

Effectiveness of a Structured Teaching Programme on Knowledge Regarding Vitamin D and Vitamin B12 Deficiency among Adolescents: A Quasi-Experimental Study

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Abstract: ***Background:** Vitamin D and vitamin B12 are important micronutrients during adolescence, a period of rapid growth and development. Limited knowledge about their functions, deficiency, sources and prevention may hinder healthy choices. School-based structured education may help address this knowledge gap. **Objective:** To assess knowledge regarding vitamin D and vitamin B12 deficiency among adolescents, evaluate the effectiveness of a structured teaching programme, and determine the association between knowledge level and selected socio-demographic variables. **Methods:** A quantitative quasi-experimental one-group pre-test post-test design was used among 100 adolescents aged 11–17 years studying at Government Senior Secondary School, Mashobra, District Shimla, Himachal Pradesh. Participants were selected by probability simple random sampling. Data were collected using a self-structured 25-item knowledge questionnaire. The tool was reviewed by 12 experts for content validity and had a split-half reliability coefficient of $r = 0.803$. The structured teaching programme was administered after the pre-test and the post-test was conducted on the seventh day. Data were analysed using descriptive statistics, paired t-test and chi-square test. **Results:** Before the intervention, 19% of participants had inadequate knowledge, 72% had moderate knowledge and 9% had adequate knowledge. After the intervention, 0% had inadequate knowledge, 22% had moderate knowledge and 78% had adequate knowledge. Mean knowledge score increased from 11.62 ± 3.437 to 19.84 ± 4.151 , with a mean difference of 8.220. The paired t-test value was 24.022 ($p < 0.001$). Gender was significantly associated with pre-test knowledge ($\chi^2 = 7.56$, $df = 2$, $p = 0.02$), while mother's education was significantly associated with post-test knowledge ($\chi^2 = 9.82$, $df = 4$). **Conclusion:** The structured teaching programme was associated with a substantial and statistically significant improvement in adolescents' knowledge regarding vitamin D and vitamin B12 deficiency. Structured school-based health education may be a useful strategy for improving micronutrient awareness among adolescents.*

Keywords: adolescents; vitamin D deficiency; vitamin B12 deficiency; knowledge; structured teaching programme; quasi-experimental study

1. Introduction

Adolescence is a critical period of physical, psychological and cognitive development accompanied by increased nutritional requirements. Adequate micronutrient intake and awareness are important for supporting growth and maintaining health during this period. Vitamin D contributes to calcium metabolism and skeletal health, whereas vitamin B12 is essential for neurological function, DNA synthesis and red blood cell formation.

Vitamin D deficiency and vitamin B12 deficiency are important nutritional concerns in children and adolescents. The thesis literature review identifies evidence of substantial micronutrient deficiencies among Indian school-going populations and emphasizes the importance of prevention and early awareness. In India, dietary patterns, limited outdoor activity and inadequate nutritional awareness may contribute to micronutrient risk.

The school environment provides an accessible setting for health education because adolescents can be reached systematically through structured educational activities. Previous intervention studies reviewed in the thesis reported significant improvements in nutrition-related knowledge after educational interventions among adolescents.

However, limited evidence was identified in the selected setting regarding a structured teaching programme addressing knowledge of both vitamin D and vitamin B12 deficiency among adolescents aged 11–17 years. Therefore, the present study was undertaken to evaluate the effectiveness of a structured teaching programme on knowledge regarding vitamin D and vitamin B12 deficiency.

2. Objectives

- To assess knowledge regarding vitamin D and vitamin B12 deficiency among adolescents aged 11–17 years.
- To evaluate the effectiveness of a structured teaching programme on knowledge regarding vitamin D and vitamin B12 deficiency.
- To determine the association between knowledge level and selected socio-demographic variables.

3. Materials and Methods

3.1 Study design and setting

A quantitative approach with a quasi-experimental one-group pre-test post-test design was adopted. Knowledge was assessed before the intervention, the structured teaching programme was administered, and knowledge was reassessed after one week. The study was conducted at Government

Senior Secondary School, Mashobra, District Shimla, Himachal Pradesh.

3.2 Participants and sampling

The target population comprised adolescents aged 11–17 years in District Shimla. The accessible population comprised adolescents aged 11–17 years studying at the selected school. A sample of 100 adolescents was selected using probability simple random sampling.

Inclusion criteria included adolescents aged 11–17 years, regular students of the selected school, present during scheduled data collection, able to understand and respond to the questionnaire, and willing to participate with informed assent/consent. Adolescents who were unwilling, withdrew participation, had documented cognitive/ learning/ communication impairment affecting participation, or could not complete the procedure were excluded.

3.3 Intervention and procedure

A structured teaching programme on vitamin D and vitamin B12 deficiency was administered after the pre-test. The post-test was conducted on the seventh day following the intervention. Final data collection was conducted from 1 April 2026 to 30 April 2026.

3.4 Instrument

The instrument consisted of two sections. Part I collected socio-demographic information including age, class, religion, gender, parents' education, family type, history of vitamin supplementation, monthly family income, dietary pattern, previous information and source of information. Part II was a self-structured 25-item multiple-choice knowledge questionnaire covering basic concepts of vitamins; vitamin D and its deficiency; vitamin B12 and its deficiency; and prevention and dietary management. Each correct response received one mark and each incorrect response received zero.

Knowledge level	Score	Percentage range
Adequate	17–25	≥68%
Moderate	9–16	36–64%
Inadequate	0–8	≤32%

3.5 Validity and reliability

Content validity was established through review by 12 experts. The instrument was revised according to expert suggestions. Reliability was assessed using the split-half odd-even correlation method and the coefficient was $r = 0.803$.

3.6 Ethical considerations

Permission was obtained from the institutional ethics committee of Sister Nivedita Government Nursing College, IGMC, Shimla, and from the concerned school authorities. Written informed assent/consent was obtained from participants. The purpose of the study was explained and confidentiality of responses was maintained.

3.7 Statistical analysis

Descriptive statistics were used to summarize socio-demographic characteristics and knowledge scores. The paired t-test was used to compare pre-test and post-test knowledge scores. Chi-square test was used to assess associations between knowledge level and selected socio-demographic variables. Statistical significance was considered at $p \leq 0.05$.

4. Results

4.1 Participant characteristics

Among the 100 participants, 38% were aged >13–15 years, 34% were aged 11–13 years and 28% were aged >15–17 years. Females constituted 64% and males 36% of the sample. Most participants were Hindu (97%). A large majority were vegetarian (85%), 68% had no history of vitamin supplementation, and 53% reported no previous information regarding vitamin D and vitamin B12 deficiency.

Demographic Variables	Frequency (f)	Percentage (%)
1. Age		
a) 11 to 13 years	34	34.0
b) > 13 to 15 years	38	38.0
c) >15 to 17 years	28	28.0
2. Class		
a) 6th Grade	8	8.0
b) 7th Grade	13	13.0
c) 8th Grade	19	19.0
d) 9th Grade	21	21.0
e) 10th Grade	12	12.0
f) 11th Grade	16	16.0
g) 12th Grade	11	11.0
3. Religion		
a) Sikh	2	2.0
b) Hindu	97	97.0
c) Other	1	1.0
4. Gender		
a) Male	36	36.0
b) Female	64	64.0
5. Father's education		
a) No formal education	13	13.0
b) Primary Education	15	15.0
c) Secondary education	20	20.0
d) Senior secondary	33	33.0
e) Graduation and Above	19	19.0
6. Mother's education		
a) No formal education	9	9.0
b) Primary Education	19	19.0
c) Secondary education	26	26.0
d) Senior secondary	27	27.0
e) Graduation and above	19	19.0
7. Type of family		
a) Nuclear Family	43	43.0
b) Joint Family	41	41.0
c) Single Parent Family	11	11.0
d) Extended Family	5	5.0
8. History of vitamin Supplementation		
a) Yes	32	32.0
b) No	68	68.0
9. Monthly family income		
a) Less than 10,000	25	25.0

b) 10,001 – 20,000	40	40.0
c) 20,001 – 40,000	28	28.0
d) Above 40,000	7	7.0
10. Dietary Pattern		
a) Vegetarian	85	85.0
b) Non-Vegetarian	15	15.0
11. Previous information about Vitamin D and B12 deficiency		
a) Yes	47	47.0
b) No	53	53.0
12. Source of information		
a) Peer Group	2	2.0
b) Social media	11	11.0
c) Family Discussion	14	14.0
d) School Based Health Education	19	19.0
e) Other	1	1.0

4.2 Knowledge level before and after intervention

Knowledge level	Pre-test n (%)	Post-test n (%)
Adequate	9 (9%)	78 (78%)
Moderate	72 (72%)	22 (22%)
Inadequate	19 (19%)	0 (0%)

The proportion of adolescents with adequate knowledge increased from 9% in the pre-test to 78% in the post-test, while inadequate knowledge decreased from 19% to 0%.

4.3 Comparison of knowledge scores

Measure	Pre-test	Post-test
Mean $\pm$ SD	11.62 $\pm$ 3.437	19.84 $\pm$ 4.151
Mean percentage	46.50%	79.40%
Mean difference	8.220	
Paired t-test	24.022	
p value	<0.001	

There was a statistically significant improvement in knowledge scores after the structured teaching programme ($t = 24.022$, $p < 0.001$).

4.4 Association with socio-demographic variables

Gender showed a statistically significant association with pre-test knowledge level ($\chi^2 = 7.56$, $df = 2$, $p = 0.02$). Other assessed baseline variables were not significantly associated with pre-test knowledge. In the post-test, mother's education showed a statistically significant association with knowledge level ($\chi^2 = 9.82$, $df = 4$). Other assessed variables were not statistically significant.

5. Discussion

The present study found that baseline knowledge regarding vitamin D and vitamin B12 deficiency was not adequate for a substantial proportion of adolescents. Before the intervention, 72% had moderate knowledge and 19% had inadequate knowledge, while only 9% had adequate knowledge. This finding is consistent with studies reviewed in the thesis that reported gaps in micronutrient knowledge among adolescents.

The principal finding was the significant improvement in knowledge after the structured teaching programme. The

mean score increased from 11.62 to 19.84, producing a mean difference of 8.220 and a paired t-test value of 24.022 ($p < 0.001$). The categorical distribution also showed a marked shift toward adequate knowledge. This finding is consistent with previous intervention studies cited in the thesis, including structured teaching and nutrition education interventions that demonstrated significant improvements in adolescent knowledge.

The association analysis indicated that gender was related to baseline knowledge, while mother's education was related to post-test knowledge. These findings should be interpreted as secondary observations rather than evidence that these characteristics caused knowledge differences. The absence of significant associations for most variables suggests that the intervention-related improvement was broadly observed across the participant groups.

6. Conclusion

The structured teaching programme was associated with a substantial and statistically significant improvement in adolescents' knowledge regarding vitamin D and vitamin B12 deficiency. Adequate knowledge increased from 9% to 78%, and the mean knowledge score increased from 11.62 ± 3.437 to 19.84 ± 4.151 . These findings support the potential usefulness of structured school-based health education for improving micronutrient knowledge among adolescents.

7. Strengths and Limitations

Strengths include the use of a structured intervention, a standardized 25-item knowledge instrument with documented content validation and reliability, and assessment of knowledge both before and after the intervention.

The study was conducted in a single government senior secondary school, limiting generalizability. The sample was restricted to adolescents aged 11–17 years. Knowledge was assessed using self-reported questionnaire responses. Biochemical measures of vitamin D and vitamin B12 were not assessed, so improvement in knowledge could not be linked to actual nutritional status. External exposure to information from teachers, parents, peers, social media or other sources could not be completely controlled.

8. Implications for Nursing and School Health

School health nurses and nursing personnel can incorporate structured education on micronutrient deficiencies into adolescent health promotion activities. Educational sessions may cover sources, functions, risk factors, symptoms, prevention and appropriate health-seeking behaviour related to vitamin D and vitamin B12. Collaboration among nurses, teachers and parents may strengthen reinforcement of nutrition messages.

9. Recommendations

- Replicate the study with larger samples across multiple schools and geographical areas.

- Use controlled or randomized designs to provide stronger evidence of intervention effectiveness.
- Assess retention of knowledge over longer follow-up periods.
- Evaluate effects of educational interventions on dietary practices and health behaviours.
- Where feasible, include biochemical assessment of vitamin D and vitamin B12 status.
- Compare structured teaching with other educational approaches such as video-assisted, mobile-based or peer-led education.

Declarations

Ethics approval: Obtained from the institutional ethics committee of Sister Nivedita Government Nursing College, IGMCI, Shimla, as reported in the thesis.

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