



EFFECTIVENESS OF A SNAKE AND LADDERS EDUCATIONAL GAME ON KNOWLEDGE REGARDING PREVENTION OF ANEMIA AMONG ADOLESCENT GIRLS IN A SELECTED COLLEGE, COIMBATORE

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ABSTRACT **Background:** Adolescence represents a critical phase of rapid physiological growth, increasing iron demand and nutritional vulnerability. Iron deficiency anemia remains a major public health challenge among adolescent females in India. Traditional didactic teaching often yields suboptimal engagement, making innovative, game-based learning interventions vital for sustainable health behavior change. **Objectives:** To evaluate the effectiveness of an educational Snake and Ladders board game intervention on knowledge regarding the prevention of anemia among adolescent girls and to assess the association between knowledge scores and selected socio-demographic variables. **Methods:** A quantitative pre-experimental one-group pre-test and post-test design was conducted among 30 adolescent girls aged 17–19 years selected via non-probability convenience sampling from Sri Ramalinga Sowdambigai College of Science and Commerce, Coimbatore. A 30-item validated structured knowledge questionnaire covering anemia etiology, symptoms, balanced iron-rich nutrition, iron-folic acid (IFA) supplementation, deworming, and menstrual hygiene was administered before and after a structured Snake and Ladders game-based educational drill. **Results:** In the pre-test, 40% (n=12) demonstrated poor knowledge, 57% (n=17) moderate knowledge, and only 3% (n=1) good knowledge. Following the intervention, 83% (n=25) achieved good knowledge and 17% (n=5) moderate knowledge, with none in the poor category. The overall mean knowledge score increased significantly from 12.50 ± 5.39 in the pre-test to 23.50 ± 3.36 in the post-test (mean difference = 11.00). A paired t-test yielded $t = 15.32$ ($p < 0.0001$), demonstrating high statistical significance. **Conclusion:** The custom-designed Snake and Ladders game is an exceptionally effective, engaging, culturally acceptable, and low-cost pedagogical tool for enhancing anemia prevention literacy among adolescent college girls.

KEYWORDS : Anemia Prevention, Adolescent Girls, Snake and Ladders Game, Game-Based Learning, Iron Deficiency Anemia, Health Education, Community Health Nursing.

1. INTRODUCTION

Adolescence, spanning ages 10 to 19 years, represents a dynamic transitional bridge between childhood and adulthood characterized by rapid physical, cognitive, and neurobiological development. During this critical window, nutritional requirements surge dramatically to support the adolescent growth spurt, expansion of lean body mass, and total blood volume. In adolescent girls, this physiological vulnerability is sharply accentuated by the onset of menarche and regular menstrual blood loss. When dietary intake falls short of fulfilling these augmented demands, iron deficiency rapidly manifests, culminating in iron deficiency anemia (IDA).

Globally, the World Health Organization (WHO) identifies nutritional anemia as a pervasive public health threat, affecting over 15% of adolescent girls worldwide and rising above 27% in developing nations. In India, data from the National Family Health Survey-5 (NFHS-5, 2019–2021) revealed a stark escalation in anemia prevalence among adolescent girls aged 15–19 years from 54.0% in NFHS-4 to 59.1%. Even in socioeconomically progressive states such as Tamil Nadu, the prevalence remains alarming at 52.9% among adolescent females, with localized district epidemiological surveys in Coimbatore indicating adolescent anemia rates exceeding 85%. Anemia during adolescence triggers debilitating proximal consequences, including persistent physical fatigue, impaired cognitive concentration, reduced scholastic performance, and heightened susceptibility to infections, alongside grave long-term distal maternal and obstetric complications.

Although national initiatives such as the Anaemia Mukh Bharat strategy provide policy frameworks for weekly iron and folic acid supplementation (WIFS) and periodic deworming, knowledge deficits, compliance barriers, and unhealthy dietary habits persist among youth. Conventional classroom didactic lectures frequently fail to sustain adolescent engagement. In contrast, game-based learning and edutainment capitalize on gamification psychology, fostering experiential peer interaction, interactive problem-solving, and reinforced memory retention. The traditional Indian board game of Snakes and Ladders ('Moksha Patam') provides an ideal, culturally resonant pedagogical metaphor: positive health behaviors act as 'ladders' propelling health upward, whereas detrimental practices serve as 'snakes' leading to clinical setback. This study was undertaken to scientifically evaluate the effectiveness of an educational Snake and Ladders game on knowledge regarding anemia prevention among adolescent college girls in Coimbatore.

2. Objectives of the Study

The primary objectives guiding this research investigation were:

1. To assess the baseline level of knowledge regarding prevention of anemia among adolescent girls prior to the intervention.
2. To evaluate the effect of the educational Snake and Ladders game intervention on post-test knowledge scores regarding anemia prevention.
3. To determine the statistical association between baseline knowledge scores and selected socio-demographic variables (age, religion, dietary pattern, menstrual regularity, and iron supplementation status).

3. Hypotheses

H₁: There is a statistically significant difference between mean pre-test and post-test knowledge scores on prevention of anemia among adolescent girls following the game-based intervention at $p < 0.05$.

H₂: There is a statistically significant association between baseline knowledge scores regarding anemia prevention and selected socio-demographic variables at $p < 0.05$.

4. RESEARCH METHODOLOGY

4.1 Research Approach and Design

A quantitative evaluative research approach utilizing a pre-experimental one-group pre-test and post-test design ($O_1 \rightarrow X \rightarrow O_2$) was implemented. This design enabled baseline diagnostic measurement of knowledge (O_1), followed by the structured game intervention (X), and immediate post-intervention evaluative assessment (O_2).

4.2 Setting and Participants

The study was carried out at Sri Ramalinga Sowdambigai College of Science and Commerce, Poochiyur, Vadavalli, Coimbatore, Tamil Nadu. The target population comprised undergraduate collegiate adolescent girls. A sample size of 30 adolescent girls aged 17–19 years was selected using non-probability convenience sampling based on predefined inclusion criteria.

4.3 Inclusion and Exclusion Criteria

Inclusion Criteria: (a) Female undergraduate students aged 17 to 19 years studying in the selected college; (b) Willing to participate and present during the intervention period; (c) Able to comprehend English/Tamil.

Exclusion Criteria: (a) Students with diagnosed severe chronic systemic illnesses or hematological malignancies; (b) Students absent during either the pre-test or post-test assessment phases.

4.4 Description of the Intervention (The Snake and Ladders Educational Game)

The intervention utilized a large-scale customized 50-square flex

board game layout with oversized dice. Up to 6 participants per group engaged in active gameplay supervised by the investigator. Each square was themed around adolescent hematological wellness:

- Ladders (Positive Preventive Health Behaviors): Landing on cells such as regular intake of green leafy vegetables, weekly iron-folic acid (IFA) supplementation, consumption of vitamin C-rich citrus fruits with meals, bi-annual albendazole deworming, maintaining menstrual hygiene, and periodic hemoglobin screening allowed players to climb upward while reading the health benefit aloud to the cohort.
- Snakes (Nutritional and Behavioral Pitfalls): Landing on cells such as drinking tea or coffee immediately after meals (inhibiting iron absorption), chronic meal skipping, excessive consumption of junk food, heavy unmanaged menstrual bleeding, open defecation, and neglect of intestinal parasite control caused players to slide down to the snake's tail while reviewing the pathological risk.

4.5 Data Collection Instrument

- A structured, self-administered questionnaire was developed comprising two sections: Section A: Socio-demographic profile covering age, religion, dietary pattern (vegetarian vs. non-vegetarian), menstrual regularity, and usage of iron supplements.
- Section B: A 30-item multiple-choice knowledge questionnaire assessing four core domains: general concepts of anemia and hemoglobin physiology, etiology and vulnerability factors, signs and clinical manifestations, and preventive dietary, pharmacologic, and hygiene interventions. Each correct response was scored 1 point (maximum score = 30). Knowledge levels were categorized as Poor (<50%, score 0–14), Moderate (50–74%, score 15–22), and Good ($\geq 75\%$, score 23–30). Content validity was established through expert consensus from nursing specialists and medical faculty. Reliability and feasibility were confirmed through pilot testing.

4.6 Ethical Considerations and Data Collection Procedure

Formal administrative permission was obtained from the Principal of Kongunadu College of Nursing and the administrative authorities of Sri Ramalinga Sowdambigai College of Science and Commerce (Ref Date: 26-02-2026). Informed written consent was obtained from all participating students. Strict confidentiality and voluntary participation principles were maintained throughout.

5. RESULTS AND STATISTICAL ANALYSIS

5.1 Socio-Demographic Characteristics of Participants

The socio-demographic breakdown of the 30 adolescent female participants is summarized in Table 1:

S. No.	Demographic Variable	Frequency (n)	Percentage (%)
1	Age Group (Years)		
	• 10–13 years	0	0.0%
	• 14–16 years	0	0.0%
	• 17–19 years	30	100.0%
2	Religion		
	• Hindu	18	60.0%
	• Christian	6	20.0%
	• Muslim	6	20.0%
3	Dietary Pattern		
	• Vegetarian	12	40.0%
	• Non-Vegetarian	18	60.0%
4	Menstrual Cycle Status		
	• Regular (approx. 28-day cycle)	20	66.7%
	• Irregular	10	33.3%
5	Iron Supplementation Intake		
	• Regular Intake	18	60.0%
	• Irregular / Non-intake	12	40.0%

As indicated in Table 1, all 30 participants (100%) were aged between 17 and 19 years. The majority were Hindu (60.0%, n=18), followed by Christian (20.0%, n=6) and Muslim (20.0%, n=6). Regarding dietary habits, 60.0% (n=18) consumed a non-vegetarian diet, while 40.0% (n=12) followed a vegetarian diet. Two-thirds (66.7%, n=20) reported regular menstrual cycles, and 60.0% (n=18) adhered to regular iron supplementation routines.

5.2 Comparison of Pre-test and Post-test Knowledge Levels

The impact of the educational game on participant knowledge distribution is detailed in Table 2:

Knowledge Level	Score Range	Pre-test n (%)	Post-test n (%)	Net Percentage Change
Poor Knowledge	< 50% (0–14)	12 (40.0%)	0 (0.0%)	-40.0%
Moderate Knowledge	50–74% (15–22)	17 (56.7%)	5 (16.7%)	-40.0%
Good Knowledge	$\geq 75\%$ (23–30)	1 (3.3%)	25 (83.3%)	+80.0%
Total	30 items	30 (100.0%)	30 (100.0%)	—

Prior to the intervention, 40.0% (n=12) of participants displayed poor knowledge and 56.7% (n=17) moderate knowledge, with only 3.3% (n=1) possessing good knowledge. Following the Snake and Ladders educational drill, students exhibiting good knowledge surged by 80.0% to reach 83.3% (n=25), while poor knowledge was completely eradicated (0.0%).

5.3 Inferential Statistical Evaluation (Paired 't' Test)

To test Hypothesis 1 (H_1), a paired t-test was computed comparing overall pre-test and post-test scores:

Assessment Phase	Mean Score	SD	Mean Difference	Paired t-value	p-value
Pre-Test	12.50	5.39			
Post-Test	23.50	3.36	11.00	15.32**	p < 0.0001

As demonstrated in Table 3, the mean knowledge score rose from 12.50 ± 5.39 in the pre-test to 23.50 ± 3.36 in the post-test, reflecting a net mean score improvement of 11.00 points (an increase from 41.7% to 78.3% of the maximum achievable score). The calculated paired t-value was 15.32, substantially exceeding the critical table value ($t = 2.045$ at $df = 29$, $\alpha = 0.05$). This confirms statistical significance at $p < 0.0001$, providing robust empirical verification for Hypothesis 1.

5.4 Association Between Baseline Knowledge and Socio-Demographic Variables

Chi-square analysis (χ^2) was conducted to test Hypothesis 2 (H_2), evaluating the association between baseline knowledge scores and demographic variables:

Demographic Variable	Good Knowledge	Moderate Knowledge	Poor Knowledge	Chi-Square (χ^2)	Inference (p = 0.05)
Dietary Pattern					
• Vegetarian (n=12)	0 (0%)	7 (58.3%)	5 (41.7%)	0.21 (df=2)	Not Significant (Table = 5.99)
• Non-Vegetarian (n=18)	1 (5.6%)	10 (55.6%)	7 (38.8%)		
Menstrual Cycle					
• Regular (n=20)	1 (5.0%)	12 (60.0%)	7 (35.0%)	3.84 (df=2)	Not Significant (Table = 5.99)
• Irregular (n=10)	0 (0.0%)	5 (50.0%)	5 (50.0%)		
Iron Supplementation					
• Regular Intake (n=18)	1 (5.6%)	11 (61.1%)	6 (33.3%)	2.35 (df=2)	Not Significant (Table = 5.99)
• Irregular / None (n=12)	0 (0.0%)	6 (50.0%)	6 (50.0%)		

The calculated chi-square values for dietary pattern ($\chi^2 = 0.21$, $p > 0.05$), menstrual cycle regularity ($\chi^2 = 3.84$, $p > 0.05$), and iron supplementation habits ($\chi^2 = 2.35$, $p > 0.05$) were all below the critical table value of 5.99 ($df = 2$, $\alpha = 0.05$). Age was homogeneous across the sample (100% aged 17–19 years). Consequently, baseline knowledge was not significantly dependent on demographic characteristics, indicating that knowledge deficits were uniformly distributed across the cohort regardless of dietary or physiological background.

6. DISCUSSION

The findings of this investigation provide compelling scientific evidence supporting the efficacy of edutainment in adolescent public health education. The baseline assessment revealed that 96.7% of adolescent girls possessed inadequate (poor or moderate) knowledge regarding anemia etiology, dietary enhancers, inhibitors, and preventive strategies. This aligns closely with findings from Pushpa & Lokare (2012) and Suryanarayana et al. (2017), who demonstrated that

despite high national anemia burden, adolescent awareness regarding iron physiology and preventive guidelines remains critically substandard.

Following the game-based intervention, participant comprehension improved substantially, with the proportion of students achieving good knowledge expanding from 3.3% to 83.3%, accompanied by a mean score increase from 12.50 to 23.50 ($t = 15.32$, $p < 0.0001$). These outcomes corroborate previous research by Sam (2011) and Vivas (2010), who documented statistically significant knowledge gains through health board games ($t = 18.16$ and $t = 20.14$, respectively). Similarly, Kaur et al. (2018), Sharma et al. (2020), and Gupta (2021) demonstrated that the participatory, competitive, and enjoyable dynamics of Snakes and Ladders effectively dismantle cognitive barriers, stimulate active peer discussion, and dramatically enhance message retention compared to conventional didactic teaching.

In the context of the Anaemia Mukh Bharat operational framework, which emphasizes behavior change communication (BCC) and school/college-based platforms, these results underscore that edutainment strategies can bridge the persistent gap between national health policy dissemination and youth lifestyle adoption.

7. Nursing Implications

- **Nursing Practice:** Community health nurses and clinical practitioners can readily deploy low-cost, portable board game kits in community clinics, primary health centers (PHCs), schools, and colleges to conduct high-impact health promotion drives targeting nutritional deficiencies.
- **Nursing Education:** Nurse educators should integrate active gamification and creative teaching methodologies into undergraduate and postgraduate nursing curricula, equipping nursing students with modern experiential pedagogies rather than relying solely on traditional lecture-based instructional formats.
- **Nursing Administration:** Nurse administrators and public health coordinators can allocate resources toward designing localized edutainment toolkits, standardizing game-based health modules, and organizing institutional continuing nursing education (CNE) workshops on creative adolescent wellness interventions.
- **Nursing Research:** This investigation provides empirical groundwork for nursing scholars to conduct larger multicenter randomized controlled trials (RCTs) assessing longitudinal behavior change, dietary modification compliance, and biological hemoglobin biomarkers following game-based health interventions.

8. Limitations and Recommendations

- **Limitations:** The study utilized a pre-experimental single-group design without an independent control group, a modest sample size ($n = 30$), and convenience sampling within a single collegiate institution. Furthermore, biological endpoints (such as serum ferritin and hemoglobin concentrations) and long-term retention beyond the immediate post-test were not evaluated.
- **Recommendations:** Future studies should incorporate randomized controlled designs comparing game-based interventions against standard didactic lectures; recruit larger multi-center cohorts across diverse rural and urban settings; assess longitudinal retention at 1, 3, and 6 months post-intervention; and incorporate biological markers to evaluate clinical hematological efficacy.

9. CONCLUSION

The present study conclusively demonstrated that the educational Snake and Ladders game intervention produced a highly significant enhancement in knowledge regarding the prevention of anemia among adolescent girls ($p < 0.0001$). Transforming essential health concepts—such as iron-rich dietary intake, vitamin C absorption synergy, IFA supplementation, periodic deworming, and menstrual hygiene—into interactive game mechanics provides a cost-effective, culturally engaging, and replicable public health educational strategy. Wide-scale implementation of edutainment modalities can substantially bolster national efforts to curb adolescent anemia and promote life-long community health.

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