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Effectiveness of peer education based on social cognitive theory in preventing anemia among adolescent girls at the State Senior High School 1 Kebomas Gresik

Efektivitas peer education berbasis teori kognitif sosial dalam pencegahan anemia pada remaja putri di SMAN 1 Kebomas Gresik

Eka Srirahayu Ariestiningsih[1*], Dwi Faqihatus Syarifah Has[2], Bhagaskoro Ardhianto Kurniawan[3], Luluk Yuliati[4], Hilda Putri Laurita[5], Maghfiratun Nisa Arifani[6]

[1] Nutrition Science Study Program, Universitas Muhammadiyah Gresik, Indonesia. E-mail: eka.ariesty@umg.ac.id
[2] Nutrition Science Study Program, Universitas Muhammadiyah Gresik Indonesia.
E-mail: dwisyarifah@umg.ac.id
[3] Politeknik Semen Indonesia, Indonesia.
E-mail: bhagaskoroak@gmail.com
[4] Sekolah Tinggi Ilmu Kesehatan Bakti Utama Pati, Indonesia.
E-mail: Lulukyuliati69@gmail.com
[5] Nutrition Science Study Program, Universitas Muhammadiyah Gresik, Indonesia.
E-mail: akuhildaputri@gmail.com
[6] Nutrition Science Study Program, Universitas Muhammadiyah Gresik, Indonesia.
E-mail: maghfiratunfira@gmail.com

***Correspondence Author:**
Universits Muhammadiyah Gresik, Kampus 2 Jl. Proklamasi No.54, Gresik Jawa Timur, Indonesia.
E-mail: eka.ariesty@umg.ac.id

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Abstract

Anemia remains a significant global public health issue, particularly among adolescent girls. In Indonesia, 48,9% of adolescent girls were anemic in 2018, and East Java reported a prevalence of 42% in 2020. Contributing factors include poor nutrition, unhealthy dietary habits, and low awareness of anemia prevention. This study aimed to evaluate the effectiveness of peer education in enhancing adolescents' knowledge and awareness of anemia prevention and analyze its behavioral impact based on Social Cognitive Theory (SCT). A mixed-method approach with an explanatory sequential design was employed. Quantitative data were collected from 110 students (grades X and XI) at the State Senior High School 1 Kebomas Gresik between March and April 2025, using pre- and post-tests (20 items) and a validated SCT-based questionnaire (15 items, r = 0,847). Qualitative insights were obtained through in-depth interviews with peer educators, guided by five key SCT-based questions. Statistical analyses included paired t-tests or Wilcoxon tests for knowledge improvement and SEM-PLS for behavioral correlations. Post-intervention results showed a significant increase in knowledge (mean score: 75,06 to 95,28) with a moderate yet significant correlation (r= 0,494; p= 0,000). In conclusion, peer education grounded in SCT proved effective in promoting knowledge transfer and behavioral change, supporting its use as a health education strategy for adolescents.

Keywords: Adolescent Girls, anemia, behavior change, knowledge, peer education

Abstrak

Anemia masih menjadi masalah kesehatan masyarakat yang serius di seluruh dunia, terutama pada remaja putri. Di Indonesia, sebanyak 48,9% remaja putri mengalami anemia pada tahun 2018, dan Jawa Timur mencatat prevalensi sebesar 42% pada tahun 2020. Faktor penyebab utama meliputi asupan gizi yang kurang, pola makan yang tidak sehat, serta rendahnya kesadaran akan pentingnya pencegahan anemia. Penelitian bertujuan untuk mengevaluasi efektivitas pendidikan sebaya dalam meningkatkan pengetahuan dan kesadaran remaja terhadap pencegahan anemia, serta menganalisis pengaruhnya terhadap perubahan perilaku berdasarkan kerangka *Social Cognitive Theory* (SCT). Pendekatan *mixed-methods* dengan desain *explanatory sequential* digunakan dalam studi ini. Data kuantitatif dikumpulkan dari 110 siswa kelas X dan XI di SMAN 1 Kebomas pada bulan Maret–April 2025 melalui pre-test dan post-test (20 soal) serta kuesioner berbasis SCT (15 item, validitas r= 0,847). Data kualitatif diperoleh melalui wawancara mendalam dengan pendidik sebaya menggunakan lima pertanyaan utama. Hasil analisis menunjukkan peningkatan pengetahuan yang signifikan setelah intervensi (nilai rata-rata dari 75,06 menjadi 95,28) dengan korelasi sedang namun bermakna (r= 0,494; p= 0,000). Pendidikan

sebaya berbasis SCT terbukti efektif dalam meningkatkan pengetahuan dan mendorong perubahan perilaku, sehingga direkomendasikan sebagai strategi edukasi kesehatan yang sesuai untuk remaja.

Kata Kunci: Anemia, perubahan perilaku, pengetahuan, pendidik sebaya, remaja putri

Introduction

Anemia remains a critical global public health concern, particularly among women of reproductive age and adolescent girls. An accurate estimation of its prevalence is crucial for informing targeted interventions aligned with global disease reduction strategies (Haematol, 2023). According to the World Health Statistics (2021), the global prevalence of anemia among women aged 15–49 years was 29,9% in 2019, with a similar rate of 29,6% among non-pregnant women, including adolescents (Amanda & Kamidah, 2024). Regionally, the burden of anemia is highest in Africa (44,4%), followed by Asia (25–33%), and lowest in North America (7,6%) (Haryanti et al., 2024). In Southeast Asia, the World Health Organization (WHO) reported a prevalence of 41,9% (Ariana & Fajar, 2024), with approximately 25–40% of cases occurring among adolescent girls aged 15–19 years (Asrinal et al., 2021).

In Indonesia, the prevalence of anemia in women aged 15 years and older is 23%, exceeding that in neighboring countries, such as Malaysia (21%) and Singapore (22%) (Marfiah et al., 2023). Among children aged 5–12 years, the prevalence is 26%, and 23% in adolescents aged 13–18 years. Data from the 2018 Indonesian Basic Health Research (Riskesdas) showed that 48,9% of adolescent girls aged 15–24 years were anemic, an alarming increase compared with previous surveys in 2007 (6,9%) and 2013 (18,4%) (Kemenkes RI, 2018).

East Java Province is among the 20 provinces in Indonesia with anemia rates exceeding the national average, ranking 11th in terms of prevalence among adolescent girls (Windari and Prajayanti, 2024). In 2020, the East Java Provincial Health Office reported a prevalence rate of 42% among adolescent girls (Iftitah and Hanum 2021; Yani et al. 2023). Specifically, in Gresik Regency, the rate has decreased slightly from 27% in 2023 to 25% in 2024 (Nuriyah, 2025), although this remains well above the global threshold of 12% for women aged 15 and older (Marfiah et al., 2023).

Anemia among adolescents, especially girls, is influenced not only by nutritional deficiencies, such as iron, folic acid, vitamin B12, and protein, but also by inadequate vitamin C intake, low levels of health knowledge, poor dietary habits, insufficient sleep, and excessive menstrual blood loss (Aulya et al., 2024; Alfiah & Deny, 2023; Aulya et al., 2022). According to WHO, anemia is diagnosed when hemoglobin levels are below 12 g/dL in females over 15 years old and not pregnant (Utari & Al Rahmad, 2022; Helmiyati et al., 2023). Anemia during adolescence poses risks of impaired cognitive development, decreased immunity, and, if continued into adulthood, adverse pregnancy outcomes, such as low birth weight and premature birth (Norris et al., 2021; Taner et al., 2015).

Several studies have highlighted the significant correlation between knowledge levels and anemia status among adolescent girls, particularly those living in Islamic boarding schools (Arifianti & Sudiarti, 2023). Nutrition education is a proven strategy for increasing knowledge and self-awareness and promoting positive behavioral changes to improve nutritional status (Sari et al., 2020). Among adolescents, peer education has emerged as an effective approach because of the developmental stage of identity formation and influential role of peers (Al Rahmad, 2023; Fakhrina & Hanif, 2024). Peer-led health education is considered successful because it uses relatable language and communication styles to enhance the delivery and reception of health messages (Fanaqi et al., 2020).

Previous research has shown that peer education improves anemia-related knowledge and attitudes among adolescent girls (Astuti & Suryani, 2020). However, most studies remain limited in scope, often lacking a structured educational model or behavioral theory framework (Nursya'adah et al., 2024). A preliminary study in 2023 at SMAN 1 Kebomas revealed that several students had low hemoglobin levels and inadequate knowledge of

anemia (Melvani et al., 2023). A follow-up study in 2024 demonstrated that education supported by parental and peer involvement significantly improved knowledge and self-awareness of anemia prevention (Riswanto et al., 2024). Nevertheless, these studies did not systematically incorporate peer educators as primary facilitators or apply behavioral theories such as Social Cognitive Theory (SCT) to guide interventions.

This study seeks to address this gap by integrating SCT into a structured peer-led intervention. SCT emphasizes observational learning, self-efficacy, and reinforcement as mechanisms of behavioral change (Bandura, 1986). In this context, peer educators can serve as role models, facilitating knowledge acquisition and behavior modification through continuous interactions and mutual influence.

The novelty of this study lies in its application of SCT within a structured, peer-led health education program to improve knowledge, awareness, and anemia-prevention behaviors among adolescent girls. By leveraging peer influence and theoretical grounding, this study offers a scalable and sustainable model for school-based nutritional education.

Therefore, this study aimed to measure the effectiveness of peer educators in enhancing knowledge, awareness, and preventive behaviors toward anemia among adolescent girls at the State Senior High School 1 Kebomas Gresik using the Social Cognitive Theory framework. This study contributes to the advancement of public health nutrition strategies targeting adolescents and offers an evidence-based intervention model for anemia prevention in school settings.

Methods

Study Design

This study employed a mixed-methods approach using an Explanatory Sequential Design in which quantitative and qualitative data were collected sequentially rather than concurrently. The research was conducted at State Senior High School 1 Kebomas Gresik, East Java Province, Indonesia. This study was conducted between March and April 2025.

This two-phase design allows for a more comprehensive understanding of the research problem by initially collecting and analyzing quantitative data, followed by qualitative data to further explain the quantitative findings. The implementation of this design is illustrated in Figure 1.

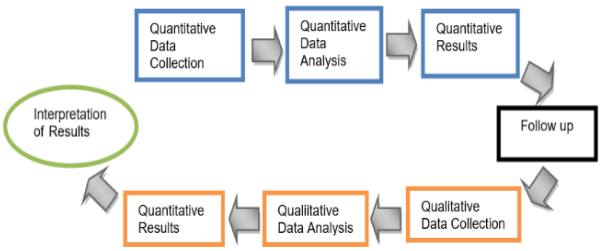

Figure 1. Explanatory sequential design

Population and Sample

The study population consisted of female students in grades X and XI, across 22 classes. The School Health Unit (Indonesian called UKS) coordinator appointed five students per class, totaling 110 participants. A purposive sampling technique was applied to ensure alignment with the research objective. Of the total participants, 22 students (one per class) were selected as peer educators based on the following inclusion criteria: completion of training, demonstrated communication and leadership skills, interest in health education, active participation in school organizations, and written consent to participate. These were substantiated by a leadership training certificate and formal appointment letter issued by the school principal.

The remaining 88 students were the intervention recipients. Peer educators underwent a two-week training session on anemia prevention, which was led by the research team in March 2025.

Data Collection

Quantitative data were collected using a structured questionnaire administered before and after the intervention. The instrument comprises 20 items that assess demographic characteristics and changes in knowledge, attitudes, and behavior related to anemia. The questionnaire demonstrated a strong internal consistency (r= 0,847), confirming its validity and reliability. To assess the relationship between Social Cognitive Theory (SCT) constructs and knowledge improvement, an additional 15-item questionnaire was administered. It measures four SCT dimensions: (1) attention, (2) retention, (3) reproduction, and (4) motivation.

Qualitative data were obtained through in-depth interviews with peer educators to explore their experiences, challenges, and perceptions of the effectiveness of delivering educational interventions. Data were analyzed using thematic analysis, as described by Braun and Clarke (2008), focusing on themes relevant to the SCT framework.

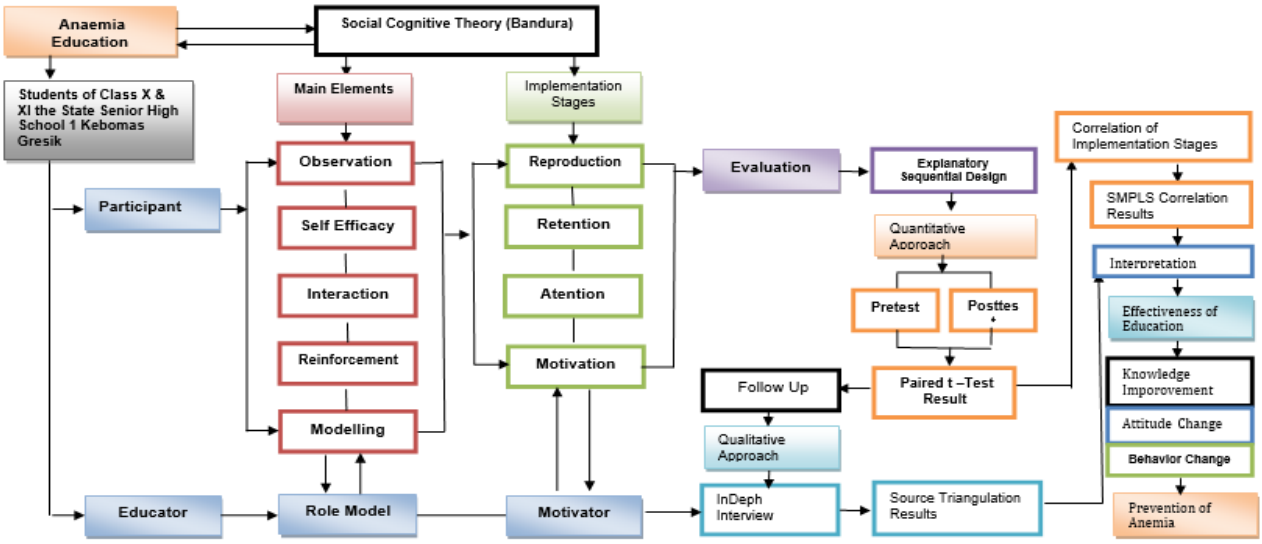

Figure 2. Flowchart of peer educator effectiveness through the implementation of Social Learning Theory stages as moderation of anemia prevention

Data Analysis

Quantitative data were analyzed using IBM SPSS version 25.0. Depending on the normality of the data distribution, either the paired t-test or Wilcoxon signed-rank test was applied to determine the significance of the changes in students' knowledge and behavior pre- and post-intervention. Statistical significance was set at $p < 0,05$.

Structural equation Modeling using Partial Least Squares (SEM-PLS) was performed to examine the relationships between SCT components and knowledge outcomes. This analysis linked the four SCT dimensions to knowledge improvement, enabling a comprehensive assessment of the effectiveness of peer education. Qualitative data were coded and categorized through thematic analysis using manual coding procedures aligned with SCT components. Triangulation of data sources enhances the trustworthiness of the findings.

Ethical Approval

This study was reviewed and approved by the Health Research Ethics Committee of Universitas Muhammadiyah Gresik, Indonesia (approval number: 19/KET/II.3.UMG/KEP/A/2025). Written informed consent was obtained from all participants prior to data collection.

Result and Discussion

Respondents Characteristics

The results (table 1) presents the demographic characteristics of the participants. All 88 respondents were female students at State Senior High School 1, Kebomas Gresik, ranging in age from 16 to 18 years. The majority of participants (50%) were 17 years old, followed by 39,8% aged 16 years, and 10,2% aged 18 years. All participants were female and were evenly distributed across grades X and XI.

Table 1. Demographic characteristics of participants (n = 88)

Characteristic	n	%
Sex		
Female	88	100,0
Grade		
X	44	50,0
XI	44	50,0
Age (years)		
16	35	39,8
17	44	50,0
18	9	10,2

As shown in Table 1, the majority of respondents were 17 years old (44 respondents, 50%). Meanwhile, 35

respondents (39,8%) were 16 years old and the remaining nine respondents (10,2%) were 19 years old.

Effectiveness of Peer Education: Pre and Post-Test Comparison

Pre- and post-tests were conducted to assess the effectiveness of peer education on anemia-related knowledge. Table 2 shows a notable improvement in knowledge scores following the intervention.

Table 2. Pre and post-test knowledge scores of participants (n = 88)

Test Period	Mean Score	Std. Deviation	Std. Error Mean
Pre-test	75,06	6,67	0,71
Post-test	95,28	4,17	0,45

The average knowledge score increased significantly from 75,06 (SD = 6,67) to 95,28 (SD = 4,17), representing an improvement of 20,22 points. The reduction in standard deviation also indicates a more consistent understanding of anemia-related content among participants after peer education intervention.

Correlation Between Pre-Test and Post-Test Scores

Table 3 illustrates the relationship between participants' knowledge before and after the intervention. A moderate positive correlation (r = 0,494, p < 0,001) was found between the pre- and post-test scores. This indicates that students with higher initial knowledge tended to retain higher scores after the intervention, while those with lower baseline scores showed improvement.

Table 3. Correlation between pre-test and post-test knowledge scores

Variable Pair	n	Correlation (r)	p-value
Pre and Post-Test Knowledge Scores	88	0,494	< 0,001*

*p < 0,05 indicates statistical significance

Structural Model Analysis Using Smart PLS

To evaluate how components of Social Cognitive Theory influence knowledge gains, structural equation modeling via Smart PLS was conducted. Figure 1 illustrates the path relationships between the key variables: attention, retention, reproduction, motivation, and knowledge improvement.

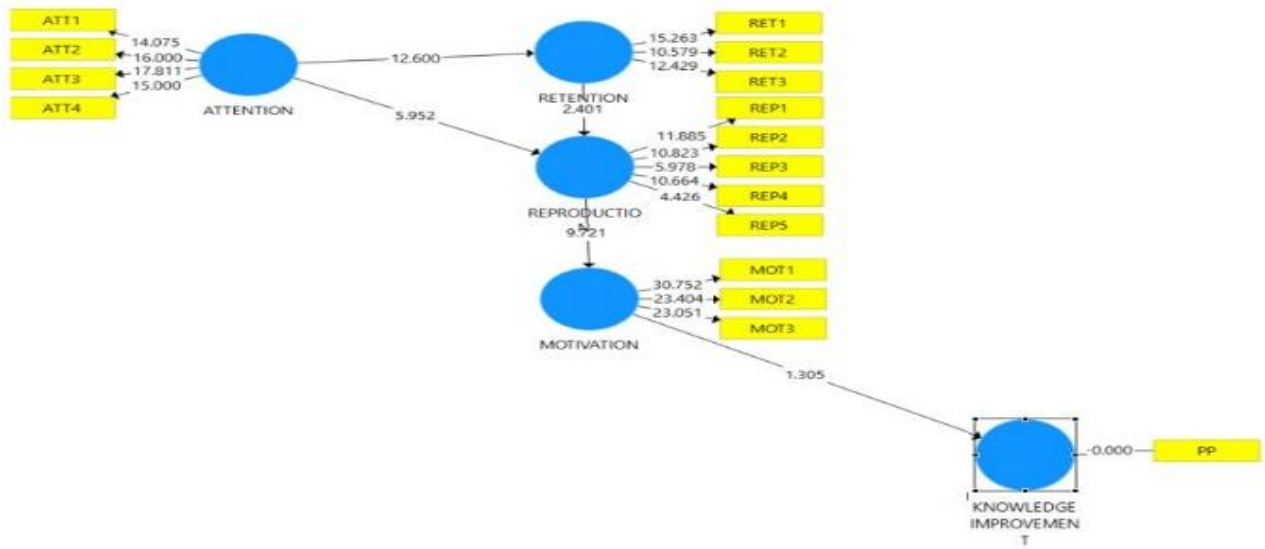

Figure 2. Path model illustrating the effectiveness of peer education on student knowledge based on Social Cognitive Theory using SmartPLS

The path analysis based on Social Cognitive Theory using SmartPLS revealed several key relationships that highlight the mechanisms through which peer education influences knowledge improvement. Notably, attention had a strong and direct effect on retention (β = 12,600) and also significantly influenced reproduction (β = 5,952), indicating that participants who were more attentive were better able to retain and reproduce educational

content. Furthermore, retention positively affected reproduction (β = 2,401), suggesting a sequential flow of learning processes, in which memory consolidation supports the ability to replicate learned behaviors. The influence of reproduction on motivation was also substantial (β = 9,721), emphasizing that practicing or simulating learned behaviors can enhance intrinsic motivation. Finally, motivation was positively associated with knowledge improvement (β = 1,305), underscoring its role as a proximal determinant of learning outcome. Collectively, these findings demonstrate that all core constructs of Social Cognitive Theory— attention, retention, reproduction, and motivation— contribute significantly to the enhancement of students' knowledge through peer education interventions.

Discussion

This study provides robust evidence supporting the effectiveness of peer education interventions grounded in Social Cognitive Theory (SCT) in enhancing adolescent girls' knowledge about anemia prevention. The significant increase in the average knowledge score—from 75,06 to 95,28%, represents a 26,9% improvement, underscoring the capacity of peer-led strategies to facilitate meaningful knowledge acquisition. This finding not only affirms the relevance of peer influence in adolescent health education, but also substantiates the SCT proposition that learning is enhanced through social modeling, reinforcement, and active engagement (Bandura, 2001).

The moderate yet statistically significant correlation between pre- and post-test scores (r = 0,494, p < 0,001) indicated that baseline knowledge partially predicted post-intervention outcomes. However, the magnitude of knowledge gain, especially among students with lower initial scores, suggests that the peer-led approach effectively bridges the knowledge gap. This finding reinforces the view that peer similarity and social proximity enhance message receptivity and cognitive engagement among adolescents (Merten et al., 2022; Turner & Shepherd, 2015).

Structural model analysis revealed attention as a foundational construct influencing both retention and reproduction, consistent with Schunk & DiBenedetto's (2020) assertion that attentional engagement is a prerequisite for effective learning. Furthermore, the pathway from retention to reproduction, and subsequently to increased motivation, illustrates the interdependent dynamics of the SCT constructs. As participants actively applied the information through discussions and role-play, they developed greater confidence and intrinsic motivation, which are key predictors of sustained behavioral change (Zimmerman & Schunk, 2011). These findings validate SCT's applicability of SCT to nutrition education contexts, wherein experiential learning and peer modeling can amplify knowledge internalization.

These findings align with a growing body of literature demonstrating the effectiveness of peer education in promoting health knowledge and behavior among adolescents. Studies by Dennis et al. (2019) and Abdulrahman et al. (2021) emphasize the critical role of peer influence in adolescent health behavior, particularly when interventions are tailored to be age-appropriate and culturally relevant. In a systematic review, Ghaffari et al. (2023) reported that peer-led health education significantly improves nutrition-related knowledge and attitudes in school settings.

Moreover, the specific application of SCT constructs in this study advances the theoretical rigor of peer education research, an area previously criticized for lacking conceptual clarity (Glanz et al., 2015). By empirically validating the mediating roles of attention, retention, reproduction, and motivation, this study not only supports the existing evidence but also extends it by offering a theoretically grounded explanation of *how* and *why* peer education works in adolescent health contexts.

From a practical standpoint, this study underscores the viability of peer education as a scalable and cost-effective approach for adolescent nutrition promotion, particularly in resource-limited settings. Schools offer a structured environment in which peer influence is naturally embedded, making them an ideal platform for SCT-informed interventions. This approach promotes student empowerment, enhances communication competencies, and fosters a culture of collaborative learning, all of which are aligned with the Health Promoting Schools framework (WHO, 2021).

Theoretically, this study enriches the application of SCT in health education by operationalizing its constructs and validating their interrelationships in the context of anemia

prevention. This highlights the central role of social learning processes, particularly attention and reproduction, in facilitating health-related knowledge gains. This study contributes to the evolving literature on SCT by demonstrating its utility beyond behavioral change, extending into cognitive and motivational outcomes in health education.

Despite these strengths, several limitations should be acknowledged. First, it employed a quasi-experimental design without random assignment, which limits causal inference. Future studies should incorporate randomized controlled trials to strengthen their internal validity. Second, the research was conducted in a single junior high school, potentially limiting the generalizability of the findings to broader populations in varying cultural, socioeconomic, and educational contexts. Third, this study focuses exclusively on short-term knowledge gains. While knowledge acquisition is a critical precursor to behavioral change, the absence of behavioral outcome measures constrains our understanding of the intervention's long-term impact.Additionally, the structural model did not account for external moderating variables such as parental influence, dietary environment, or access to health services, factors shown to be significant in adolescent nutrition behavior (Sunguya et al., 2022). These omissions may have limited the comprehensiveness of the theoretical model.

Building on these findings, future research should prioritize longitudinal designs to assess the sustainability of knowledge retention and its translation into behavioral outcomes, such as dietary changes and anemia prevalence reduction. Expanding the structural model to include contextual variables, such as family support, media exposure, and school health policy, could provide a more holistic understanding of peer education's efficacy.

Furthermore, integrating digital tools such as mobile apps or gamified modules into peer education frameworks can enhance engagement and scalability (Pérez-Rodrigo et al., 2020). Such innovations may also offer personalized feedback and continuous reinforcement, aligning with the SCT's emphasis on self-regulation and motivation.

Conclusion

This study demonstrates that peer education grounded in Social Cognitive Theory (SCT) is an effective strategy for enhancing adolescent girls' knowledge of anemia prevention. The findings provide empirical support for the role of peer-led interventions in fostering meaningful learning through attention, retention, reproduction, and motivation, which are key constructs of SCT. By engaging students in relatable and interactive learning experiences, peer education promotes not only knowledge acquisition, but also confidence and motivation for sustained behavioral change.

The findings highlight the practical significance of incorporating peer education models grounded in theoretical frameworks into school-based nutrition and health promotion initiatives, especially within settings characterized by limited resources. Given its scalability and cost-effectiveness, this approach holds promise for broader public health efforts targeting anemia and other adolescent health issues. Future research should explore the long-term impact of such interventions on behavior change and health outcomes as well as the potential role of external factors and digital enhancements in strengthening peer education models.

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