



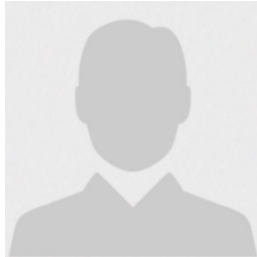
## An innovative nutrition education intervention to improve nutrition knowledge in school children



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### Keywords

diet;  
healthy lifestyle;  
innovative nutrition;  
nutrition knowledge;  
school-based  
intervention;

### Abstract

Malnutrition in school-going children may be attributed to non-communicable diseases, psychological distress, and inadequate living standards. To address this issue, it is imperative to implement an intervention program aimed at enhancing understanding of nutrition education. The study aims to introduce the Kolar Nutrition Education Intervention Programme (KNEIP) to children and assess their knowledge. A total of 418 schoolchildren from urban and rural areas participated in this study. The experimental group comprised of 237 participants, whereas 181 children who did not partake in the nutrition education package served as controls. The intervention program was conducted over five weeks, featuring five sessions that covered various topics related to nutrition. Teaching strategies and activities employed during the intervention included small group discussions and group work. Only 3.3 percent of the study participants achieved a fair score (50-75% of answers were correct) in the pre-intervention phase, which encompassed all sessions combined. However, this percentage rose to 50.6% following the implementation of the intervention ( $P < 0.0001$ ). The study also revealed that 17.0% of the participants were overweight, while 10.9% were obese. This research demonstrates that a school nutrition intervention program can yield positive outcomes in enhancing the nutrition knowledge of school children.

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## 1 Introduction

According to the reports of the World Health Organization, around 151 million and 51 million children under 5 years of age were stunted and wasted (reduced weight gain followed by thinness are termed as underweight, stunting, and wasting) respectively. The number of overweight children under five was noted to be 38 million in 2017 globally (WHO, 2016). In Asia, more than half of the children are found to be stunted, wasted, and overweight. Particularly in South-East Asia, one in every four children under five is stunted; one in every ten is wasted and overweight (World Health Organization, 2018).

As per the first cross-national studies of child growth, India is ranked third with increased patterns of growth faltering, a concerning trend observed in many countries (Abarca-Gómez et al., 2017). Structural factors viz. household poverty and hygiene, inadequate food system, poor water, and sanitation are the major attributing factors for India's child undernutrition problem (Nguyen et al., 2021). Strategies like overnutrition and undernutrition coexist majority of school-going children in India. As per the National Family Health Survey (NFHS)-5 2022, the overall prevalence of stunting was noted in 31.7% of children in India.

Educational institutions continue to play a pivotal role in influencing and impacting the dietary habits of children and adolescents. School settings also help for free access to a large population for longer duration and throw light to minimize population-wide chronic disease. For instance, the World Health Organization (WHO) suggests that schools adopt a comprehensive strategy for promoting healthy eating throughout the institution. This strategy should encompass teaching, learning, and professional development activities, as well as partnerships with physical and cultural aspects of students, staff, and community partnerships (WHO, 2021).

Globally, a considerable amount of research is going on to identify school-based nutrition interventions (World Health Organization, 2020), this study is planned with the Kolar Nutrition Education Intervention Programme (KNEIP) in collaboration with the District Director of Public Instructions (DDPI), Kolar. The study aims to implement, the Kolar Nutrition Education Intervention Programme (KNEIP) and to assess the knowledge of children before and after the Kolar Nutrition Education Intervention Programme (KNEIP).

## 2 Materials and Methods

This was a Cluster randomized controlled trial. The list of 162 schools was obtained from the Office of DDPI, Kolar District. Out of which 64 were selected randomly. Schools are randomized into Intervention Groups and Control Groups by using Block Randomization. 32 clusters will be allotted for each group.

A 10' × 10' banner was pre-designed which includes various concepts such as Height and weight standard references (ICMR 1990), 5 food groups to be consumed daily, symptoms of Protein-Energy Malnutrition (Bony appearance, Potbelly shape, stunted growth, underweight), Vitamin A deficiency (Bitot spots, Phrynoderma), Vitamin D & Calcium deficiency (Rickets), Vitamin B & C deficiency (Angular Stomatitis, Bleeding Gums, BeriBeri, Pellagra), Iron deficiency (Pale hands, pale eyes, pale tongue, Koilonychia), Sample menu for a day. Nutrition Education was given using the banner in one session. Nutrition knowledge of 55 students from each school both in the Control group and Intervention Group will be assessed before the intervention using a questionnaire. These subjects were followed after 2 weeks to assess their nutrition knowledge using the questionnaire (Figure 1).

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**DEPARTMENT OF CLINICAL NUTRITION AND DIETETICS**  
 In collaboration with  
**DISTRICT DEVELOPMENT PRIMARY EDUCATION BOARD**

**EAT THESE FOODS DAILY**

Avoid these Nutritional Deficiencies.  
 "Let food be your medicine"

**PROTEIN ENERGY MALNUTRITION**

**VITAMIN A DEFICIENCY**

**VITAMIN D AND CALCIUM DEFICIENCY**

**IRON DEFICIENCY**

**VITAMIN B & C DEFICIENCY**

**SAMPLE MENU**

**Early Morning 7.00-7.30 am**  
Milk- Boiled Egg + Banana

**Breakfast 8.00-8.30am**  
Idli + Sambhar + Chutney

**Midmorning 10.00-10.30 am**  
Guava (or any fruit)

**Lunch 12.30-1.00pm**  
Veg salad+ Ragi traddde + Rice + Sambhar + Soppu Saaru + Green leafy veg curry + Boiled Egg + Curd

**Evening 3.00-3.30 pm**  
Chickpeas Salad with nuts

**Late Evening 5.00-5.30pm**  
Orange (or any fruit)

**Dinner 7.30-8.00pm**  
Veg Salad- Rice + Masala Dal+ Lady finger Sambhar + Tomato Rasam+ Potato curry+ Green leafy veg curry + Curd + Milk based sweet

**Bedtime 10.00pm**  
Milk

**INDIAN CHILDREN Height & Weight Chart**

**GIRLS**

**BOYS**

**5 Formula for Growth**

**Primary School**

**100% Growth**

**www.dde.gov.in**



Figure 1. Education tool used for the study

Certain elements, like complex equations, visual representations, and data tables, are not specified, but the different styles for table text are provided. The person formatting the document will have to develop these elements, applying the relevant standards that are outlined.

### *Knowledge assessment questionnaire*

A questionnaire was developed to assess the knowledge of school children before and after the intervention. Questionnaire consists of two sections.

### *Demographic profile*

Demographic characteristics like age, date of birth, sex, level of education, name of the school, and location of the school were noted.

### *Nutrition Knowledge-related questions*

The questionnaire consists of 20 questions related to different food groups to be consumed daily, 2-3 symptoms of Protein-Energy Malnutrition, Vitamin A deficiency, Vitamin D and Calcium deficiency, Vitamin B & C deficiency, Iron deficiency, Sample menu for a day, Height and weight standard references. The questions are partially categorized, open-ended questions that require respondents to provide short answers in their own words. These questions are accompanied by a list of correct answers, along with the options "Other" and "Don't know."

### Data Collection

All the students participating in the study were explained regarding the study. Participants' information sheets were given and informed written consent was taken. Data were collected before and after the intervention using the questionnaire. These subjects were followed after 2 weeks to assess their nutrition knowledge after the intervention.

### Statistical analysis

The collected information was analyzed using SPSS version 23.0. A student t-test was employed to determine the average nutrition scores prior to and following the intervention. Analysis of variance (ANOVA) was used to analyze means of nutrition knowledge scores and  $P < 0.05$  was considered significant.

### Ethical consideration

Ethical approval and logistical support were carried out by school authorities and family members. Due to COVID-19, the expected schools as well as sample size were not met.

## 3 Results and Discussions

Among a total of 330 students, one-quarter of the sample (80 out of 330) was lost in the follow-up, and the final sample was 247 including 148 (59.9%) males and 99 (40.1%) females. The sample was lost due to missing data after the intervention and students not being present on the days when data was collected. Total knowledge scores related to nutrition in the studied sample before the application of the education intervention program are shown in Table 1.

Table 1  
Total nutrition knowledge score before intervention by gender and school type

Variable	Total number	Total knowledge Mean±SD	P value
Gender	N=247		0.02*
Male	148	13.0±4.4	
Female	99	14.3±3.9	
School type			
Male	N=148		0.004**
Urban	80	13.6±4.6	
Semi urban	33	13.8±3.4	
Rural	35	10.9±3.9	
Female	N=99		0.002**
Urban	40	15.9±3.4	
Semi urban	22	13.4±2.7	
Rural	37	13.1±4.4	
All samples	N= 247	13.5±4.2 (33%)	

\*Student's t-test \*\* Analysis of variance (ANOVA) test

The mean and standard deviation of the total score of nutrition knowledge (all sessions combined) for the studied sample was 13.5±4.2. The mean total nutrition knowledge score in females (14.3) was significantly higher than that in males (13.0) ( $P=0.02$ ). Moreover, the location of the school played a vital role in analyzing gender. In males, the mean total score of nutrition knowledge of students from rural areas (10.9) was significantly lower compared to scores of students from schools in the urban area (13.6) or semi-urban area in

Kolar taluk (13.8) (P=0.004). However, in females mean of the total score of nutrition knowledge of students from semi-urban areas o (15.9) was significantly higher than

Table 2  
Nutrition knowledge score of preparatory school students before and after intervention by gender

k	(N=247)		
	Pre	Post	Post
P	213(86.2)	29(11.7)	8(8.1)
F	34(13.8)	87(35.2)	43
g	-	131(53.1)	48
Mean	4.6±1.8	9.4±2.4	9.3±2.1
sc			
Poor	(83.4)	(17.8)	19
Fair	41 (16.6)	(46.6)	42
Good	-	88 (35.6)	38
Mean	3.5±2.1	7.5±2.2	7.7±2.3
sc			
Poor	(69.6)	64 (25.9)	26
Fair	45 (18.2)	72 (29.2)	28
Good	30 (12.2)	(44.9)	45
Mean	1.7±1.4	3.0±1.1	3.0±1.2
sc			
Poor	(83.8)	48 (19.4)	16
Fair	23 (9.3)	42 (17.0)	14
Good	17 (6.9)	(63.6)	69
Mean	1.3±1.2	3.7±1.3	3.4±1.3 P1 P3**
sc			
Poor	(93.1)	(44.9)	33
Fair	17 (6.9)	(55.1)	66
Mean	2.4±1.6	4.4±1.5 P1	4.8±1.3 P1 P4=0.002
sc			
Poor	(96.7%)	30 (12.2)	12
Fair	(3.3%)	(50.6)	44
Good	-	92 (37.2)	43
Mean	13.5±4.2	28.1±6.3P1	28.8±6.2 P1, P4=0.18
sc			

Scores; good, score>75%; fair, score 50%-75%; poor, score<50% of maximum

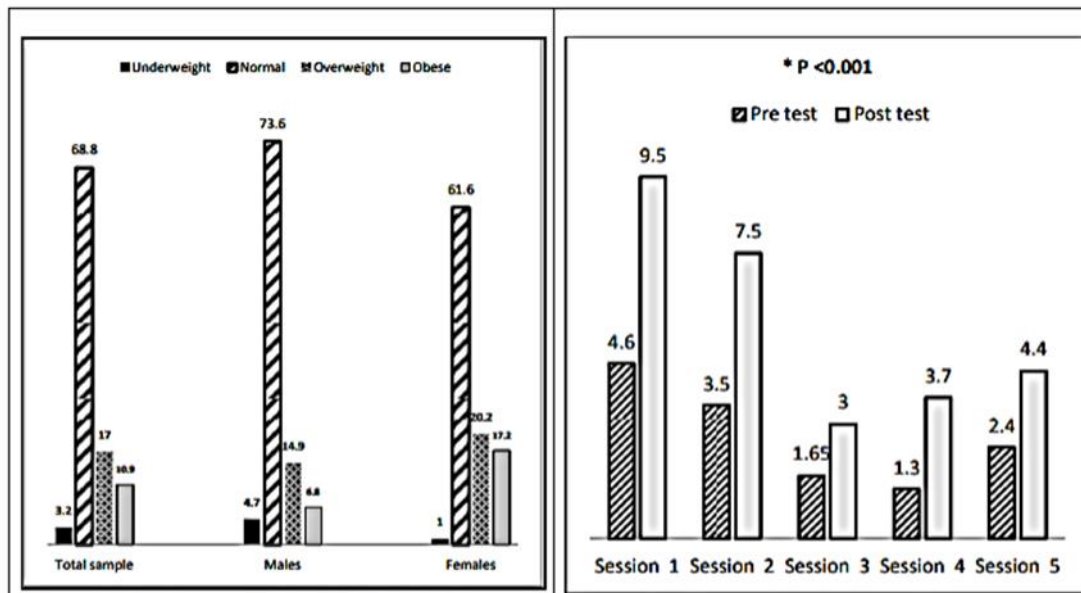


Figure 2. Percentage of students according to weight status by gender

The scores of students in semi-urban (13.4) and rural areas (13.1) ( $P=0.002$ ). Figure 2 showed the percentage of students according to weight status by gender. This figure showed that the percentages of overweight and obese in the studied sample were 17.0% and 10.9% respectively. The prevalence of obesity among female students (17.2%) was significantly higher ( $p$  value= 0.01) than the prevalence of obesity among male students (6.8%).

Scores; good, score >75%; fair, score 50%-75%; poor, score <50% of maximum. P1 Comparison between pre-intervention and post-intervention using paired samples T-test, all  $p_1$  was <0.0001. P2 Comparison between pre-intervention in males and pre-intervention in females using independent samples t-test. P3 Comparison between post-intervention in males and post-intervention in females using independent samples T-test's= not significant, \*  $p \leq 0.05$ , \*\* $P \leq 0.01$

Table 2 shows scores of nutrition knowledge pre- and post-interventions by gender. Pre-intervention, the percentages of students who scored fair (50-75% of answers were correct) were 13.8% in session 1 (knowledge about health benefits of essential nutrients); 16.6 % in session 2 (knowledge about food groups in the food pyramid); 18.2% in session 3 (knowledge about dietary guidelines), 9.3% in session 4 (knowledge about milk and dairy products and bone health) and 6.9% in session 5 (knowledge about physical exercise). The percentages of students who scored fair after the application of intervention increased to 35.2%, 46.6%, 29.1%, 17.0%, and 55.1% in sessions 1 to 5 respectively. Only Three percent of the studied sample scored fair in all sessions combined pre-intervention and the percentage increased to 50.6% after application of the intervention.

Similar patterns in percentages of those who scored poor, fair, and good were found in both male and female students in sessions 1 to 5 and all sessions combined respectively (see table 2). Table 2 also showed a statistical increase in mean score knowledge post-intervention compared to pre-intervention in the 5 previous sessions (9.4 vs 4.6 in session 1; 7.5 vs 3.5 in session 2; 3.0 vs 1.7 in session 3; 3.7 vs 1.3 in session 4 and 4.4 vs 2.4 in session 5) with  $p$  value less than 0.0001 in all. The overall mean score of knowledge obtained in the five sessions combined increased from 13.5 pre-intervention to 28.1 after the nutrition intervention program and the increase was statistically significant ( $p$ -value < 0.0001). There was a statistical difference between male and female students' pre-intervention in session 2 (3.3 vs 3.8,  $p$  value= 0.05); session 3 (1.4 vs 1.9,  $p$  value=0.002), session 4 (1.5 vs 1.1,  $p$  value=0.004) and all sessions combined (12.9 vs 14.3,  $p$  value=0.02). Post-intervention there was a significant difference between male and female students only in session 4 (3.5 vs 3.4,  $p$  value= 0.006) and in session 5 (4.2 vs 4.8,  $p$  value=0.002). Table 2 also showed that there was a significant increase in the mean score of knowledge post-intervention compared to pre-intervention in each

session and all sessions combined in both male and female students (Murimi et al., 2017; Scherr et al., 2017; Sahyoun et al., 2004; Yadnya et al., 2016).

Table 3  
Overall total nutrition knowledge score (all sessions combined) of preparatory school students before and after intervention based on gender and location of the school

	Semiurban	Semiurban	Semiurban Giza	Rural Giza
Males	N=80		N=33	
preintervention	13.6±4.6		13.7±3.4	
Post-intervention	27.4 ±6.6		29.1±6.5	
P value*	<0.0001		<0.0001	<0.0001
Females		N=40	N=22	N=37
preintervention		15.9±3.4	13.4±2.7	13.05±4.4
Post-intervention		27.5±5.5	29.6±7.1	29.7±6.4
P value*		<0.0001*	<0.0001*	<0.0001*

\* Paired t-test

Table 3 showed the overall total score of knowledge of middle school students before and after intervention based on gender and location of school. There was a significant increase in overall scores of nutrition knowledge after intervention in male and female students irrespective of the location of the school and P was less than 0.0001. Also, in Figure 2 the change in mean nutrition knowledge score before and after the intervention is demonstrated.

### Discussion

Globally, poor diet quality stands as a leading cause of ill health (Stanaway et al., 2018). A healthy diet is essential in all stages of the life cycle; however, children and major adolescents have unique nutritional requirements (Hollis et al., 2020; Fox & Timmer, 2020). The present study was conducted to evaluate the effectiveness of a school-based intervention and to prevent malnutrition among school-going children in India.

Even though national surveys in India comprise important nutrition information; the prevalence of stunting, wasting, overweight, and anemia, do not currently summarize overall diet quality. India has 29 states and 9 union territories with varied diets. Each state and regions have diverse culinary traditions and food quality differs across the country. The country's diversity, insufficient expertise in dietary valuation across regions, and the high cost and time burden of collecting high-quality dietary data all contribute to the delay in dietary intake research in India (Coates et al., 2017).

Dietary surveys among children and adolescents are important for the progress of effective policies and agendas aimed at enhancing eating behaviours among India's youth. This study highlights marked gaps in nutrition-related knowledge of school children chosen from selected governmental schools in Kolar. A high prevalence of overweight and obesity was noticed in both male and female students. The findings of this study also showed that after the application of nutrition education intervention, a significant improvement in nutrition knowledge irrespective of gender or location of school. The current study showed that only 3.3% of the studied sample have fair knowledge. However, the percentage of students (aged 12.5-15.49 years old) who have fair knowledge in a study conducted in nine European countries was 15 times much higher (60%) than the percentage reported in the current study (Sichert-Hellert et al., 2011). In another study of urban Asian Indian children from governmental schools (aged 12-14 years old), the percentage was four times higher (Shah et al., 2010). The low literacy related to nutrition in the current study may have bad repercussions in their adulthood translated into bad choices of food, energy imbalance, and consequently failure in weight management. However, this low literacy may not generally represent the whole school children in Kolar, as the current study was a purposive sample and included only selected governmental schools from Kolar Taluk.

Interestingly, the mean score of total knowledge was slightly higher in female students (14.3) compared to male students (12.9). Similarly, studies from several countries in Europe, the USA, and Malaysia found that female students have a higher knowledge score than their male counterparts (Sichert-Hellert et al., 2011; Shah

et al., 2010; Farah Wahida et al., 2011; Pirouznia, 2001). The elevated incidence of overweight and obesity among adolescents in the present investigation may partially be attributed to alterations in dietary habits linked to the accelerated pace of urbanization, alongside a decrease in physical activity levels (Galal, 2002). Furthermore, the study uncovered a greater prevalence of obesity among females in comparison to males.

Our research, alongside studies conducted across various nations, presents a compelling argument through the notable enhancement in educational outcomes observed among the targeted schoolchildren (Saksvig et al., 2005). The duration of the intervention program implementation significantly influences the effectiveness of the intervention. Numerous studies have demonstrated that a period ranging from 4 to 13 weeks is adequate for enhancing students' nutrition knowledge. However, these findings have been inconclusive regarding the extent to which this knowledge translates into actual practice (Harrabi et al., 2010). Our study has shown that an intervention of 5 weeks duration produced significant improvements in the overall knowledge of the participants. A nutrition intervention program targeting adolescents produced successful results when they have multiple pillars to focus on including behavioural, individual, environmental, and theoretical content (duration and intensity) appropriate to the age of the audience (Hoelscher et al., 2002; Pérez-Rodrigo & Aranceta, 2001). To summarize, this study has demonstrated that a school nutrition intervention program could have positive effects on school children (Poddar et al., 2010; Patterson et al., 1994; Loef & Walach, 2012).

#### 4 Conclusion

Finally, school-based nutrition interventions have the potential to improve dietary intake in children and adolescents. To plan and carry out the intervention in preventing malnutrition, researchers, medical professionals and various school authorities could use the study's findings.

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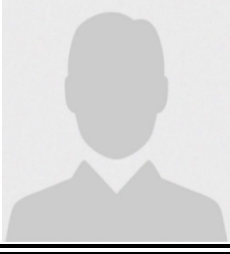

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