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Original Research Article

A Quasi -Experimental Study to Assess the Effect of Structured Nutritional Education Program on the Dietary Practices of Middle School Children of Private Schools in Urban Chennai

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Abstract

Background: Dietary practices formed in childhood strongly influence long-term health. During adolescence, parental supervision declines and peer influence rises, resulting in unhealthy habits such as skipping meals, television viewing during meals, eating out, and increased junk food intake. Early nutritional education can positively shape dietary habits.

Objectives: 1. To assess the dietary practices of middle school children. 2. To evaluate the effect of a structured nutritional education program on their dietary practices.

Methods: A quasi-experimental study was conducted among 90 middle school children aged 11–14 years from three private schools in North Chennai (January 2019–November 2020). Group A (n=30) received structured nutritional education with periodic reinforcement; Group B (n=30) received a one-time intervention; Group C (n=30) served as control. Educational tools included trifold brochures, food plate models, display boards, painted pots, stadiometers, and digital weighing machines.

Results: The mean dietary practices scores improved significantly across all groups ($p = 0.000$), with the highest gain in Group A (6.73 ± 3.48), followed by Group B with moderate improvement (2.90 ± 0.49) and Group C with less significant improvement (2.06 ± 2.03). In Group A, breakfast intake increased from 66.7% to 93.3%, television viewing during meals reduced from 83.3% to 53.3%, family meal participation rose from 66.7% to 76.7%, and hotel food consumption declined in 80% of children. Balanced diet adherence improved from 10% to 43.3%, while healthy dietary practices showed a remarkable rise from 40% to 96.7% highlighting the superior effectiveness of structured nutritional education in Group A.

Conclusion: Structured nutritional education with periodic reinforcement significantly improved knowledge and dietary practices among middle school children compared with one-time interventions. Continuous engagement of children and parents is crucial for fostering healthy eating behaviours and nurturing healthier adolescents.

Keywords: Nutritional Education, Dietary Practices, Middle School Children, Quasi-Experimental Study, Reinforcement, Healthy Eating.

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Introduction

Global and national data highlight the dual burden of malnutrition. The Global Nutrition Report (2018) estimated that 5.7% of adolescent girls were underweight, while Food and Agriculture Organization (2017) reported that about 821 million people worldwide remained undernourished, with the majority in developing nations [1,2]. In India, National Family Health Survey NFHS-4 (2015–16) revealed widespread anaemia along with rising prevalence of overweight and obesity, particularly among urban children [3]. Although Indian diets commonly include cereals, pulses, and vegetables, regular consumption of fruits and dairy is still lacking, leading to unbalanced diets. Moreover, neuroscientific evidence suggests that early adolescence is a critical period of brain reorganization, influencing emotional, physical, and mental capabilities [4].

Dietary practice refers to the observable actions and behaviours of individuals in relation to their food intake [5]. The foundation of healthy eating begins early in life with exclusive breastfeeding and is reinforced during complementary feeding. However, while parents initially invest considerable care in ensuring the right nutrition for their young children, this attention often diminishes as children grow older. By the time a child transitions into middle school, they enter adolescence—a phase marked by rapid physical growth, hormonal changes, sexual maturation, and emotional variability [4,6]. This period also coincides with a heightened need for good nutrition to support growth spurts, strengthen immunity, and develop critical bone mass essential for lifelong skeletal health.

Adolescence, however, presents unique nutritional challenges. Children start to establish independence, often modelling their eating behaviours on peers rather than parents, while also being preoccupied with body image and lifestyle preferences. Many adolescents are exposed to irregular eating patterns, excessive consumption of junk food and sugar-sweetened beverages, and low intake of fruits, vegetables, and dairy products [6,7]. This results in a shift from the nutrient deficiency diseases once common in the early 20th century to contemporary issues of overconsumption, obesity, and poor dietary quality. Parents, especially mothers, play a crucial role in shaping children's food environment—determining the availability of healthy foods and modelling dietary habits. When family meals are irregular and junk foods are easily accessible, children are more likely to develop unhealthy dietary practices that persist into adulthood. This highlights the importance of timely interventions such as nutritional education to prevent the long-term consequences of unhealthy eating practices [8]. Given this background like increasing public health concern of a dual burden of malnutrition, particularly among urban schoolchildren. While undernutrition and micronutrient deficiencies continue to exist, lifestyle-related conditions such as obesity, diabetes, and cardiovascular diseases are emerging rapidly. Yet, national data such as NFHS-4 provides limited insights into the actual dietary habits of Indian adolescents, creating barriers to effective nutrition promotion and disease prevention strategies. Hence the objective of this study is to assess the dietary practices of middle school children and the impact of a structured nutritional education program on improving these practices. Middle school is an ideal setting for such interventions since children spend much of their time in school, and adolescence is a phase when long-lasting health behaviours can be established. Targeting private school children in urban areas is especially relevant, as they are at greater risk of unhealthy dietary transitions driven by changing lifestyles. Ultimately, school-based nutritional education can yield multiple benefits: better physical health and academic performance in students, healthier home food environments, improved outcomes for schools, and enhanced support for public health policies. By assessing and improving the dietary practices of middle school children through structured nutritional education, this study aims to contribute to long-term health promotion and the prevention of nutrition-related disorders among adolescents.

Materials and Methodology

Study Design: Quasi -experimental Study.

Study Area: This quasi-experimental study was conducted in private matriculation schools of Zone II and Zone III of North Chennai.

Study Period: The study was carried out from January 2019 to November 2020.

Study Population: The study population comprised middle school children aged 11 to 14 years from classes VI, VII, and VIII, along with their mothers. Children in this age group who were willing to participate and provided informed consent, together with their mothers, were included in the study. Exclusion criteria consisted of children with pre-existing chronic diseases, congenital or developmental defects, and those whose primary caregivers were not their mothers.

Sample Size Calculation: The sample size for the study was calculated using the formula for intervention studies comparing two means: $N = 2(Z\alpha + Z\beta)^2 \times SD^2 / (\mu1 - \mu2)^2$. The calculation was based on a study by Parisa Keshani et al. [9] on the effect of a school-based nutrition education program on the nutritional status of primary school children, where knowledge score was considered an integral part of dietary practices assessment. From this study, the mean post-intervention knowledge score ($\mu1$) was 11.15, the mean pre-intervention knowledge score ($\mu2$) was 9.37, with a mean difference of 1.78, and the standard deviation (SD) of the change in score was 2.10. At a 95% confidence interval, $Z\alpha$ was 1.96, and at 80% power, $Z\beta$ was 0.84. Substituting these values into the formula, the required sample size was calculated as 22. Allowing for 10% permissible error to account for possible non-response, the minimum sample size came to 24, which was rounded off to 30 for each group. Thus, the final sample size for the study was 90 participants (30 each in two intervention groups and one control group).

Sampling Method: A multistage sampling method was adopted for the study. In the first stage, private schools from the urban field practice area were

listed, and three schools were selected using simple random sampling. In the second stage, classes VI, VII, and VIII were chosen from each selected school, and in the third stage, students aged 11–14 years along with their mothers who met the inclusion criteria were enrolled by systematic random sampling until the required sample size was achieved. This approach ensured representativeness while maintaining feasibility of data collection.

Study Tools: The study instruments included a validated, pretested semi-structured questionnaire prepared in English, translated into Tamil, and back-translated to ensure accuracy, covering socio-demographic details, dietary practices, food frequency, knowledge questions, and anthropometric measurements. For the intervention, educational aids such as a trifold brochure, PowerPoint presentation, "My Plate" model of USDA with cooked food display, painted pots depicting food groups, and a display board showing healthy versus unhealthy foods were used to reinforce key messages. Anthropometric measurements were taken using an Omron digital weighing scale for weight and a portable stadiometer for height, following standard protocols to ensure accuracy and reliability.

Data Collection: Data collection was scheduled in line with school calendars, avoiding exams and holidays. Written informed consent from parents and assent from children were obtained, with the mother–child pair treated as one study unit. Mothers were interviewed using a validated semi-structured questionnaire on dietary practices, food frequency, and nutrition knowledge, while children's height and weight were measured. Participants were divided into three groups: Group A received periodic nutritional education with six sessions over six months using brochures, presentations, food plate demonstrations, and games; Group B received a one-time education session with the same protocol; and Group C served as controls with no intervention. Post-intervention assessments were conducted after six months using the same questionnaire to evaluate changes in dietary practices, knowledge, and anthropometry.

Nutrition Knowledge Score: Dietary practices were evaluated through two domains: food habits (maximum score 14), which included breakfast intake, snacking patterns, meal frequency, eating environment, family meal participation, hotel/online food consumption, and water intake; and food frequency (maximum score 22), which assessed intake of items from various food groups. Together, these provided a maximum dietary practices score of 36, with a pilot study median of 23 used to categorize participants into unhealthy (≤23) and healthy (>23) dietary practices. The nutritional knowledge of participants was assessed using a validated scoring method based on their understanding of food nutrients, food groups, and the ability to identify junk foods, with a maximum score of 26. In the pilot study, the median pre-intervention score was 17, and participants scoring ≤17 were categorized as having unsatisfactory knowledge, while those scoring >17 were considered to have satisfactory knowledge.

Statistical Analysis: Statistical analysis was conducted using SPSS version 21 after data entry in Microsoft Excel. Continuous variables were expressed as Mean ± SD or Median with Inter-Quartile Range, depending on data normality assessed via the Kolmogorov-Smirnov test. Categorical variables were summarized using frequency distributions. Associations between variables were analyzed using McNemar test, Chi-square test, Paired t-test, and Kruskal-Wallis test, with a significance level set at $p < 0.05$.

Results

The three study groups were comparable with respect to their sociodemographic characteristics. The mean age of participants ranged from 11.7 ± 0.86 to 12.2 ± 1.01 years. Gender distribution was nearly equal across groups. The majority of participants were Hindus and belonged to nuclear families. Most mothers were literate, and the predominant socioeconomic status of the study population was upper-middle and middle class as shown in table 1. Table 2 shows that following the intervention, participants in Group A demonstrated significant improvements in regular breakfast intake, adoption of a balanced diet, and reduction in television viewing during meals. Group B showed a significant decrease in TV watching while eating, whereas no notable changes were observed in Group C. Overall, post-intervention findings indicate a positive shift in dietary and lifestyle behaviours among participants exposed to the intervention. Table 3 shows that Post-intervention, Group A showed improvements in all knowledge components, including food nutrients, MyPlate concept, and junk food identification. Group B had modest gains, while Group C showed minimal or no improvement. Overall, the intervention was most effective in enhancing nutritional knowledge in Group A.

Table 1: Socio-demographic details of participants in each group (n=30 in each group)

	Group A n (%)	Group B n (%)	Group C n (%)
Mean Age ±SD	11.7 ± .086	12.2 ± 1.01	12 ± .96.
Gender			
Male	15(50%)	13(43.3%)	13(43.3%)
Female	15(50%)	17(56.7%)	17(56.7%)
Religion			
Hindus	23(76.7%)	21(70%)	25(83.3%)
Christians	7(23.3%)	5(16.7%)	4(13.3%)
Muslims	-	4(13.3%)	1(3.3%)
Others	-		
Type of family			
Nuclear	23(76.7%)	22(66.7%)	25(83.3%)
Joint	3(10%)	1(3.3%)	2(6.7%)
Three generation	4(13.3%)	7(23.3%)	3(10%)
Mother's educational status			
Literate	29(96.7%)	29(96.7%)	30(100%)
Illiterate	1(3.3%)	1(3.3%)	-
Socio-economic class			
Upper	5(16.7%)	6(20%)	5(16.7%)
Upper middle	20(66.7%)	12(40%)	16(53.3%)
Middle	4(13.3%)	10(33.3%)	6(20%)
Lower middle	1(3.3%)	2(6.7%)	3(10%)
Lower	-	-	-

Table 2: Pre- and Post-Intervention Comparison of Dietary and Lifestyle Practices among Study Participants in each group (n=30 in each group)

		Group A (30) n(%)		Group B (30) n (%)		Group C (30) n (%)		
		Pre	**Post**	**Pre**	**Post**	**Pre**	**Post**	**P****
Regular Breakfast intake	**Yes**	20(66.7)	28(93.3)	22(73.3)	27(90)	26(86.7)	25(83.3)	$\chi^2 = 10.79$ df=5 p = 0.056
	No	10(33.3)	2(6.7)	8(26.7)	3(10)	4(13.3)	5(16.7)	
p* value		0.021		0.180		1.00		
Balanced diet	**Yes**	3(10)	13(43.3)	3(10)	6(20)	1(3.3)	1(3.3)	χ^2=27.05 df=5 p= 0.000
	No	27(90)	17(56.7)	27(90)	24(80)	29(96.7)	29(96.7)	
p* value		0.002		0.250		1.00		
Tv watching while eating	**Yes**	25(83.3)	16(53.3)	25(83.3)	18(60)	23(76.7)	21(70)	χ^2=11.25 df=5 p= 0.047
	No	5(16.7)	14(46.7)	5(16.7)	12(40)	7(13.3)	9(30)	
p* value		0.004		016		0.500		
At Home, Eating along with family members	**Yes**	10(33.3)	4(13.3)	7(23.3)	5(16.7)	5(16.7)	5(16.7)	χ 2=5.00 df=5 p=0.416
	No	20(66.7)	26(86.7)	23(76.7)	25(83.3)	25(83.3)	25(83.3)	
p* value		0.031		0.50		1.0		
Frequency Intake of Hotel Food	**>2 /week**	5(17)	1(3)	(0)	(0)	8(27)	4(13)	χ 2=8.9 df=5 p=0.638
	<2 / month	9(30)	5(17)	8(27)	8(27)	7(23)	9(30)	
	Never	16(53)	24(80)	24(73)	24(73)	15(50)	17(57)	
p* value		0.06		0.51		042		
Daily Drinking water Quantity	**<2 litres**	21(70)	11(37)	19(63)	16(53)	16(53)	14(47)	χ 2=1.7 df=5 p=0.426
	>2 litres	9(30)	19(63)	11(37)	14(47)	14(47)	16(53)	
p* value		0.01		0.43		0.26		

p* Obtained by Mc Nemar test; P Obtained by Chi square test; χ 2 -Pearson's chi square value; df = degree of freedom; p value<0.05 was considered significant**

Table 3: Comparison of Components under knowledge score Pre and Post Intervention among Study participants (n=30 in each group)

Components	Group A (30)		Group B (30)		Group C (30)	
	Pre Mean±SD	Post Mean±SD	Pre Mean±SD	Post Mean±SD	Pre Mean±SD	Post Mean±SD
Knowledge on Food Nutrients	10.4±2.25	11.8±1.76	9.7±2.63	8.64±1.31	9.5±3.08	8.1±2.00
My Plate Concept	1.66±0.60	1.86±0.43	1.43±0.62	1.53±0.73	1.66±0.71	1.73±0.52
No of Junk food identified correctly	5.53±1.77	6.23±1.54	5.53±1.47	6.83±1.14	5.26±1.65	5.06±1.20

p* Obtained by Mc Nemar test; P Obtained by Chi square test; χ 2 -Pearson's chi square value; df = degree of freedom; p value<0.05 was considered significant**

Figure 1 and 2 shows that Post-intervention, Group A showed a significant improvement in knowledge scores (mean difference 2.33 ± 2.03, $p < 0.001$) with a large effect size (d = 0.80) and median gain of 2.0, indicating substantial benefit. Group B showed a negligible, non-significant improvement (mean difference 0.33 ± 3.65, p = 0.621; d = 0.12), while Group C demonstrated a significant decline (mean difference −1.53 ± 2.50, p = 0.002; d = 0.45).

Intergroup comparison confirmed a significant difference ($p < 0.001$), highlighting the marked effectiveness of the intervention in Group A.

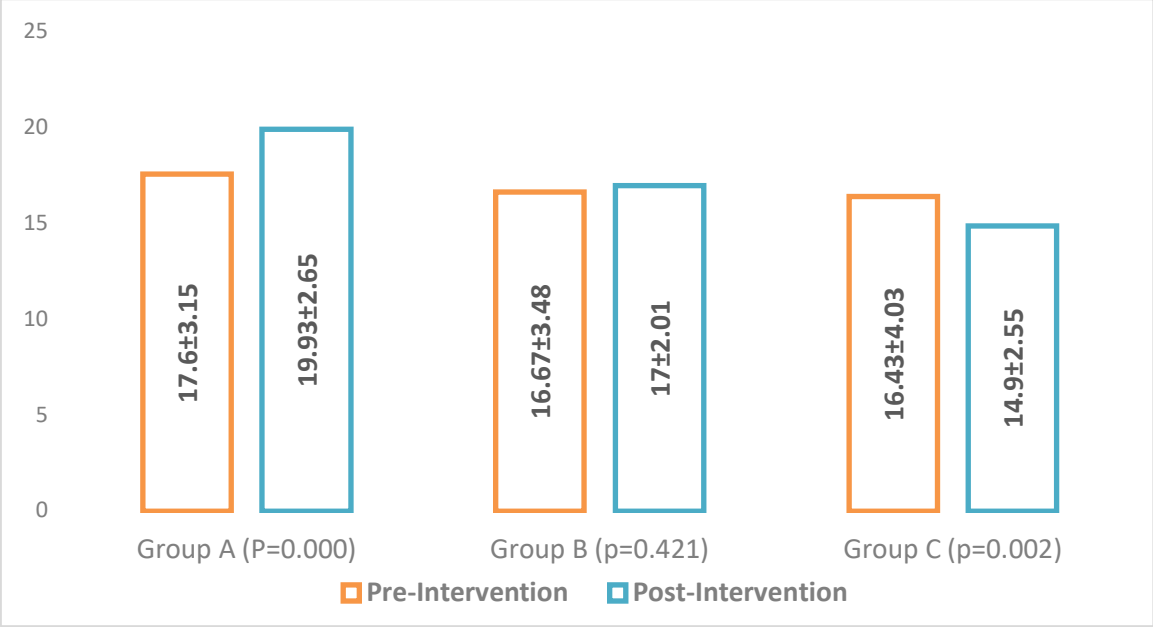

Figure 1: Comparison of Mean Knowledge scores pre- and post-intervention (n=30 in each)

All values are Mean ± SD p*paired t test; p value<0.05 was considered significant

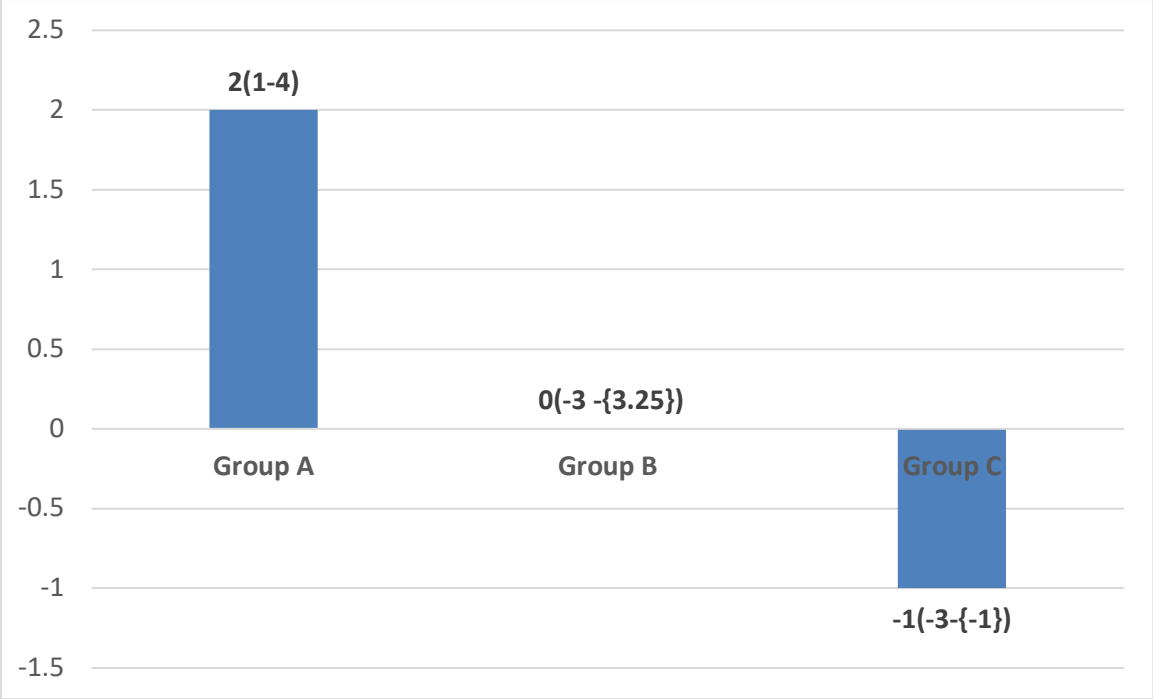

Figure 2: Comparison of Difference in Median knowledge score across groups (n=30 in each group) P<0.001

** Between and within groups comparison by Kruskal Wallis test; p value<0.05 was considered significant

Following the intervention, Group A showed a significant increase in satisfactory nutritional knowledge (57% to 86.7%, p = 0.012) and a corresponding reduction in unsatisfactory knowledge. Group B demonstrated minimal improvement (40% to 43.3%, p = 1.00), while Group C exhibited a decline in satisfactory knowledge (43.3% to 10%, p = 0.002).

Intergroup comparison indicated a statistically significant overall difference in nutritional knowledge post-intervention ($\chi^2 = 37.50$, $p < 0.001$, Cramer's V = 0.456), highlighting the effectiveness of the intervention in Group A as shown in table 4.

Table 4: Nutritional Knowledge among participants pre- and post-intervention (n=30 in each group)

Knowledge score category	Group A (30) n (%)		Group B (30) n (%)		Group C (30) n (%)		
	Pre	Post	Pre	Post	Pre	Post	P**
Unsatisfactory knowledge	13 (43)	4 (13.3)	18 (60)	17 (56.7)	17 (56.7)	27 (90)	χ 2= 37.50 df=5 p= .000 Cramer's V= 0.456
Satisfactory Knowledge	17 (57)	26 (86.7)	12 (40)	13 (43.3)	13 (43.3)	3 (10)	
p* value	.012		1.00		.002		

p* Obtained by Mc Nemar test; P Obtained by Chi square test; χ 2 -Pearson's chi square value; df = degree of freedom; p value<0.05 was considered significant**

Table 5 shows that Post-intervention, all study groups demonstrated significant improvements in dietary practices scores ($p < 0.001$).

Group A showed the greatest increase from 23.00 ± 3.69 to 29.93 ± 3.48 (mean difference 6.73 ± 3.48), followed by Group B (24.40 ± 3.32 to 27.30 ± 2.90; mean difference 2.90 ± 0.49) and Group C (22.06 ± 3.78 to 24.13 ± 3.36; mean difference 2.06 ± 2.03). These findings indicate the intervention was effective in improving dietary practices, particularly in Group A.

Table 5: Mean Dietary Practices Score Pre- and Post-Intervention and Difference in Mean Scores among Study Groups (n = 30 in each group)

Group	Pre-intervention Mean ± SD	Post-intervention Mean ± SD	Difference in Mean Score (Mean ± SD)	p-value*
Group A (n = 30)	23.00 ± 3.69	29.93 ± 3.48	6.73 ± 3.48	<0.001
Group B (n = 30)	24.40 ± 3.32	27.30 ± 2.90	2.90 ± 0.49	<0.001
Group C (n = 30)	22.06 ± 3.78	24.13 ± 3.36	2.06 ± 2.03	<0.001

Comparison of median differences showed Group A had the highest improvement [6.00 (IQR 4.75–10.00)] compared to Group B [2.50 (IQR 0.00–5.00)] and Group C [2.00 (IQR 1.00–3.25)], with a statistically significant difference across groups (p = .000, Figure 3) Cohen's d indicated a large effect size for dietary practices score improvement in Group A (1.93) and Group B (0.93), and a medium effect in Group C (0.58). This suggests a strong impact of periodic reinforcement in Group A, moderate effect in Group B, and smaller gains in Group C.

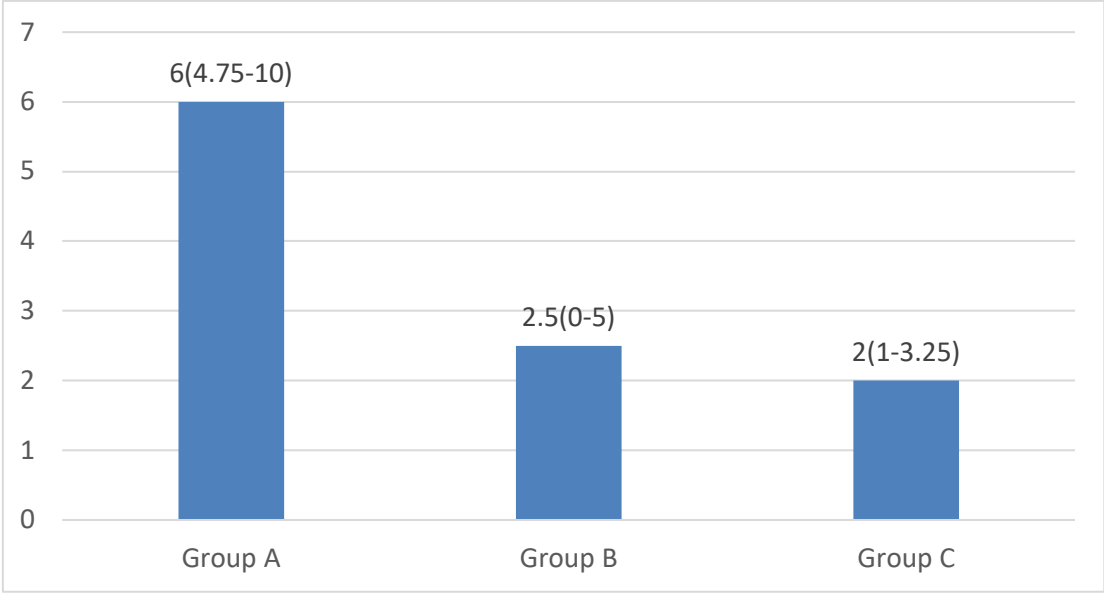

Figure 3: Comparison of difference in dietary practices score across groups (n=30 in each group) p<0.001

** Between and within groups comparison by Kruskal Wallis test; p value<0.05 was considered significant. Post-intervention, Groups A and B showed significant improvement in dietary practices, with unhealthy behaviours decreasing and healthy practices increasing (p < 0.001). Group C showed minimal, non-significant change. Overall, the intervention effectively enhanced dietary behaviours across the study groups as shown in table 6.

Table 6: Dietary practices score category among participants pre- and post-intervention (n=30 in each group)

Dietary practices score category	Group A (30) n (%)			Group B (30) n (%)			Group C (30) n (%)			
	Pre	Post	p*	Pre	Post	p*	Pre	Post	p*	P**
Unhealthy	18 (60)	1 (3.3)	.000	14 (46.7)	2 (6.7)	.000	18 (60)	14 (46.7)	.125	χ 2=42.343 df=5 p= .000 Cramer's V= 0.485
Healthy	12 (40)	29 (96.7)		16 (53.3)	28 (93.3)		12 (40)	16 (53.3)		

p* Obtained by Mc Nemar test; P Obtained by Chi square test; χ 2 -Pearson's chi square value; df = degree of freedom; p value<0.05 was considered significant**

Discussion

The present study demonstrated that periodic reinforcement of nutritional education was highly effective in improving both dietary practices and nutritional knowledge among middle school children. Group A, which received repeated interventions, showed significant improvements in regular breakfast intake, reduced television viewing

during meals, greater family meal participation, improved water and balanced diet intake, and overall dietary practices scores. In contrast, one-time intervention in Group B showed modest improvements, while minimal changes were observed in Group C. The findings on breakfast skipping are consistent with previous reports from Delhi, Baroda, Kochi, and the UK, where prevalence ranged between 30–40% [10-13]. Similar reasons for skipping breakfast, such as lack of time or appetite, were also noted in earlier studies. This highlights the universality of the problem and reinforces the need for structured educational programs. Reduction in television viewing during meals, particularly in Group A, aligns with prior studies linking screen time to unhealthy dietary patterns and higher BMI. Likewise, the improvement in family meal participation observed here reflects the importance of family systems in shaping healthy habits, findings that were more pronounced than those reported in Romanian children [14].

The decline in outside food consumption in Group A contrasts with higher prevalence of fast-food intake in Singapore and Malaysia, suggesting that lower accessibility and affordability in Indian settings may act as protective factors [15,16]. Water intake improved post-intervention, but adequacy remained low, a finding similar to reports from China where average daily intake was below recommended levels [8,17]. This emphasizes the role of schools in reinforcing hydration practices. The marked improvement in balanced diet intake in Group A (33% increase) was greater than that reported in other intervention studies from Tunisia and Pune [18,19], suggesting the added benefit of periodic reinforcement. Nutritional knowledge also improved significantly in Group A, comparable to earlier school-based interventions in Iran, Kenya, and Chennai [9,20,21]. The large effect size observed in Group A (Cohen's d = 1.93 for dietary practices, 0.80 for knowledge) further supports the superiority of repeated reinforcement over single-session interventions.

Overall, the study highlights that nutrition education, when delivered periodically and reinforced over time, can produce substantial and sustainable improvements in children's dietary practices and knowledge. These findings underscore the importance of integrating structured and ongoing nutrition education within school health programs to promote long-term healthy lifestyle behaviours.

This quasi-experimental study has some limitations. It was conducted only among middle school children in urban private matriculation schools in Chennai, limiting generalizability to rural areas or other school curricula. Dietary assessment relied on self-reported food frequency without quantifying servings, and children may have felt inhibited answering questions on breakfast skipping or outside food consumption in the presence of their mothers. Changes in anthropometry cannot be attributed solely to the intervention, as natural adolescent growth may have contributed. Based on the findings, it is recommended that schools implement periodic nutritional monitoring, engage students in creating culturally appropriate "My Plate" meals, and replicate similar studies in other settings. At the community level, initiatives such as healthy food festivals, public "My Plate" displays, simplified food labelling, and regulation of unhealthy food advertising are suggested. Families should reinforce healthy habits through role modelling, avoiding junk food as rewards, and maintaining regular family mealtimes.

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