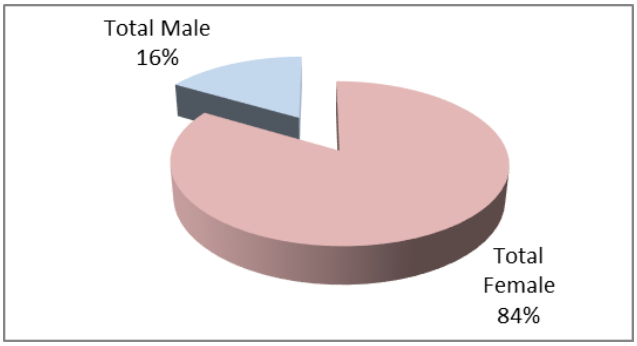
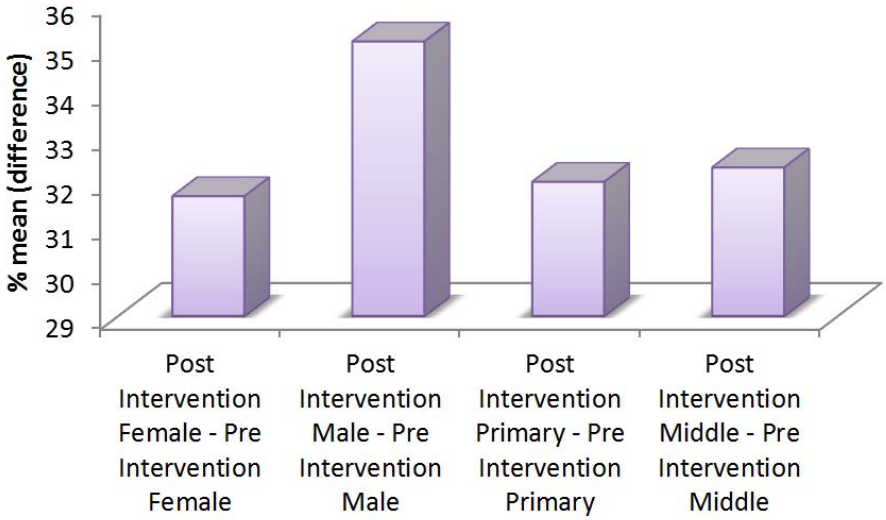


Figure 1b. Gender distribution of students



*p ≤ 0.05; df-9

Figure 2. Percent mean difference between post and pre nutritional intervention

Table 3. Correct response of primary (6-10 year) and middle school (11-14 year) students in pre and post nutritional intervention

	Pre Nutritional Intervention		**Post Nutritional Intervention**	
	Primary School (6-10Y) n=752	Middle School (11-14Y) n=2697	Primary School (6-10Y) n=752	Middle School (11-14Y) n=2697
Q.1	218 (28.99%)	976 (36.19%)	503 (66.88%)	1905 (70.63%)
Q.2	206 (27.39%)	1270 (47.09%)	473 (62.90%)	2084 (77.27%)
Q.3	164 (21.81%)	1007 (37.34%)	407 (54.12%)	1844 (68.37%)
Q.4	245 (32.58%)	1017 (37.71%)	461 (61.30%)	1939 (71.89%)
Q.5	194 (25.80%)	996 (36.93%)	429 (57.05%)	1818 (67.41%)
Q.6	210 (27.93%)	1165 (43.19%)	478 (63.56%)	1820 (67.48%)
Q.7	245 (32.58%)	996 (36.93%)	422 (56.12%)	1895 (70.26%)
Q.8	214 (28.46%)	1013 (37.56%)	447 (59.44%)	1917 (71.10%)
Q.9	196 (26.06%)	931 (34.52%)	415 (55.19%)	1829 (67.82%)
Q.10	228 (30.32%)	878 (32.55%)	491 (65.29%)	1912 (70.90%)

*Q.1-10: refer to Table No. 2

Table 4. Correct response of male and female students in pre and post nutritional intervention

	Pre Nutritional Intervention		**Post Nutritional Intervention**	
	Male Students (n=569)	Female Students (n=2880)	Male Students (n=569)	Female Students (n=2880)
Q.1	170 (29.89%)	1025 (35.58%)	405 (71.16%)	2003 (69.55%)
Q.2	185 (32.48%)	1291 (44.83%)	416 (73.09%)	2141 (74.34%)
Q.3	177 (31.14%)	994 (34.51%)	343 (60.30%)	1908 (66.25%)
Q.4	194 (34.01%)	1069 (37.12%)	395 (69.47%)	2005 (69.61%)
Q.5	176 (30.97%)	1014 (35.20%)	363 (63.74%)	1884 (65.42%)
Q.6	233 (40.95%)	1142 (39.65%)	385 (67.73%)	1913 (66.41%)
Q.7	200 (35.06%)	1042 (36.16%)	382 (67.07%)	1935 (67.20%)
Q.8	186 (32.72%)	1041 (36.14%)	399 (70.14%)	1965 (68.23%)
Q.9	161 (28.26%)	966 (33.55%)	378 (66.34%)	1867 (64.81%)
Q.10	187 (32.93%)	919 (31.90%)	401 (70.53%)	2002 (69.50%)

*Q.1-10: refer to Table No. 2

Table 5. Paired Sample Test between post nutritional intervention and pre nutritional intervention

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Post Intervention Female - Pre Intervention Female	31.67	2.84	0.90	33.70	29.64	-35.23	9.00	0.00
Post Intervention Male - Pre Intervention Male	35.12	4.81	1.52	38.56	31.67	23.07	9.00	0.00
Post Intervention Primary - Pre Intervention Primary	31.99	4.23	1.34	35.02	28.96	23.89	9.00	0.00
Post Intervention Middle - Pre Intervention Middle	32.31	3.68	1.16	34.94	29.68	27.76	9.00	0.00

The knowledge, attitude and practices on whole-grain consumption in pre-intervention and post-intervention of male and female students are given in Table 4. In pre-intervention assessment, 28.26% - 40.95% of male students were observed to be aware of composition, type, nutrients, importance, dietary recommendation of whole grains. Similarly, in female students, this awareness was observed in the range from 32.55% - 46.09%, which was slightly higher than male students. After the nutritional intervention was done, in the post-intervention assessment; both male and female students showed a statistically significant ($p \leq 0.05$) increase in knowledge acquisition with an average percent mean of 35.12 and 31.67 (Table 4/ Figure 2), respectively, when analyzed for responses to different questions related to whole grains. Shah & Misra [13] evaluated the effect of health and nutritional intervention among urban Asian Indian school children and found low baseline knowledge and behavioral scores in 75-94 % of government and 48-78 % of private school children, across all age groups (8-18 years).

3.1. Comparative Nutritional Assessment in Pre Intervention

A comparative study concerning gender and different age groups was carried out in pre nutritional intervention, and the results are presented in Table 6. The results showed that irrespective of their gender, a significant ($p \leq 0.05$) increase in knowledge regarding whole grains was observed in the middle school children in the age group of 11-14 years. Similarly, the knowledge and awareness about different examples of whole-grain and nutritional composition of whole-grain were measured significantly ($p \leq 0.05$) higher in the age group of 11-14 years. The students of higher age groups (11-14y) were more aware of the importance and processing of whole grains than the primary school children. Like wisely, when enquired about the colour of the bread as an indicator of whole-grain among both the primary and middle school students, as per the previous findings, 10-14 years students showed significantly ($p \leq 0.05$) higher awareness as compared to the 6-10 years. Correspondingly, the knowledge and awareness about the presence of soluble fiber in different whole grains, meals rich in whole grain, serving size as well, as the importance of oats were observed to be significantly ($p \leq 0.05$) superior in the higher age group (11-14 years) as compared to lower age group (6-10 years) students.

Regardless of their age group, when the knowledge was compared between female and male students, then a higher aptitude and awareness about different aspects of whole grains was observed among female students as compared to male students. Except for awareness regarding the recommended portions of servings from whole grains, the difference was only numeric. It was found to be insignificant when analyzed statistically.

Table 6. Comparative nutritional assessment in pre intervention

		Mean % Female students ± SEM	Mean % Male students ± SEM	Average
	Primary	16.82 ±3.67	11.21 ±3.67	14.02 ±2.60^{A}
Q.1	Middle	39.40 ±2.72	32.60 ±6.09	36.00 ±3.34^{B}
		28.11 ±2.29^{a}	21.91 ±3.56^{a}	
	Primary	17.70 ±5.06	11.80 ±5.06	14.75 ±3.58^{A}
Q.2	Middle	48.06 ±3.75	33.44 ±8.39	40.75 ±4.59^{B}
		32.88 ±3.15^{a}	22.62 ±4.90^{a}	
	Primary	18.30 ±4.19	12.20 ±4.19	15.25 ±2.97^{A}
Q.3	Middle	36.96 ±3.11	31.13 ±6.96	34.04 ±3.81^{B}
		27.63 ±2.61^{a}	21.66 ±4.06^{a}	
	Primary	19.05 ±3.49	12.70 ±3.49	15.88 ±2.47^{A}
Q.4	Middle	38.56 ±2.59	34.18 ±5.79	36.37 ±3.17^{B}
		28.81 ±2.17^{a}	23.44 ±3.38^{a}	
	Primary	18.42 ±3.69	12.28 ±3.69	15.35 ±2.61^{A}
Q.5	Middle	38.87 ±2.73	32.39 ±6.11	35.63 ±3.35^{B}
		28.64 ±2.29^{a}	22.34 ±3.57^{a}	
	Primary	17.94 ±4.16	11.96 ±4.16	14.95 ±2.94^{A}
Q.6	Middle	42.87 ±3.09	46.53 ±6.90	44.70 ±3.78^{B}
		30.41 ±2.59^{a}	29.25 ±4.03^{a}	
	Primary	20.18 ±3.81	13.45 ±3.81	16.81 ±2.70^{A}
Q.7	Middle	37.32 ±2.83	32.38 ±6.32	34.85 ±3.46^{B}
		28.75 ±2.37^{a}	22.92 ±3.69^{a}	
	Primary	19.02 ±4.40	12.68 ±4.40	15.85 ±3.11^{A}
Q.8	Middle	37.24 ±3.26	28.80 ±7.30	33.02 ±4.00^{B}
		28.13 ±2.74^{a}	20.74 ±4.26^{a}	
	Primary	16.93 ±3.18	11.29 ±3.18	14.11 ±2.25^{A}
Q.9	Middle	36.33 ±2.36	24.81 ±5.27	30.57 ±2.89^{B}
		26.63 ±1.98^{b}	18.05 ±3.08^{a}	
	Primary	16.13 ±3.93	10.75 ±3.93	13.44 ±2.78^{A}
Q.10	Middle	33.30 ±2.92	33.05 ±6.52	33.17 ±3.57^{B}
		24.71 ±2.45^{a}	21.90 ±3.81^{a}	

Values are presented as mean ±SEM

Small and capital letters in superscripts indicate significant differences ($p<0.05$) between gender and age group, respectively

Q.1-10: refer to Table No.2

3.2. Comparative Nutritional Assessment in Post Intervention

After imparting the nutrition education on the importance, types, and variety of whole grains and their composition to the primary and middle school students, a post-assessment was conducted using the same questionnaire. The results of the comparative assessment are given in Table 7. An overall increase in the knowledge and awareness regarding the importance of whole grain consumption was observed. Moreover, like the pre nutritional intervention, irrespective of their gender, a significant ($p\leq0.05$) increase in the knowledge was observed in the age group of 10-14 years compared to the age group of 6-10 years. In contrast, regardless of age group, a numeric difference in knowledge about whole grain was observed between male and female students; however, this was statistically insignificant. These findings were consistent with a study conducted by Richa et al. [19] on nutritional intervention on iron amongst school children

in Delhi and Mumbai in the age group of 11- 14 years. There was a remarkable increase in the school-going students' knowledge about iron deficiency disorders after the nutritional intervention. Knowledge about the importance and 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% after post-intervention assessment. Similarly, El Harake [20] assessed the impact of nutrition intervention in school children for a period of 6 months. It was observed that the students who undertook the intervention had a positive impact on the dietary knowledge, attitude, and nutritional status of Syrian refugee children.

Table 7. Comparative nutritional assessment in post intervention

		Mean %Female students ± SEM	Mean %Male students ± SEM	Average
	Primary	36.68 ±4.50	24.45 ±4.50	30.56 ±3.18^{A}
Q1	Middle	73.96 ±3.33	78.27 ±7.45	76.11 ±4.08^{B}
		55.32 ±2.80^{a}	51.36 ±4.35^{a}	
	Primary	38.18 ±3.80	25.45 ±3.80	31.82 ±2.69^{A}
Q2	Middle	79.25 ±2.82	80.87 ±6.30	80.06 ±3.45^{B}
		58.72 ±2.37^{a}	53.16 ±3.68^{a}	
	Primary	33.59 ±4.30	22.40 ±4.30	27.99 ±3.04^{A}
Q3	Middle	71.04 ±3.19	66.75 ±7.13	68.89 ±3.91^{B}
		52.31 ±2.68^{a}	44.57 ±4.16^{a}	
	Primary	34.73 ±4.20	23.15 ±4.20	28.94 ±2.97^{A}
Q4	Middle	71.93 ±3.12	77.84 ±6.97	74.89 ±3.82^{B}
		53.33 ±2.62^{a}	50.49 ±4.07^{a}	
	Primary	35.64 ±4.15	23.76 ±4.15	29.70 ±2.94^{A}
Q5	Middle	70.82 ±3.08	71.23 ±6.89	71.02 ±3.77^{B}
		53.23 ±2.59^{a}	47.49 ±4.02^{a}	
	Primary	34.45 ±5.84	22.96 ±5.84	28.71 ±4.13^{A}
Q6	Middle	69.28 ±4.33	59.49 ±9.69	64.38 ±5.31^{B}
		51.86 ±3.64^{a}	41.23 ±5.66^{a}	
	Primary	30.46 ±4.87	20.30 ±4.87	25.38 ±3.45^{A}
Q7	Middle	73.04 ±3.62	76.42 ±8.08	74.73 ±4.43^{B}
		51.75 ±3.03^{a}	48.36 ±4.72^{a}	
	Primary	33.44 ±4.52	22.29 ±4.52	27.86 ±3.20^{A}
Q8	Middle	72.14 ±3.35	80.45 ±7.50	76.30 ±4.11^{B}
		52.79 ±2.81^{a}	51.37 ±4.38^{a}	
	Primary	32.23 ±5.01	21.49 ±5.01	26.86 ±3.55^{A}
Q9	Middle	69.90 ±3.72	76.84 ±8.31	73.37 ±4.55^{B}
		51.07 ±3.12^{a}	49.16 ±4.85^{a}	
	Primary	36.87 ±4.76	24.58 ±4.76	30.73 ±3.37^{A}
Q10	Middle	70.79 ±3.53	76.87 ±7.90	73.83 ±4.33^{B}
		53.83 ±2.97^{a}	50.72 ±4.61^{a}	

Values are presented as mean ±SEM

Small and capital letters in superscripts indicate significant differences ($p<0.05$) between gender and age group, respectively

Q.1-10: refer to Table No.2

Table 8. Pearson correlation study among different factors of pre and post nutritional intervention

Pearson Correlations								
	Pre Female	Pre Male	Pre Primary	Pre Middle	Post Female	Post Male	Post Primary	Post Middle
Pre Female	1							
Pre Male	0.477	1						
Pre Primary	0.358	0.193	1					
Pre Middle	.768**	.891**	0.074	1				
Post Female	0.535	0.009	-0.279	0.358	1			
Post Male	-0.019	-0.597	-0.158	-0.381	0.609	1		
Post Primary	0.241	0.145	-0.598	0.376	.824**	0.367	1	
Post Middle	0.149	-0.551	-0.007	-0.298	.643*	.969**	0.277	1

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

3.3. Pearson Correlation Analysis

A correlation study was performed between pre and post-nutritional intervention among the different categories of students, and results are presented in Table 8. A significant ($p \leq 0.01$; $p \leq 0.05$) positive correlation between 10-14 age group students and male and female students indicated that higher age is the main factor for their existing knowledge and awareness and the ability to comprehend nutritional information on whole grains. Interestingly, post- nutritional intervention, a highly significant ($p \leq 0.01$) positive correlation between female students and 6-10 years age group students indicated that girls of lower age group demonstrated more remarkable aptitude for knowledge acquisition. In a similar study conducted by de Villiers et al. [21], the intervention significantly improved nutrition knowledge and self-efficacy in primary school children; however, it did not improve their eating behaviour. Similarly, elementary school (ES) students who participated in the IMPACT (The Improving Meals and Physical Activity in Children and Teens) curriculum in the intervention classes reported increased intake of calcium-rich foods and grains, fruit and vegetables (+0.85 servings/day compared with controls; $p < 0.05$) and improved knowledge of the food group in which to eat the most servings ($p < 0.01$), though these results were not statistically significant [22].

4. Conclusions

Fostering healthy eating practices and optimal physical activity can positively influence the health and well-being of children and later as adults. Therefore, it is appropriate that school-based nutrition education programs should involve all stakeholders, namely students, teachers and parents, for best results. The present study showed an incremental rise in the knowledge and attitude of primary and secondary school children in the age group of 6-14 years in all aspects of whole-grain education. Thus, it is seen that nutritional literacy is the bedrock for improving and inculcating healthy dietary habits amongst children right from the early stages of life. Therefore, nutrition education should become an integral part of the school education curriculum, particularly in low and middle-income countries (LMIC) like India.

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