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The Effect of mHealth on Preventing Anemia in Adolescent Girls: A Literature Review

Sri Rahayu[1], Mohamed Saifulaman Mohamed Said[2], Tukimin Bin Sansuwito[3]

[1] Student Ph.D. In Health Science, Lincoln University College, Malaysia
[1] Faculty of Health Sciences, Nursing Science Study Program, Faletehan University, Indonesia
[2] Lecturer Ph.D. In Health Science, Lincoln University College, Malaysia
[3] Lecturer Ph.D. In Nursing and Public Health, Lincoln University College, Malaysia

Abstract

A significant number of teenage girls are at risk of developing anemia. When it comes to adolescent girls, there are still significant knowledge, attitudes, and practice gaps, as well as health education gaps, which can affect anemia. App-based health technology, such as mobile health (mHealth), is a promising tool that has the potential to overcome obstacles and give suitable health guidelines as part of efforts to promote, prevent, cure, and rehabilitate patient health. Objective: to assess the impact of MHealth interventions on the prevention of anemia in adolescent girls. Method: This research is a review of the existing literature. With the assistance of the publish or perish application, data sources were gathered in the form of publications published in national and international journals between the years 2019 and 2023. These articles were obtained from the PubMed database and Google Scholar. PICOS was used as the inclusion and exclusion criteria for the selection of articles, and the selection process was accordingly. This research was carried out in a manner that was compliant with the PRISMA recommendations. A total of 352 articles were collected from the search results. Next, an elimination process was performed based on predefined criteria based on PICOS requirements, resulting in a total of nine studies included in the review (n = 9). This was depicted in PRISMA. The study utilized various mHealth apps, including WANTER, TEENFIT, LADIES, She Smart, eHealth, Android-based apps, E-WoHealth, Aneminfo, and Android apps that use videos. The findings suggest that comprehensive implementation of health apps can effectively reduce the occurrence of anemia in adolescent girls. Conclusion: The utilization of mHealth applications in health technology has the potential to enhance

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knowledge, modify behavior and attitudes more effectively, and facilitate the implementation of anemia prevention measures to decrease and avert anemia.

Keywords: mHealth, Preventing Anemia, Adolescent Girls

Corresponding Author: Sri Rahayu
Email: sri.rahayu680513@gmail.com

1. Introduction

The medical illness known as anemia can manifest itself at any point in a person's life cycle; however, the most susceptible individuals are women of reproductive age, girls in their teenage years, and children who are still growing inside their bodies (Nation, 2021). Anemia is a condition that occurs when the blood does not have enough ability to deliver oxygen throughout the body. When it comes to adolescents, a typical hemoglobin level is 12 grams per deciliter. Numerous factors, including vitamin A, B12, folate, iron deficiency, chronic inflammation, parasite infections, and congenital disorders, can cause the disease known as anemia (Tardy *et al.*, 2020).

Anemia is a prevalent nutritional issue on a global scale, particularly in nations with lower and moderate incomes. Anemia poses a substantial public health threat, impacting a staggering 1.62 billion individuals worldwide. The prevalence of anemia in non-pregnant women is expected to be 30%, while in schoolchildren it is considered to be 25% (Vázquez *et al.*, 2019). Additionally, it is predicted that 35% of anemia cases are dispersed among low- and middle-income countries (LMICs) (Alem *et al.*, 2023). Anemia impacts 33% of women in the reproductive age group, with the highest occurrence observed in Asia and Africa. Anemia among teenagers in Indonesia is very prevalent, with a prevalence rate of 32%, according to (Kemenkes RI, 2018). Based on the data, it can be inferred that 40% of adolescents in Indonesia experience anemia, which poses a significant health concern (Sari *et al.*, 2022). This is particularly worrisome as adolescent girls are of reproductive age and are crucial for the nation's future, as they will shape the next generation.

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Because they are in the reproductive age range, adolescent girls are at a greater risk of developing anemia than adolescent boys. This is because adolescent girls have menstruation every month, which means that they require three times more iron than adolescent boys do (Zeleke *et al.*, 2020). Adolescents' poor eating habits make this worse. They frequently follow diets that result in a body that is unable to meet its daily nutritional needs because the amount of food it consumes does not correspond to what it needs. Inadequate sanitation, a lack of iron-containing dietary intake, and the consumption of contaminated water are also factors that contribute to the development of anemia. According to Jumiyati *et al* (2023) study findings, teenagers who do not consume enough nutrients may be more likely to develop anemia. These findings are in line with those of Sari *et al* (2022) research, which contends that young women's anemia is primarily due to a lack of nutrient intake.

Anemia has several negative effects, including but not limited to the following: fatigue, shortness of breath, immunity, difficulty concentrating, and decreased cognitive performance. If it persists into adulthood, it can also cause complications during pregnancy and birth, including bleeding during and after childbirth, giving birth to babies with low birth weight (LBW), premature birth, or stillbirth (Marshall *et al.*, 2022). Furthermore, according to UNICEF's 2020 report, children who are born to moms who are anemic have a greater likelihood of being stunted, wasting, or underweight. To combat the issue of anemia among adolescents, the government has implemented a program that provides iron supplements. Students who are in their junior and senior years of high school receive iron supplements once per week (UNICEF and WHO, 2020). The poor use of iron tablets among schoolgirls, on the other hand, is a factor that contributes to the perception that this campaign is failing. Knowing about anemia is one of the factors that can have an effect. As a result, there is a desire for development as a means of making an effort to lessen the prevalence of anemia in young women.

According to the World Health Organization (WHO), mobile health was developed to enhance public health and health services, including health education, health system

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management, support for health behavior modification, and disease management. The term "mHealth" refers to a tool that operates in the field of medicine and makes use of information and communication technology (Maaß *et al.*, 2022). One of the most forward-thinking advancements in the field of information and communication technology is mobile technology. Mobile health, also known as mHealth, is a significant component of electronic health, which is the provision of medical services via mobile phones. The general population can benefit from mHealth education, which is a promising technique for increasing their understanding of health issues. The objective of this research is to investigate the impact that mobile health has on the prevention of anemia in young women.

2. Research Method

The study collected data from articles published in national and international journals from 2019 and 2024. The PubMed database and Google Scholar, assisted by the publish or perish program, were used to search for these data sources. The articles are chosen based on the PICOS technique, and the criteria for inclusion and exclusion are listed in Table 1. The investigation was carried out using the reporting standards for systematic reviews and meta-analyses (PRISMA), as depicted in Figure 1.

Table 1. Inclusion and exclusion inside the PICOS Ekstraksi

Description	Inclusion	Exclusion
Population	Adolescent girls	Pregnant women
Intervention	MHealth, eHealth, and cellular applications that are based on Android	Booklet, leaflet, brochure
Comparison	Including	-
Outcomes	Minimize and avert anemia in adolescent females	Reduce and prevent anemia in pregnant women
Design Study	Primary research, individual case analyses, surveys of a specific population, comparisons of cases and controls, studies with limited control groups, pre- and post-intervention analyses, randomized controlled trials	editorials, perspectives, proceedings of symposiums, abstracts of conferences, commentary, meta-analyses, systematic reviews, literature reviews, and abstracts of conferences

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Language	English and Indonesian	Other than English or Indonesian
Period of time	Studies published from January 2019 to December 2023	< 2019

3. Results and Discussions

a. Result

Queries were executed on the Google Scholar and PubMed databases, resulting in the acquisition of a total of 352 articles. Subsequently, it eliminated duplicate articles (n = 82), articles excluded due to title and abstract (n = 72), articles excluded based on study design (n = 54), population (n = 129), inaccessible full text (n = 3), full text assessed for eligibility (n = 12), full text with unreported results (n = 3), and the number of studies included in the review (n = 9). The summary is depicted in Figure 1, which presents the Systematic Review and Meta-analysis (PRISMA).

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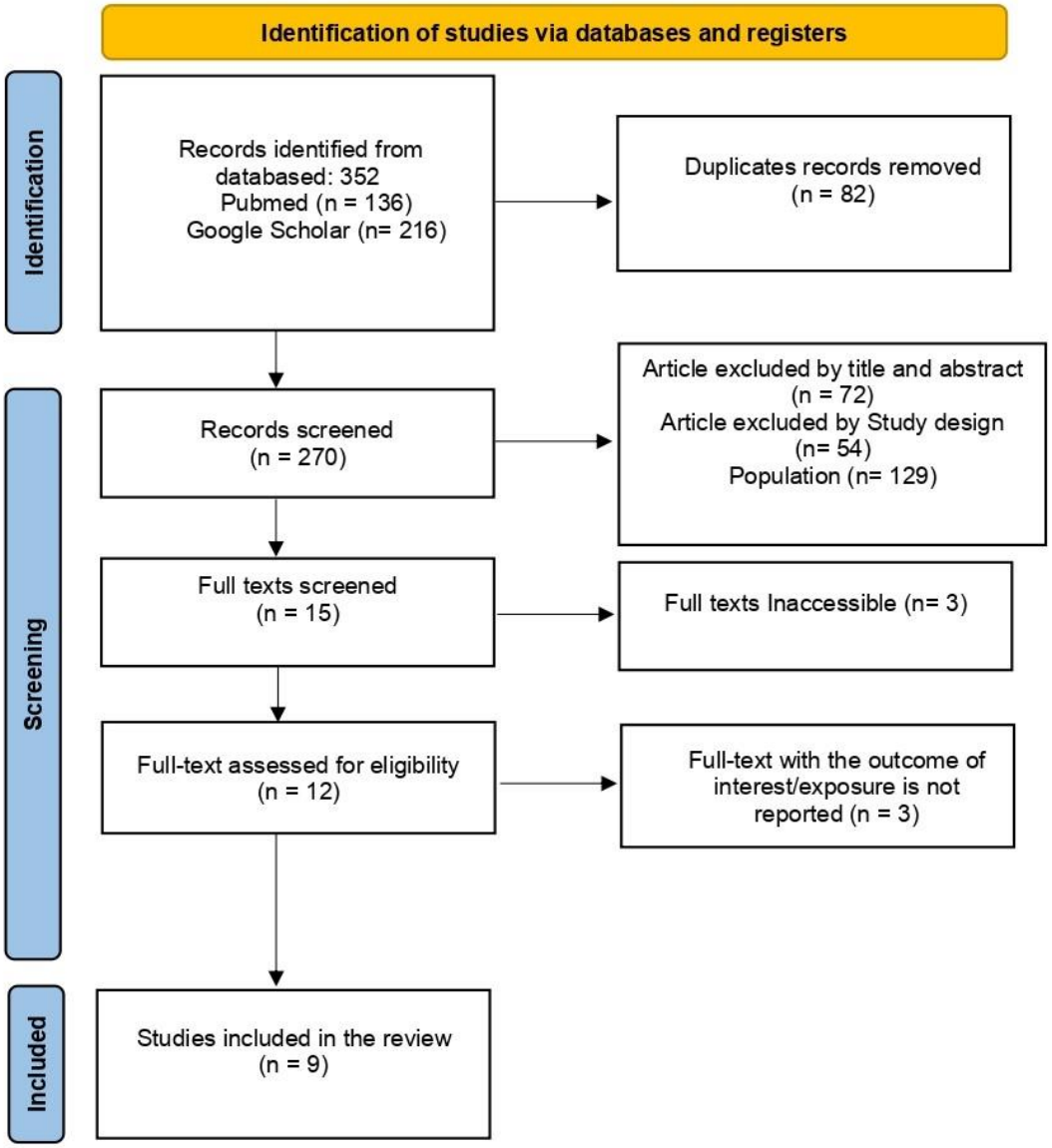

Figure 1. Results of a PRISMA (Haddaway *et al.*, 2022)**.**

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Table 2. Result of Article Analysis

Author	Purpose	Population	Intervention	Outcome	Study Design	Result
(Sari *et al.*, 2022)	The purpose of this study is to investigate the impact that health education delivered using a mobile application, namely the Wanter application, has on the enhancement of knowledge, attitudes, and practices around anemia, specifically among female students	162 adolescent girls	Wanter apps	Bringing down the percentage of teenage girls who suffer from anemia	Quasi-experiment	At the end of three months following the anemia prevention WANTER intervention, it was demonstrated that the adolescents' knowledge and attitude had significantly improved, with a p-value of less than 0.001.
(Tuti Rohani *et al.*, 2020)	The purpose of this study is to evaluate the effectiveness of the smartphone application "TEENFIT" in boosting adolescents' understanding of anemia.	95 adolescent girls	"TEENFIT" application.	Improving adolescents' knowledge about anemia	RCT	The treatment group that received the TEENFIT application had a mean value that was higher than the control group's post-test mean value, according to the post-test results.

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(Magfirah *et al.*, 2023)	The purpose of this study is to examine the impact that e-posters and the LADIES android-based application have on the knowledge, food consumption, and hemoglobin levels of adolescent girls.	49 adolescent girls	E-poster and LADIES app	Improve the degree of awareness that adolescent girls have regarding the consumption of nutrients and the levels of hemoglobin.	Quasi-experiment	It has been found that education using Android-based media (LADIES) is more effective than education through e-poster media in terms of boosting the knowledge, nutritional intake, and hemoglobin levels of teenage girls."
(Ernawati *et al.*, 2022)	The purpose of this study is to determine the impact that She Smart's web-based anemia education has on increasing teenagers' knowledge, attitudes, and practices around the condition.	47 Adolescent girls	She Smart	Enhancing one's understanding of, attitudes toward, and practices toward anemia	Quasi-experiment	Anemia education using web-based applications she smart can improve knowledge, attitudes, and practice before and after an intervention.
(Rahman *et al.*, 2023)	Assess the influence of ehealth education and modifications on the knowledge, attitudes, and behaviors of adolescent girls concerning anemia.	138 adolescent girls	Ehealth	Reducing anemia among adolescent girls.	RCT	Research findings indicate that ehealth education is efficacious in enhancing Knowledge and promoting modifications in health behavior.

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(Handayani, Winarso and Wahyu Ningtyias, 2021)	To evaluate the efficacy of employing an android-based application as a monitoring mechanism for ensuring compliance with Fe tablet intake.	123 adolescent girls	Android-based applications	Reducing anemia among adolescent girls.	Quasi-experiment	The use of an android-based application has been found to significantly improve the compliance of adolescent females in taking Fe tablets, as indicated by a P value of 0.000, which is less than the threshold of 0.05.
(Ishak *et al.*, 2023)	Conducting a study to examine the impact of e-health on the knowledge, attitudes, and behaviors related to anemia in adolescent females.	55 adolescent girls	Education Woman Health (E-Wohealth)	Reduce anemia rates in adolescent girls	Research and Development (R&D)	The p-value of 0.000 <0.05 indicates a substantial increase in the knowledge, attitudes, and behavior of adolescent girls after being educated via E-wohealth. This suggests that there are notable differences in these aspects before and after the education.
(Saraswati, Kartini and Agushybana, 2020)	To assess the impact of the "Aneminfo" educational medium, which is android-	37 adolescent girls	Aneminfo apps	Prevent anemia from occurring early.	Quasi-experiment	The intervention group exhibited a substantial improvement in knowledge

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	based, on the knowledge and attitude of adolescent females towards iron deficiency anemia.					(p=0.001) and attitude (p=0.011) compared to the control group.
(Turnip and Arisman, 2022)	Examining the impact of utilizing movies via android applications as educational media for anemia on enhancing knowledge and attitudes around anemia in adolescent girls.	80 adolescent girls	Video via android app	Reducing the rate of anemia in adolescent girls	Quasi-experiment	The utilization of video through android applications has a positive effect on enhancing knowledge and attitudes around anemia in adolescent girls.

Type of Study

Out of the nine papers analyzed, two were randomized controlled trials (Rahman *et al.*, 2023), (Tuti Rohani *et al.*, 2020), six quasi-experimental research (Sari *et al.*, 2022), (Turnip and Arisman, 2022), (Saraswati, Kartini and Agushybana, 2020), (Handayani, Winarso and Wahyu Ningtyias, 2021), (Ernawati *et al.*, 2022), (Magfirah *et al.*, 2023), and one study using a Research and Development study design (R&D) (Ishak *et al.*, 2023),

Intervention

In the study Sari *et al* (2022) using the WANTER app, study Tuti Rohani *et al* (2020) "TEENFIT" application, e-poster and LADIES app (Magfirah *et al.*, 2023), She Smart (Ernawati *et al.*, 2022), eHealth (Rahman *et al.*, 2023), android-based applications (Handayani, Winarso and Wahyu Ningtyias, 2021), Education Woman Health (E-WoHealth) (Ishak *et al.*, 2023), Aneminfo app (Saraswati, Kartini and Agushybana, 2020), video through an android app (Turnip and Arisman, 2022).

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Population, Sample and Type of Results Obtained

Research study Sari et al (2022) A study was carried out on 162 adolescent females, and the findings revealed a substantial increase in the knowledge and attitudes of the adolescents after a three-month WANTER intervention for anemia prevention, with a p-value of less than 0.001. In a study undertaken by Tuti Rohani et al (2020) research was carried out on a sample of 95 adolescent girls, yielding certain findings. A notable disparity was observed in the post-test results between the experimental group and the control group ($p<0.001$). The mean score of the post-test in the treatment group using the TEENFIT application is greater than the mean score of the post-test in the control group. Magfirah et al (2023) did a study involving 49 teenage females. The study found that education via Android-based media (LADIES) was more effective than e-poster media in improving the knowledge, nutritional intake, and hemoglobin levels of adolescent girls.

The study conducted by Ernawati et al (2022) involved 47 adolescents and found that educating them about anemia through a web-based platform called "She Smart" resulted in improved knowledge, attitudes, and practices both before and after the intervention. Rahman et al (2023) on 138 anemic adolescent females, with the findings of the study demonstrating that eHealth education helps raise knowledge and bring about changes in health behavior. Handayani, Winarso and Wahyu Ningtyias (2021) conducted a study including 123 teenage girls. The results of the study indicate that utilizing an Android-based application helps improve the adherence of adolescent girls to taking Fe tablets. The statistical analysis showed a P value of 0.000, which is less than the significance level of 0.05. Ishak et al (2023) conducted a study on 55 adolescent girls and found that their knowledge, attitudes, and behavior significantly improved after being educated using E-WoHealth. The statistical analysis showed a p-value of 0.000 <0.05, indicating that there were significant differences in the knowledge, attitudes, and behavior of the girls before and after the education. (Saraswati, Kartini and Agushybana, 2020) The intervention group of 37 adolescent females demonstrated a noteworthy improvement in knowledge ($p = 0.001$) and a considerable enhancement in attitudes ($p = 0.011$) compared

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to the control group. Turnip and Arisman (2022) A study was conducted with 80 adolescent girls to examine the impact of using video content via Android applications on enhancing knowledge and attitudes toward anemia in adolescent females.

b. Discussion

Health-focused technology holds significant promise for disseminating health information to the general public. In a recent study by Sari *et al* (2022) the researchers examined the impact of health education delivered through a mobile application called WANTER on enhancing knowledge, attitudes, and practices related to anemia among female students. Sari *et al* (2022) indicated that most teenagers in the intervention group resided with their families. Furthermore, the intervention group was provided with additional information regarding anemia from WANTER. Adolescents who live with their parents may be inclined to gather knowledge on anemia by utilizing social media, technological media, and their surroundings. Conversely, residing in a dormitory can restrict one's ability to use social media and necessitate dependence on knowledge obtained from their immediate surroundings, such as peers and educators. Consequently, it is anticipated that teachers will proactively distribute information regarding anemia and its prevention.

To improve adolescents' understanding of anemia Tuti Rohani *et al* (2020) looked into the efficacy of the smartphone application "TEENFIT." The research suggests that promoting individual-based health through adolescent health applications can enhance adolescent engagement in preventing anemia through the consumption of iron supplements. Teen health apps serve as a means to enhance awareness, attitudes, and behaviors to avoid anemia in adolescents through the use of iron supplements. Furthermore, teenage health applications also serve as a means to avoid anemia (Melzner et al., 2014; Payne dkk., 2015). Enhancing the knowledge, attitudes, and behaviors related to adherence to taking iron supplements through mobile apps will have a positive impact on adolescent health, therefore empowering individuals.

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The study conducted by Magfirah et al (2023) compared the impact of e-posters and LADIES android-based applications on the knowledge, food intake, and hemoglobin levels of adolescent girls. The research found that Android-based educational media, in contrast to electronic posters, offers several advantages, such as being readily accessible to adolescents at any time and location through the application. This accessibility facilitates the acquisition of accurate information about anemia for adolescents. The existence of Android-based educational media (LADIES) can influence the knowledge level of adolescents, leading to alterations in their behavior regarding food consumption and hemoglobin levels. This suggests that the application could be utilized as a potential preventive measure against anemia in adolescent girls.

According to the findings of a study conducted by Ernawati et al (2022) titled "The Effect of Smart Web-Based Anemia Education to Improve Knowledge, Attitudes, and Practices in Adolescent Girls," it has been determined that visual and audio-visual media based on Android applications play a role in the dissemination of knowledge when it comes to the prevention of anemia. According to the findings of a prior study, individuals who acquired their education through the use of audio-visual media had a higher rate of success compared to those who did not. Acquiring new information is one of the initial steps in the process of altering one's behavior. Knowledge is crucial because it influences a person's awareness of how to act. It is possible to affect the behavior of adolescents by educating them about anemia and helping them better comprehend the condition. Studies that were carried out in Ghana, Ethiopia, and India found that the majority of teenagers are unaware of iron deficiency anemia, its causes, effects, and preventative techniques. This lack of knowledge contributes to the high prevalence of anemia among adolescent girls.

Rahman *et al* (2023) proposed that an effective strategy to lessen the burden of anemia in school-going adolescent girls be the implementation of this health education through counseling and phone calls with SMS at the national level. This would raise their awareness and better prepare them to become healthy moms in the future. Participant motivation and awareness were both raised as a result of the mobile phone health education

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program, which aimed to prevent and reverse anemia. Handayani, Winarso and Wahyu Ningtyias (2021) mentioned that teenage girls can use this Android-based program to learn new things and to remind them to take their Fe tablets at the right time. Because this application has offered information elements concerning the definition of anemia, indications and symptoms, causes of anemia, and measures to prevent anemia, this application, which is based on Android, can also be used as a monitoring media that can be done by anybody, including health providers, teachers, and families, to observe whether or not adolescent girls are following the prescribed course of action regarding the consumption of iron pills.

According Ishak et al (2023) nutrition education programs have the potential to increase people's knowledge, attitudes, and health practices around anemia in teenagers. As a result of the fact that a lack of information and a history of not taking iron supplements might increase the risk of anemia, this factor needs to be taken into consideration when establishing strategies to minimize the prevalence of anemia in teenage girls, such as Education Woman Health (E-WoHealth). Android applications can serve as an alternative form of media that may be utilized for health education to reduce and prevent anemia. According to Saraswati, Kartini and Agushybana (2020) research.

Turnip and Arisman (2022) asserted that delivering anemia education through video media via Android applications yields superior results compared to anemia education conducted through traditional lectures. This is because video media is inherently more captivating, and the assimilation of knowledge through videos is more comprehensible compared to traditional lectures. Video media, as a medium, can elicit thoughts, emotions, focus, and receptiveness in the intended audience, thus promoting the acquisition of knowledge. This aligns with Sadiman (2012), theory that videos can stimulate both visual and auditory senses, incorporating psychomotor, behavioristic, and cognitive principles. By engaging the ears and eyes, respondents can effectively receive information, maximizing the impact of the conveyed message.

4. Conclusion

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The implementation of mobile application-based health technology, known as mHealth, has demonstrated its efficacy in preventing and decreasing the occurrence of anemia in adolescent females. Through the analysis of different types of applications, it was discovered that health technology applications, such as mHealth, can enhance knowledge, modify behavior and attitudes more effectively, and facilitate anemia prevention practices. This, in turn, leads to a decrease in the occurrence of anemia among adolescent girls, thereby improving their overall health. This has the potential to enhance health services through promotive, preventative, curative, and rehabilitative endeavors.

5. Compliance with Ethical Standards

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Conflict of Interest

This study does not contain any potential conflicts of interest.

Statement of Informed Consent

Every action we as authors undertake is a result of a mutual agreement or permission.

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