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Effectiveness of the anemia rematri m-health application on knowledge and attitudes toward anemia among adolescent girls: a quasi-experimental study

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ABSTRACT

Adolescent girls are particularly vulnerable to anemia due to inadequate iron intake, increased physiological demands, and menstrual blood loss. Limited knowledge and unfavorable attitudes toward anemia prevention further exacerbate this problem. Mobile health (m-Health) interventions offer a promising approach to delivering health education tailored to adolescents. This study aimed to evaluate the effectiveness of the Anemia Rematri m-Health application in improving knowledge and attitudes regarding anemia among adolescent girls. A quasi-experimental study with a pretest–posttest control group design was conducted among 108 adolescent girls enrolled in private vocational secondary schools in Palangka Raya, Central Kalimantan, Indonesia. Participants were allocated to either an intervention group (n = 54), which received education through the Anemia Rematri application, or a control group (n = 54), which received educational booklets. Knowledge and attitudes toward anemia were assessed before and after the intervention. The findings revealed significant differences between the intervention and control groups in both knowledge ($p < 0.001$) and attitudes ($p < 0.001$). The mean increase in knowledge scores was higher in the intervention group (68.67) than in the control group (40.37). Likewise, the intervention group demonstrated a greater improvement in attitude scores (67.35) compared with the control group (41.65). These findings suggest that the Anemia Rematri m-Health application may contribute to improvements in anemia-related knowledge and attitudes among adolescent girls. The application has the potential to become an innovative strategy for strengthening anemia prevention efforts, particularly through integration into the School Health Program (*Usaha Kesehatan Sekolah* [UKS]), school-based health promotion initiatives, and digital iron supplementation programs.

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1. INTRODUCTION

Adolescence is a transitional period between childhood and adulthood, spanning the ages of 10–19 years. It represents a unique and critical stage of development that plays an essential role in establishing the foundation for optimal health. During this period, adolescents undergo rapid physical, cognitive, and psychosocial development [1]. Nutritional deficiencies during adolescence can lead to various health problems, one of which is anemia, with adolescent girls being particularly vulnerable to this condition [2]. Among adolescents, girls are at a higher risk of developing anemia due to menstrual blood loss, which is

often compounded by inadequate dietary iron intake [3]. Global analyses involving more than 180 countries have consistently shown that the prevalence of anemia is higher among adolescent girls than among adolescent boys, with relatively slow progress in reducing its burden over the past decade [4], [5]. In 2019, the global prevalence of anemia was estimated at 29.9%, affecting 36.5% of women of reproductive age and 29.6% of adolescents. Among women aged 15 years and older, the prevalence of anemia was reported to be 42.1% in Myanmar, which was considerably higher than that in Singapore (13.0%). Comparable prevalence rates were observed in other countries, including Brunei Darussalam (16.7%), Vietnam (20.6%), Thailand (24.0%), Malaysia (32.0%), and China (15.5%) [6].

Data from the 2018 Indonesian Basic Health Research (*Riset Kesehatan Dasar*) indicated that the prevalence of anemia among individuals aged 15–24 years was 32%, with a prevalence of 27.2% among adolescent girls. According to the 2023 Indonesian Health Survey/*Survei Kesehatan Indonesia* (SKI), the prevalence of anemia among adolescents aged 15–24 years decreased to 15.5%, while the prevalence among adolescent girls was reported at 18.0%. Although these figures represent a decline compared with those reported five years earlier, the prevalence of 15.5% remains a significant public health concern. According to the World Health Organization (WHO), an anemia prevalence of 15.5% in a population is classified as a moderate public health problem [7]. Anemia in adolescents is defined as a condition in which the concentration of hemoglobin (Hb) in the blood falls below the normal threshold of 12 g/dL [8]. Common symptoms of anemia include fatigue, lethargy, weakness, and reduced alertness, often accompanied by headaches, dizziness, blurred vision, excessive sleepiness, rapid exhaustion, and difficulty concentrating. Clinically, anemia is characterized by pallor of the face, eyelids, lips, skin, nails, and palms [9]. Anemia adversely affects not only adolescents' physical growth and development but also their ability to achieve their full potential. It has been associated with poorer educational attainment, reduced work productivity, and impaired cognitive performance. Previous studies have demonstrated that anemia negatively affects cognitive function, mental health, school attendance, academic achievement, and overall performance among adolescents [10]. If left untreated during adolescence, anemia may increase the risk of anemia during pregnancy later in life. Maternal anemia is associated with an elevated risk of mortality in cases of severe hemorrhage, low birth weight (LBW), congenital anomalies, and an increased likelihood of childhood stunting [11].

Longitudinal evidence suggests that anemia during adolescence increases the risk of anemia during pregnancy, which is subsequently associated with adverse maternal and neonatal outcomes, including low birth weight and the persistence of intergenerational nutritional problems [12]. Health education related to anemia among adolescent girls can help them address problems caused by anemia [13]. Health education is an effective method for improving adolescent health through increased knowledge and positive changes in attitudes [14]. Educational programs have been proven to play an important role in improving knowledge and attitudes regarding anemia prevention, particularly among adolescent girls. However, varying findings across studies emphasize the need for tailored and consistent educational strategies to effectively address anemia [15]. Advances in digital technology have transformed patterns of information access and dissemination, creating new dynamics within the contemporary digital landscape. In this context, digital media have become a widely utilized platform for adolescents to access and share health-related information. Studies have shown that adolescents tend to actively engage with and respond positively to digital educational programs specifically designed to target health-related behaviors [16].

The rapid advancement of digital technology has created new opportunities to strengthen health education among adolescents. Mobile health (m-Health) is a form of information and communication technology and a subcategory of e-health. This unique service is effective in delivering both standardized and personalized health information. Previous studies have shown that m-Health services have the potential to engage adolescent girls and improve their knowledge [17], [18]. Several studies have demonstrated that mobile application-based interventions (m-Health) can improve access to health information and support positive health behavior changes across various population groups [19]. In addition, a recent systematic review reported that m-Health interventions have the potential to enhance health literacy and promote adolescent engagement in managing their own health [20]. However, the effectiveness of m-Health interventions in improving health knowledge and attitudes among adolescents remains inconsistent, highlighting the need for further research using more robust intervention designs [21]. In the context of anemia prevention among adolescent girls, most studies have focused on health education delivered through conventional methods, while the use of interactive m-Health applications as a medium for health education remains limited [22]. Nevertheless, scientific evidence regarding the effectiveness of m-Health interventions among adolescents is still limited and has yielded mixed findings, particularly with respect to long-term health behavior changes [23].

On the other hand, research on anemia prevention among adolescent girls has predominantly focused on conventional health education interventions, while the use of digital applications as a medium for health education has received relatively limited attention, particularly in developing countries [3], [22].

Although previous studies have demonstrated the benefits of digital health interventions, evidence regarding the effectiveness of m-Health applications specifically designed for anemia education among adolescent girls in school settings in Indonesia remains limited. Furthermore, most existing studies continue to focus on conventional educational methods, whereas evaluations of interactive digital applications in the context of adolescent health are still relatively scarce. Evaluating the Anemia Rematri application is important to provide scientific evidence supporting the development of digital-based adolescent health promotion strategies and to strengthen anemia prevention efforts among adolescent girls. As an effort to overcome the limitations of conventional educational methods, the Anemia Rematri application was developed as an m-Health–based educational medium that enables adolescent girls to obtain information about anemia independently, continuously, attractively, interactively, and conveniently. Through these features, the application is expected to improve knowledge and foster more positive attitudes toward anemia prevention. Given the relatively short duration of the intervention in the present study, clinical outcomes such as hemoglobin levels could not be optimally evaluated, as they require a longer observation period. Therefore, this study focused on knowledge and attitudes as the primary outcomes, as both are important determinants that precede health behavior change. Improvements in knowledge and positive attitudes are expected to encourage better anemia prevention behaviors, such as consuming iron-rich foods and adhering to iron supplementation, which may ultimately contribute to improved anemia status in the long term. Therefore, this study aimed to analyze the effectiveness of the Anemia Rematri m-Health application on knowledge and attitudes toward anemia among adolescent girls.

2. METHOD

2.1. Study design

This study employed a quasi-experimental design using a pretest–posttest with control group approach to examine the effectiveness of the Anemia Rematri m-Health application in improving adolescent girls' knowledge and attitudes toward anemia. In this study, the intervention group received health education through the Anemia Rematri m-Health application, which contains educational materials on anemia among adolescent girls and can be accessed via Android smartphones. Prior to its implementation, the application had been developed through a research and development (R&D) process using the analysis, design, development, implementation, and evaluation (ADDIE) model, which concluded that the application was appropriate for use as a health education medium for adolescent girls. Meanwhile, the control group received health education using a booklet on anemia among adolescent girls. The application was designed as an m-Health–based educational medium for adolescent girls and includes a variety of educational materials on anemia, covering its definition, causes, signs and symptoms, consequences, prevention strategies, consumption of iron-rich foods, and the importance of iron supplementation. In addition to educational content, the application is equipped with several interactive features, including information on iron supplementation tablets, anemia screening, a body mass index (BMI) calculator, a myths-and-facts section on anemia, interactive quizzes, and a counseling corner service. These features were designed to enhance user engagement, encourage self-directed learning, facilitate access to health information, and enable adolescent girls to repeatedly access educational materials through their smartphones throughout the intervention period.

2.2. Participants

The participants in this study were adolescent girls aged 15–18 years. A non-probability sampling technique, namely purposive sampling, was employed to recruit participants who met the study criteria and were considered appropriate for the intervention objectives. However, the use of purposive sampling may introduce selection bias and limit the generalizability of the findings to a broader population of adolescent girls. To minimize this potential bias, predefined inclusion and exclusion criteria were applied, and homogeneity testing was conducted to ensure baseline comparability between the intervention and control groups prior to the intervention. The inclusion criteria were adolescent girls who had experienced menstruation, owned an Android smartphone, were willing to install the Anemia Rematri m-Health application, and agreed to participate in the study. The exclusion criterion was failure to complete all study procedures until the end of the research period. The study was conducted in two private vocational high schools in Palangka Raya City, Central Kalimantan Province, Indonesia. These schools were selected because they had not previously been targeted by the Adolescent-Friendly Health Services Program/*Pelayanan Kesehatan Peduli Remaja* (PKPR) or iron supplementation programs for adolescent girls provided by local primary healthcare centers. Therefore, the potential influence of previous health interventions on the study outcomes could be minimized. In addition, the schools had a sufficient number of adolescent girls and supported the implementation of an m-Health–based intervention. The sample size was determined using the statistical formula for testing the hypothesis of two independent proportions. Based on

the sample size calculation, a total of 108 participants who met the inclusion criteria were recruited, consisting of 54 participants in the intervention group and 54 participants in the control group.

2.3. Instruments

The instruments used in this study were a knowledge questionnaire and an attitude questionnaire related to anemia among adolescent girls. The knowledge questionnaire consisted of 15 items measured using a Guttman scale and demonstrated good reliability, with a Cronbach's alpha coefficient of 0.857. The attitude questionnaire consisted of 20 statements measured using a Likert scale and showed a Cronbach's alpha coefficient of 0.891. The reliability test results indicated that both instruments had very good internal consistency (Cronbach's alpha > 0.80), confirming that the questionnaires were reliable and appropriate for data collection in this study. Pretest data were collected directly from participants in September 2025. Following completion of the pretest questionnaire, participants in the intervention group were given access to install and use the Anemia Rematri m-Health application, while participants in the control group received a booklet containing educational materials on anemia among adolescent girls. Posttest data were collected in October 2025 to assess differences in mean knowledge scores and attitude scores between the intervention and control groups following the intervention.

2.4. Intervention

The intervention was conducted over a one-month period. Prior to the intervention, participants in both the intervention and control groups completed a pretest to assess their baseline knowledge and attitudes before receiving the intervention. Following the pretest, the intervention group received health education through the Anemia Rematri m-Health application, which could be accessed via Android smartphones, while the control group received health education through a printed booklet. During the one-month intervention period, participants in the intervention group were given access to install and use the Anemia Rematri m-Health application on their Android smartphones. Participants were able to independently access the educational materials and interactive features available within the application throughout the study period. Upon completion of the intervention, all participants completed a posttest to assess the effectiveness of the Anemia Rematri m-Health application in improving participants' knowledge and attitudes toward anemia.

2.5. Data analysis

Data were analyzed using both univariate and bivariate statistical methods. Univariate analysis was performed to describe the characteristics of the participants and the distribution of the study variables. Bivariate analysis was conducted to evaluate changes in knowledge and attitudes before and after the intervention within each group, as well as to compare score improvements between the intervention and control groups. The selection of statistical tests was based on the distribution of the data and the objectives of the analysis. Prior to conducting between-group comparisons, a homogeneity test was performed to ensure comparability between the intervention and control groups and to minimize potential bias.

2.6. Ethical considerations

This study received ethical approval from the Research Ethics Committee of Poltekkes Kemenkes Palangka Raya (No. 0199/VIII/KE.PE/2025). Prior to data collection, all participants were provided with a complete explanation of the study objectives, procedures, and potential benefits. Participation in this study was voluntary and respondents had the right to withdraw from the study at any time without any consequences. Written informed consent was obtained from all participants as well as from their parents or legal guardians.

3. RESULTS AND DISCUSSION

Table 1 shows that the mean age of respondents in the intervention group was 15.57 years, while in the control group it was 15.15 years. The mean mid-upper arm circumference (MUAC) was 25.71 cm in the intervention group and 25.48 cm in the control group. The mean body mass index (BMI) was 22.14 kg/m² in the intervention group and 21.79 kg/m² in the control group. In addition, the mean hemoglobin level was 13.69 g/dL in the intervention group and 12.35 g/dL in the control group.

Table 2 indicates that the mean knowledge score in the intervention group increased from 75.70 (pretest) to 88.30 (posttest), while in the control group it increased from 77.41 to 80.31. For the attitude variable, the mean score in the intervention group increased from 67.17 to 76.87, whereas in the control group it increased from 68.61 to 71.54.

Table 3 demonstrates statistically significant differences in knowledge before and after the intervention in both the intervention group ($p < 0.001$) and the control group ($p < 0.015$). Similarly,

significant differences were observed in attitude scores before and after the intervention in the intervention group ($p < 0.015$) and the control group ($p < 0.014$).

Table 4 shows that there were significant differences in the increase of knowledge ($p < 0.001$) and attitudes ($p < 0.001$) between the intervention and control groups. The mean increases in knowledge in the intervention group (68.67) was higher than in the control group (40.73). Likewise, the increase in attitude scores was greater in the intervention group (67.35) compared to the control group (41.65). These findings suggest that the Anemia Rematri m-Health application may improve knowledge and attitudes among adolescent girls.

Table 1. Characteristics of respondents

Group	Characteristics of respondents	Mean	Median	Min-Max	SD
Intervention	Age (years)	15.57	16.00	15.00-17.00	0.602
	Mid-upper arm circumference (MUAC) (cm)	25.71	25.00	20.00-33.00	3.791
	Body mass index (BMI) (kg/m²)	22.14	21.44	15.10-36.70	4.758
	Hemoglobin level (g/dL)	13.69	14.30	7.40-18.20	2.603
Control	Age (years)	15.15	15.00	14.00-16.00	0.711
	Mid-upper arm circumference (MUAC) (cm)	25.48	25.00	19.00-34.00	3.039
	Body mass index (BMI) (kg/m²)	21.97	20.95	14.90-33.00	4.190
	Hemoglobin level (g/dL)	12.35	12.60	7.10-18.40	2.541

Table 2. Descriptive statistics of knowledge and attitudes toward anemia among adolescent girls in the intervention and control groups

Variable	Group	Assessment	Mean	Median	Min-Max	SD
Knowledge	Intervention	Pretest	75.70	80	0-93	12.955
		Posttest	88.30	87	73-100	6.790
	Control	Pretest	77.41	80	60-87	7.011
		Posttest	80.31	80	67-93	7.255
Attitude	Intervention	Pretest	67.17	69.00	20-79	9.478
		Posttest	76.87	78.00	64-80	4.189
	Control	Pretest	68.61	68.50	52-80	6.491
		Posttest	71.54	73.50	52-80	6.944

Table 3. Differences in knowledge scores and attitude scores before and after the intervention in the intervention and control groups

Variable	Group	
	Intervention	Control
Knowledge		
Pretest mean ± SD	75.70 ± 12.955	77.41 ± 7.011
Posttest mean ± SD	88.30 ± 6.790	80.31 ± 7.255
p-value	0.001*	0.015*
Attitude		
Pretest mean ± SD	67.17 ± 9.478	68.61 ± 6.491
Posttest mean ± SD	76.87 ± 4.189	71.54 ± 6.944
p-value	0.015*	0.014**

*Uji Wilcoxon; **Uji Paired t-test

Table 4. Differences in the improvement of knowledge scores and attitude scores between the intervention and control groups

Variable	Mean rank	p-value
Knowledge		
Difference in knowledge scores (intervention group)	68.67	0.001*
Difference in knowledge scores (control group)	40.73	
Attitude		
Difference in attitude scores (intervention group)	67,35	0.001*
Difference in attitude scores (control group)	41,65	

*Mann Whitney

The findings of this study showed that adolescent girls who received education through the Anemia Rematri m-Health application experienced greater improvements in anemia-related knowledge and attitudes than those who received education through a booklet. The greater improvement in knowledge and attitudes observed in the intervention group suggests that digital technology may serve as an effective health education

strategy for reaching adolescent populations. These findings strengthen existing evidence that digital technology–based interventions have considerable potential to improve health literacy among adolescents, who are active users of digital devices. The use of the Anemia Rematri application may provide a more effective learning experience than conventional educational media such as booklets. The availability of interactive features, multimedia content, and easy access through smartphones enables participants to obtain health information more flexibly and repeatedly. This finding indicates that m-Health applications may represent a practical and innovative strategy for strengthening adolescent health education programs, particularly in efforts to prevent anemia in school settings.

The characteristics of digital applications, which enable health information to be delivered in a more interactive, engaging, and accessible manner through smartphones, may contribute to improved learning outcomes. m-Health interventions have been shown to enhance access to health information and promote user engagement in the health learning process [20]. Furthermore, digital technology enables health information to be delivered repeatedly and flexibly, allowing users to learn according to their individual needs and available time [24]. The greater improvement in knowledge observed among participants in the intervention group is consistent with previous studies demonstrating that m-Health interventions are effective in improving knowledge and attitudes among adolescents. Similar findings have been reported in studies showing that the WANTER m-Health application significantly improved knowledge, attitudes, and practices related to anemia prevention among adolescent girls [25]. Likewise, mobile application–based nutrition education interventions have been shown to improve knowledge about anemia and contribute to increased hemoglobin levels among adolescent girls [22]. These findings suggest that digital technology–based interventions have considerable potential to improve health literacy and support adolescent health outcomes. Other studies have also emphasized the importance of developing user-centered m-Health applications that consider the preferences of adolescents, caregivers, and healthcare providers. Applications that are easy to use, include engaging and motivating features, and can be integrated with healthcare services may enhance user engagement and encourage sustained use over time. Such approaches may serve as innovative strategies for digital health promotion that support positive health behavior changes and improve health outcomes among adolescents [26], [27]. These findings are further supported by previous research indicating that m-Health application–based learning has the potential to increase user engagement in health education compared with conventional educational methods. In addition, m-Health applications allow adolescent girls to access content tailored to their needs and preferences, making learning more flexible and user-friendly [28].

m-Health applications represent an important intersection between healthcare and technology [29]. As a subcategory of e-health, m-Health utilizes information and communication technologies to deliver both standardized and personalized health information. Previous studies have shown that m-Health services have the potential to engage adolescent girls and improve their health knowledge [17]. m-Health applications have emerged as key drivers of the transformation toward high-quality, patient-centered healthcare. These applications facilitate access to health services and support the delivery of healthcare information to users. Knowledge has been shown to positively influence attitudes toward m-Health applications and, consequently, their utilization [30]. In addition, m-Health applications have the potential to contribute to disease prevention through the dissemination of health messages, information storage, communication, and the promotion of healthy lifestyle changes among users [31]. m-Health applications can be utilized for a variety of purposes, including health information delivery, disease prevention, treatment support, and communication between healthcare professionals and users. Their use, particularly through smartphones, enables broader dissemination of health information and may enhance healthcare delivery by promoting greater interaction between target populations and healthcare providers. Evidence from a systematic review demonstrated that m-Health interventions are associated with improvements in patients' knowledge, attitudes, behaviors, and quality of life [32].

More broadly, the use of digital technology in health promotion has expanded considerably in recent years. Systematic reviews have demonstrated that e-health and m-Health interventions have positive effects on improving health-related knowledge, attitudes, and behaviors among adolescents. Digital interventions are considered advantageous because they can reach larger populations while providing more flexible and sustainable access to health information [21]. m-Health education has been shown to improve knowledge, attitudes, and practices (KAP) related to anemia among adolescent girls. Furthermore, such interventions have been associated with improvements in body mass index (BMI), mid-upper arm circumference (MUAC), and waist and hip circumference measurements. In addition, an increasing trend in hemoglobin levels has been reported. Therefore, the implementation of this strategy may contribute to improvements in KAP and help reduce the burden of anemia among adolescent girls in resource-limited settings [33]. Evidence from randomized controlled trials has further contributed to the growing body of knowledge supporting the use of mobile technology as a complementary strategy for strengthening health systems and achieving health-related goals for adolescent girls [34], [35]. As mobile applications continue to evolve, the integration of mobile

devices into healthcare services is expected to increase and contribute to improvements in the quality of health education. Consequently, the development of m-Health–based education should not only focus on delivering knowledge, information, and skills but also play a role in shaping new concepts and fostering innovation in the development of digital health applications [36].

The findings of this study are also consistent with global developments in the use of digital technology for health promotion. m-Health interventions are increasingly being utilized to improve health behaviors across various population groups, including adolescents. m-Health technologies are practical, scalable, and have considerable potential to engage adolescents and young adults, who generally exhibit high levels of technology use and mobile phone ownership worldwide. Furthermore, a wide range of m-Health interventions, from text messaging services to more sophisticated smartphone applications, have been shown to influence factors that enhance adolescent engagement throughout the continuum of healthcare services [37]. Similar findings from a systematic review suggest that m-Health represents a promising implementation strategy for addressing gaps in prevention and healthcare services for adolescents in low- and middle-income countries. The acceptability and feasibility of m-Health interventions among adolescents have generally been reported as high. However, evidence remains mixed because many studies have employed single-group designs without control groups, while relatively few randomized controlled trials have been conducted with adequate sample sizes [38]. In addition, some m-Health products are regulated as medical devices for specific clinical purposes, whereas others are intended to promote health and well-being in everyday life [39]. These findings are also consistent with the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030), which emphasizes that achieving optimal health outcomes requires integrated, multisectoral, and innovation-driven approaches. Information and communication technologies are recognized as key multisectoral enablers that support health systems and interventions across the life course. This highlights that digital technologies are not merely complementary tools but strategic components for expanding access to services, improving the quality of health interventions, and supporting data-driven decision-making in healthcare [40].

From a public health perspective, the findings of this study have important implications for anemia prevention among adolescent girls. Anemia remains a significant global public health problem, particularly in low- and middle-income countries, where iron deficiency during periods of rapid growth and menstrual blood loss contribute substantially to its burden [3]. Digital technology–based educational interventions may represent an important preventive strategy for reducing the burden of anemia among adolescents. This study contributes to the development of digital health education strategies, particularly in the context of anemia prevention among adolescent girls in school settings, and has the potential to be integrated into adolescent health programs in schools, such as the School Health Program (*Usaha Kesehatan Sekolah*/UKS) and iron supplementation programs, thereby supporting broader adolescent health promotion efforts. Furthermore, these initiatives may contribute to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 3 (good health and well-being), SDG 4 (quality education), and SDG 5 (gender equality), through improvements in health literacy and anemia prevention among adolescent girls. Nevertheless, several limitations should be considered when interpreting the findings of this study. The quasi-experimental design without subject randomization may have introduced selection bias and limited control over potential confounding factors, which could affect internal validity and the interpretation of causal relationships. In addition, the relatively short intervention period did not allow for the assessment of long-term effects on health behavior changes or clinical anemia outcomes. Furthermore, the study was conducted in only two private vocational high schools in Palangka Raya City, indicating the need for future studies involving more diverse populations and settings to strengthen the generalizability of the findings. Knowledge and attitudes were measured using self-reported questionnaires; therefore, the findings reflect participants' responses at the time of data collection. Another limitation is that the application was developed exclusively for the Android operating system and is not yet available for iOS devices, which may restrict its potential reach. Future studies are recommended to employ more rigorous experimental designs and longer intervention periods. In addition, the development of cross-platform applications is needed to reach broader populations and enhance the sustainability of digital health interventions.

4. CONCLUSION

The findings of this study indicate that the Anemia Rematri application was associated with greater improvements in anemia-related knowledge and attitudes among adolescent girls compared with conventional educational methods. These findings suggest that m-Health–based digital technology has the potential to serve as an innovative strategy for strengthening adolescent health promotion, particularly in efforts to prevent anemia in school settings. The findings of this study support the integration of the Anemia Rematri application into school-based adolescent health programs, including the School Health

Program/*Usaha Kesehatan Sekolah* (UKS) and iron supplementation programs. In addition, policymakers may consider incorporating digital health platforms into adolescent health promotion strategies, while educators and health program managers may utilize interactive applications as tools to enhance health literacy and adolescent engagement. Future research should involve broader populations, longer intervention periods, and evaluations of health behavior changes and clinical outcomes, including adherence to iron supplementation and changes in hemoglobin levels.

CONFLICT OF INTEREST STATEMENT

No conflicts of interest, either directly or indirectly, were identified in relation to the present article.

ETHICAL APPROVAL

This study has received ethical approval from the Research Ethics Committee of Poltekkes Kemenkes Palangka Raya, with approval number 0199/VIII/KE.PE/2025 dated July 15, 2025.

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