e-ISSN : 2597-6052

MPPKI MEDIA PUBLIKASI PROMOSI KESEHATAN INDONESIA

Review Articles Open Access

Digital Media Interventions for Anemia Prevention Among Adolescent Girls: A Scoping Review

Annisa Aulia Fitri[1]*, Mohammad Zen Rahfiludin[2], Farid Agushybana[3]
[1]Faculty of Public Health, Diponegoro University, Semarang, Central Java, Indonesia
[2]Faculty of Public Health, Diponegoro University, Semarang, Central Java, Indonesia
[3]Faculty of Public Health, Diponegoro University, Semarang, Central Java, Indonesia

***Corresponding Author: E-mail:** annisaauliafitri200101@gmail.com

ARTICLE INFO

Manuscript Received: 25 Aug, 2025
Revised: 23 Oct, 2025
Accepted: 31 Oct, 2025
Date of Publication: 03 Dec, 2025
Volume: 8
Issue: 12
DOI: 10.56338/mppki.v8i12.8449

KEYWORDS

Anemia;
Scoping Review;
Social Media;
Digital Health;
mHealth

ABSTRACT

Introduction: Anemia among adolescent girls remains a global health concern, with prevalence reaching 30.7% among women aged 15–49 years in 2023. Education is essential in shaping behaviors toward anemia prevention. The rapid expansion of digital platforms provides new opportunities to deliver engaging and accessible health education. This review aimed to map available evidence on digital media interventions designed to improve anemia-related behaviors among adolescent girls.

Methods: This review followed PRISMA guidelines. Eligible studies were interventional in design (quasi-experimental or pre–post), evaluated digital media interventions (e.g., videos, animations, social media, mobile applications, websites, or e-leaflets), targeted adolescent girls aged 12–22 years, and reported at least one behavioral outcome related to anemia. Studies published between 2014 and 2024 in English or Indonesian full text were included. Exclusion criteria comprised studies published before 2014, non-original research, studies not specific to anemia or adolescent girls, interventions not involving digital media, inaccessible paid articles, and ineligible designs. Searches were conducted in Scopus, ScienceDirect, and PubMed, and completed on 24 December 2024. Screening and extraction were managed using Mendeley and followed the PRISMA stages. Data were extracted on study characteristics, intervention details, comparator groups (where available), outcomes, and findings.

Results: Nine studies fulfilled the criteria. Most reported significant improvements in knowledge, while some also showed gains in attitudes and practices. The most frequently used interventions included animated videos, mobile applications, and social media platforms, with interactive and visually engaging formats yielding stronger effects.

Conclusion: Digital media interventions have demonstrated effectiveness in improving anemia-related behaviors among adolescent girls, with consistent effects observed in knowledge. Integration of these approaches into adolescent health programs is recommended. However, further rigorous research comparing different digital modalities is needed to guide implementation in diverse settings.

Publisher: Fakultas Kesehatan Masyarakat Universitas Muhammadiyah Palu

INTRODUCTION

Anaemia, as defined by the World Health Organization (WHO), is a condition characterized by reduced haemoglobin concentration below 12 g/dL for non-pregnant women and 11 g/dL for pregnant women, which impairs the blood's ability to carry oxygen efficiently. A population prevalence exceeding 40% is considered a severe public health problem (1). According to the latest WHO estimates, the global prevalence of anaemia among women aged 15–49 years in 2023 was 30.7%, showing a modest decline compared to five years earlier but still representing a major health burden (2). Consistently, the Global Burden of Disease Study 2021 reported that anaemia affected 1.92 billion people worldwide and accounted for more than 52 million years lived with disability, with the highest burden among young children and women in sub-Saharan Africa and South Asia (3).

One of the steps that can be taken is to provide comprehensive health education or counseling on anemia, so that the public can understand what anemia is, how to prevent it, and the importance of consuming Iron Tablet as one form of prevention. The WHO recommended efforts to prevent anemia among women of reproductive age and adolescent girls, emphasizing a promotive and preventive approach, particularly through the fortification of foods rich in iron and folic acid, as well as the provision of supplements in the form of Iron Tablet (4).

Anemia in adolescent girls often does not present with immediate visible symptoms, yet it has the potential to negatively impact their future quality of life. Over the long term, anemia during adolescence can increase the risk of developing anemia in pregnancy, which is associated with complications such as low birth weight, preterm delivery, and a higher risk of maternal mortality. Furthermore, adolescent anemia may hinder optimal growth and development, weaken the immune system, increase susceptibility to infections, and heighten vulnerability to toxic exposures (5,6).

Various steps and policies have been implemented by the Indonesian government to prevent anemia. The Indonesian government has taken preventive measures against anemia among adolescent girls through the "Nutrition Action Program for Improving the Health Status of Students in Schools (7). This program has several main intervention activities that must be implemented in schools, including health and nutrition education (8). Education can be delivered through various methods or techniques. However, conventional educational methods are often ineffective in reaching and maintaining the attention of adolescents who are already highly accustomed to digital media (9). In Indonesia, the increasing digital literacy and frequent use of online platforms among adolescents highlight the potential of digital-based health education to improve preventive behavior, including anemia awareness (10). Based on a previous study (11), digital technology has a significant impact on the behavior, both positively and negatively of the younger generation.

Digital media is a means of communication that utilizes digital technology to convey information, messages, and content to the public, covering various platforms such as the internet, social media, software applications, and other digital platforms. In the modern era, digital media plays a crucial role because it allows quick and easy access to various information from diverse sources. Traditionally, media consisted of print, television, and radio, but with technological advances, digital media has become an integral part of everyday life. Digital media not only provides access to news and information, but also provides a space for active public participation in discussions, exchange of ideas, and even social campaigns. Digital media is becoming increasingly important in today's social, cultural, and political contexts (12).

Previous studies have identified the influence of media use on anemia prevention behavior. However, few studies have specifically explored how digital media shapes adolescent girls' preventive health behavior concerning anemia. This study aims to examine scientific articles and explore the influence of digital media use on anemia prevention behavior in adolescent girls in Indonesia and propose contextually relevant interventions.

METHOD

This scoping review was conducted in accordance with PRISMA-ScR. The eligibility criteria included interventional studies, such as quasi-experimental or pre–post designs, that evaluated digital media interventions (e.g., videos or animated videos, mobile applications, social media, websites, or e-leaflets) targeting adolescent girls aged approximately 10–19 years and reporting at least one behavioral outcome related to anemia (knowledge, attitudes or practices). Studies had to be available in full text in English or Indonesian. Studies were excluded if they were published before 2014, were not original research (for example, reviews, editorials, letters, conference abstracts

without full data, or theses), did not specifically focus on anemia, did not target adolescent girls, did not use digital media interventions, were inaccessible due to paywall, or used an ineligible study design.

Records were searched in Scopus, ScienceDirect, and PubMed using Boolean logic, with examples of search strings as follows: Scopus (teenage* OR adolescent* OR girl AND media OR "digital media" AND anemia), ScienceDirect (teenage AND anemia AND media), and PubMed (teenage OR adolescent OR girl AND "digital media" AND anemia.

We limited the time window to ten years up to the search date (24 Dec 2024). Platform facets returned slightly different year ranges for the same query (Scopus 2014 to 2025, ScienceDirect 2015 to 2025, PubMed 2014 to 2024). We standardized to a ten year window up to 24 Dec 2024 by excluding 2025 records at screening and ensuring 2014 coverage via Scopus and PubMed. References dated 2025 are background sources and did not contribute to the selection or synthesis of included studies.

Table 1. Search Strategy

		Search Terms	Articles Obtained
Scopus	Keyword:	a. Teenage* OR adolescent* OR girl b. Media OR "media digital" c. anemia	1002
	Filter:	Year 2014 - 2025	459
PubMed	Keyword:	teenage OR adolescent OR girl; AND "Digital Media" OR media AND Anemia	18
	Filter:	Year 2014-2024	13
ScienceDirect	Keyword:	Teenage AND media AND Anemia	1363
	Filter:	Year 2015-2025	415
		Total Articles	**459+13+415 = 887**

All records were managed in Mendeley, where duplicates were removed within and across databases. Screening was then performed against the eligibility criteria through the four PRISMA stages: identification, screening, eligibility, and inclusion. We restricted to journal articles and exported all results from each database before de duplication. Across databases we identified 887 records. After removing 18 duplicates, 869 records were screened. 74 full texts were assessed. 65 were excluded with reasons. 9 studies were included.

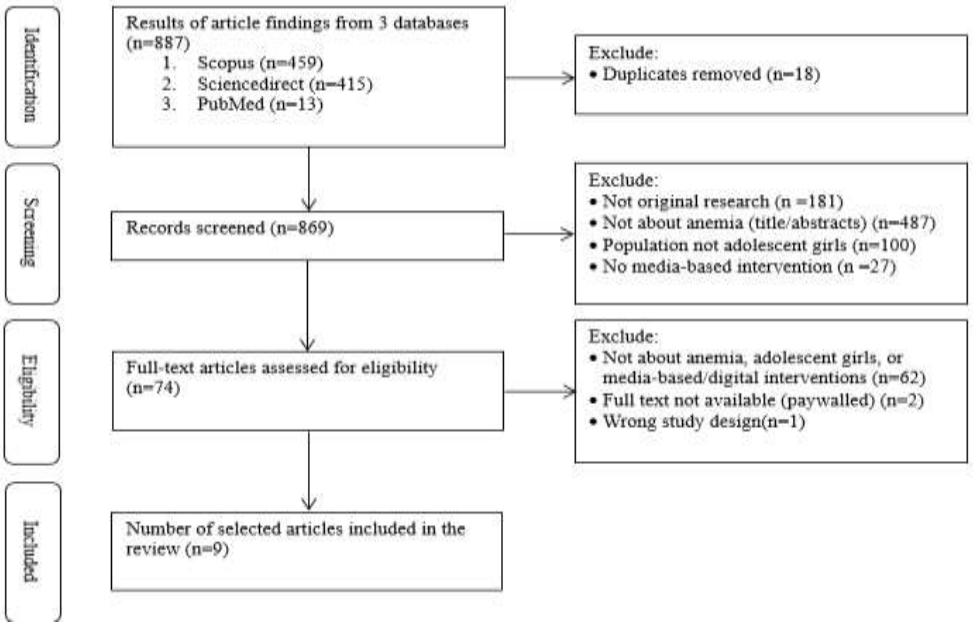

Figure 1. PRISMA-ScR Flow Chart

Data extraction was conducted for each included study, recording the author and year, country and setting, study design, sample size and age, type and duration of the intervention, presence or absence of a comparator group, outcome measures, and main findings. When summarizing intervention media, we counted only the digital component as the primary delivery medium, while non-digital elements such as leaflets, demonstrations, or packaging changes were recorded as comparators or adjuncts and were not counted in media totals. This scoping review intentionally restricted inclusion to quasi-experimental/pre–post designs to map real-world digital health interventions in school settings.

Although formal critical appraisal is not mandatory in scoping reviews, a descriptive quality appraisal was conducted to provide contextual understanding of the methodological robustness of included studies. Each study was reviewed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Quasi-Experimental Studies (13). The appraisal focused on clarity of cause–effect relationships, baseline comparability, measurement reliability, and appropriateness of statistical analysis. Item-level results were summarized narratively to ensure methodological transparency.

Ethical approval was not required as this study involved secondary analysis of published literature. The review process adhered to the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) guidelines to ensure methodological rigor and transparency.This scoping review was preregistered on the Open Science Framework (OSF: available at https://osf.io/dsnkq/), and the registration is publicly available.

RESULTS

Over 2014 to 2024, across Scopus, ScienceDirect, and PubMed we identified 887 records. After removing 18 duplicates, 869 records were screened (title and abstract). 74 full texts were assessed, 65 were excluded with reasons, and 9 studies were included. The included studies evaluated digital or media based interventions for anemia prevention among adolescent girls. The most recent study was published in 2024 and the earliest in 2021. All studies used pretest and posttest quasi-experimental designs, and all included studies (9/9; 100%) showed significant improvements in knowledge outcomes, with reported p-values ranging from $p = 0.000$ to $p = 0.017$. In addition, five studies (5/9; 55.6%) demonstrated significant changes in attitude ($p < 0.001$), two studies (2/9; 22.2%) reported improvements in dietary intake or hemoglobin ($p < 0.01$), and one study (1/9; 11.1%) showed significant enhancement in eating habits ($p = 0.002$). Of the nine included studies, the majority were conducted in Indonesia and none originated from other regions.

We classified each study by its primary delivery medium to avoid double-counting. Four studies primarily used video-based content (three used animated videos); two used mobile applications (WANTER and LADIES); and three delivered content via social media (TikTok, Instagram/WhatsApp), for a total of nine studies. Two studies also combined the primary digital medium with non-digital elements, such as demonstrations and improved iron-tablet packaging. Animated Videos and QuizWhizzer can both improve knowledge, as shown in previous quasi-experimental studies involving 20 participants per arm (14,15) which also states that animated educational videos can significantly improve the knowledge of the intervention group. Across video-based interventions, all reported significant increases in knowledge scores ($p = 0.000–0.017$), while some also found improvements in attitudes and intention ($p = 0.001$). Video, website, and e-leaflet are significantly improved students' knowledge, among the three, the educational video was identified as the most effective medium in enhancing students' knowledge. Previous studies (16,17) also demonstrated that video intervention produced a p-value of 0.001 (<0.05), indicating a significant difference in the knowledge, attitudes, and intentions of female students in the intervention group between the pre-test and post-test.

M-health WANTER application demonstrated a significant association between knowledge and attitudes before and after the intervention. It was found that WANTER improved knowledge and attitudes after three months in both the intervention and control groups. Nevertheless, no improvement in practice was observed in either group. The reported p-values for these changes were below 0.001, confirming significant within-group differences, but no significant between-group effect. Furthermore, no significant differences were identified between the intervention and control groups, both prior to and following the intervention (18). The LADIES application can help enhance adolescent girls' knowledge about anemia and can be combined with the provision of iron tablets to young

women(19). This quasi-experimental study involved 40 participants (20 per arm) and was the only included study that assessed a biological outcome, namely hemoglobin level. It also observed increases in protein and iron intake ($p < 0.01$) and in hemoglobin levels after 12 weeks, although between-group differences in hemoglobin were not significant.

Significant differences in knowledge about anemia were found before and after the educational intervention using TikTok video media (20). Health education interventions employing PowerPoint, videos, and WhatsApp on anemia prevention significantly improved knowledge and attitudes among female adolescents. Using a significance level of $p = 0.05$, differences were identified between the WhatsApp and Instagram groups in terms of knowledge, attitudes, and eating habits. These results suggest that Instagram serves as a more effective medium than WhatsApp for improving adolescents' knowledge, attitudes, and eating behaviors (21,22).

Overall, the nine included studies demonstrated a low to moderate risk of bias. Studies with clearer designs and objective outcomes, such as those measuring hemoglobin levels, were rated as low risk. Meanwhile, studies relying on self-reported outcomes, small sample sizes, or limited blinding were rated as moderate risk. Despite these limitations, all studies consistently supported the effectiveness of digital media interventions in improving anemia-related knowledge and other outcomes such as attitudes, dietary intake, eating habits, and hemoglobin levels, with most reporting statistically significant results ($p < 0.05$).

Table 2. Summary of Relevant Articles on the Use of Digital Media Interventions for Preventing Anemia among Adolescent Girls

No	Author, Year, Title	Research Design	Age range & Sample Size	Media and Comparator/ Non-digital elements	Outcome Measurement (what, instrument or unit, timepoints)	Effect Summary	Key Findings
1	El-Mahmudiyah et al. (2024). The Effect of Providing Educational Media on Anemia and Nutrition on the Prevention of Anemia in Young Women in Bekasi City (14).	Pre-experimental pretest posttest	Age: 12 to 22 years; N: 60 total; 20 per arm	Animated video; QuizWhizzer (game) Comparator: Leaflet	Knowledge of anemia and prevention, 25-item questionnaire, pre test and 30 minutes post test	Knowledge improved in all arms after the session; leaflet p=0.000, animated video p=0.017, QuizWhizzer p=0.012.	The delivery of educational information about anemia and nutrition through animated video media and QuizzWhizzer has been proven to enhance the knowledge of adolescent girls in Bekasi City.
2	Sari et al., (2022). The Effect of Mobile Health (m-Health) Education Based on the WANTER Application on Knowledge, Attitude, and Practice (KAP)	A quasi-experimental study with a pretest–posttest design	Age: 15 to 18 years; N: 277 total; 162 app; 115 booklet	WANTER Application Comparator: Booklet	Knowledge, Attitude, Practice using adapted KAP items from FAO guidance for adolescent nutrition education, pre	Knowledge and attitude increased over three months in both groups (p<0.001); practice did not improve; no	The study results indicate a significant increase in knowledge and attitudes among adolescents three months

No	Author, Year, Title	Research Design	Age range & Sample Size	Media and Comparator/ Non-digital elements	Outcome Measurement (what, instrument or unit, timepoints)	Effect Summary	Key Findings
	Regarding Anemia among Female Students in a Rural Area of Indonesia (18).				test and 3 months post test	significant between-group differences.	after the WANTER Application intervention in preventing anemia.
3	Alfiah et al. (2024). Pengembangan Media Edukasi Anemia & Pangan Halal Sumber Zat Besi Berbasis Video, Website, & E-Leaflet (16).	Quasi-experimental study.	Age: not reported (vocational high school); N: 75 total; 25 per arm	Video, Website, and e-Leaflet Comparator: -	Knowledge, multiple choice questionnaire, pretest and posttest on the same day; media effectiveness compared across video, website, and e-leaflet	All three media improved knowledge on the same day; video showed the largest gain (about +23.7 points) Video (P = 0.000*) Website (P = 0.000*) e-Leaflet (P = 0.000*).	This study produced three educational media: video, website, and e-leaflet. All media significantly improved students' knowledge, as evidenced by increased knowledge scores. Among the three, the educational video was identified as the most effective medium in enhancing students' knowledge.
4	Aisah et al. (2022). Animated educational video using the Health Belief Model on the knowledge of anemia prevention among female adolescents: An intervention study (15).	A quasi-experimental method with a randomized pre-test and post-test control group design	Age: 14 to 19 years; N: 161 total; 78 intervention ; 83 control	Animated Educational Video (HBM) Comparator: delayed standard education (non-digital/unspecified)	Knowledge and Health Belief Model constructs, validated questionnaire, three timepoints: baseline, post one, and post two around four weeks	Animated-video group showed consistent gains in knowledge and HBM indicators across follow-ups; many tests p≈0.001; control changes were limited.	Animated educational videos can significantly improve the knowledge of the intervention group.

No	Author, Year, Title	Research Design	Age range & Sample Size	Media and Comparator/ Non-digital elements	Outcome Measurement (what, instrument or unit, timepoints)	Effect Summary	Key Findings
5	Magfirah et al. (2023). Effectiveness of Android-based Educational Media on Knowledge, Dietary Intake, and Hemoglobin Levels for the Prevention of Anemia in Adolescent Females (19).	Quasi-experimental method	Age: 16 to 17 years; N: 49 total; 25 app; 24 e-poster	Android-based educational media (LADIES) Application Comparator: e-poster via WhatsApp (digital)	Knowledge, 20-item questionnaire; Dietary intake, 24 hour recall for protein, iron, and vitamin C; Hemoglobin, EasyTouch GCHb in g per dL; baseline and 12 weeks	App outperformed e-poster for knowledge and protein/iron intake ($p<0.01$); hemoglobin did not differ between groups; within-group hemoglobin increased in both arms by 12 weeks.	Android-based educational media (LADIES) has proven to be more effective than e-posters in improving knowledge, protein and iron intake, and hemoglobin levels in adolescent females. The LADIES application can help enhance adolescent girls' knowledge about anemia and can be combined with the provision of iron tablets to young women.
6	Firdawiyanti and Kurniasari, (2023) Pengaruh Penggunaan Media Edukasi Video Tiktok dan Infografis Terhadap Pengetahuan Anemia pada Remaja Putri (20).	Pre-test and post-test with a control group design.	Age: 15 to 17 years (majority); N: 40 total; 20 per arm	TikTok Video Comparator: Infographic (digital)	Knowledge, online questionnaire, pre test and post test after TikTok or infographic exposure	Knowledge increased in both TikTok and infographic groups; $p=0.000$ in each arm.	The results of the study indicate a significant difference in knowledge about anemia before and after the educational intervention using TikTok video media.
7	Neherta and Nurdin (2021). Primary Prevention	Pre-test-Post-test Group	Age: 12 to 19 years; N: 397 total	messages through WhatsApp, and Video	Knowledge and Attitude, structured	Repeated-measures analysis	Interventions providing health

No	Author, Year, Title	Research Design	Age range & Sample Size	Media and Comparator/ Non-digital elements	Outcome Measurement (what, instrument or unit, timepoints)	Effect Summary	Key Findings
	of Neglect in Children through Health Education for Adolescent Girls in West Sumatra, Indonesia (21).	Design.		Non Digital Elements: Interactive lecture, discussion, demonstration	questionnaires, repeated measures at baseline and after each of three intervention sessions	showed significant improvement across cycles ($p \approx 0.00$); high-knowledge category rose from 11.1% to 76.7%.	education on anemia prevention significantly enhanced knowledge and attitudes among female adolescents.
8	Madestria (2021). Effect of education through video and packaging modifications of iron tablets on female adolescent behavior in the ironsupplementation intake in SMPN 2 and SMPN 1 Parigi (17) .	Quasi-experimental design with pretest–posttest control group design	Age: 12 to 15 years; N: 124 total; 62 per arm	Video Non Digital Elements: Packaging modification of iron tablets Comparator: video only	Knowledge, Attitude, and Intention toward iron tablet use, questionnaires at baseline and post intervention; between group comparison of video plus packaging modification versus video only	Both arms improved in knowledge, attitude, and intention; the video plus packaging-modification arm had larger gains; many tests $p=0.001$.	The video intervention significantly changed knowledge, attitudes, and intentions among the female students in the intervention group between the pretest and posttest.
9	Hernianti et al. (2023). Education using Instagram on knowledge, attitudes, and eating habits as prevention of anemia in adolescent girls in Makassar (22).	Pre-test post-test quasi-experimental design.	Age: 13-14 years; N: 60 total; 30 per arm	Instagram and WhatsApp Comparator: -	Knowledge, 20 items; Attitude, 20 items; Eating habits, food frequency questionnaire; measured at baseline, five weeks, and ten weeks; comparison of Instagram versus WhatsApp delivery	Instagram outperformed WhatsApp for knowledge and attitude ($p=0.000$) and For eating-habits improvement ($p=0.002$) at 5 and 10 weeks.	The findings indicate that Instagram is a more effective medium than WhatsApp for enhancing adolescents' knowledge, attitudes, and eating habits.

DISCUSSION

Overall, this scoping review found that digital media interventions, including videos, mobile applications, and social media platforms, were effective in improving anemia-related knowledge and attitudes among adolescent girls. The use of media, which was initially conventional, has now shifted toward digital platforms. Therefore, it is essential for the government to advance health promotion efforts through digital media, including the utilization of social media and application-based platforms accessed via gadgets and the internet. Short social media videos that combine information and entertainment have been proven effective in enhancing adolescents' knowledge. This study can serve as a recommendation for future research, with the expectation of facilitating faster, and better-targeted dissemination of health-related information (23). A video is a digital medium that shows a sequence of images, making them appear to move and often creating imaginative or fantastical effects(24). Animated videos and QuizWhizzer can both improve knowledge, with intervention groups generally demonstrating significant post-test gains compared to pre-test scores (14,15). Significant differences in knowledge about anemia were found before and after the educational intervention using TikTok video media (20). Based on the research findings, it can be concluded that health education delivered through videos is effective in improving adolescents' knowledge about anemia before and after the intervention (25).

Video, website, and e-leaflet interventions significantly improved students' knowledge; among these, educational video was the most effective medium (16). The e-leaflet, which can also be associated with a digital pocketbook, is considered not only effective (with or without additional explanation) but also informative in enhancing the knowledge and attitudes of adolescent girls toward anemia prevention (26). Another study confirmed that video intervention produced a p-value of 0.001 (<0.05), indicating a significant difference in the knowledge, attitudes, and intentions of female students in the intervention group between the pre-test and post-test (17).

Preventive interventions for anemia using animated videos have been proven to increase behavioral change in adolescent girls. A previous study (27) found that students scored significantly higher on all pre-retrospective questions after watching the video, and also evaluated the effects of the animated video, concluding that audiovisual materials are highly effective in learning and promoting concept formation. The quality of the video, clarity of audio, and logical flow of information are the most important factors in enhancing learning ability. A recent study (28) also stated that there is an influence of education on anemia prevention on the knowledge of adolescent girls using animated video media.

Mobile phones, which are almost always carried and frequently used, serve as an effective medium for health interventions. These can be delivered through applications or text messages, the latter being ideal due to the global ubiquity of mobile phones. Text messaging enables rapid and repeated communication of health information within daily routines, while mobile health (mHealth) more broadly improves access, comprehension, and services for hard-to-reach populations and provides new opportunities to study behavior across place, time, and context through continuous contextual data (29).

M-health WANTER application demonstrated a significant association between knowledge and attitudes before and after the intervention. It was found that WANTER improved knowledge and attitudes after three months in both the intervention and control groups. Nevertheless, no improvement in practice was observed in either group. Furthermore, no significant differences were identified between the intervention and control groups, both prior to and following the intervention (18). The LADIES application can help enhance adolescent girls' knowledge about anemia and can be combined with the provision of iron tablets to young women (19). These findings highlight that mobile applications can effectively deliver repeated, self-paced learning, particularly when integrated with behavior reinforcement features such as reminders or gamification. Nutrition education delivered through a digital game can positively influence adolescent girls' knowledge, attitudes, and practices related to iron deficiency anemia, and may also enhance their dietary intake of protein, fat, iron, vitamin C, and potassium (30).

Mobile applications are effective in delivering education on iron deficiency anemia, improving adolescents' knowledge and fostering early prevention. Evidence shows significant gains in knowledge and attitudes among adolescent girls after using an Android-based anemia prevention application (31,32).

Previous literature (33) defined social media as interactive online platforms that enable individuals and groups to share information, news, links, photos, and videos within a virtual network. Adolescents use social media to share experiences, opinions, and creativity (34). It has also been noted (33) that the barriers to using social media

are low because most platforms are freely available and can be accessed at any time of day from any internet-connected device. Social media interventions aimed at improving health behaviors have utilized forums, blogs, Facebook, Twitter, YouTube, and chat rooms, sometimes in combination with interactive games (33). These interventions are less costly to implement than face-to-face approaches and are not geographically limited, allowing them to reach individuals in rural areas as well as those with restricted mobility or limited transportation (33).

The characteristics of social media can shape the benefits that users gain, highlighting their potential as tools for intervention. In the Indonesian context, platforms such as TikTok, Facebook, Instagram, Snapchat, and Likee are widely used, with social media penetration reaching 59% of the total population of 272.1 million. This widespread adoption suggests that interventions delivered via these platforms could reach a substantial portion of the target population, potentially enhancing their effectiveness (35).

Health education interventions employing PowerPoint, videos, and WhatsApp on anemia prevention significantly improved knowledge and attitudes among female adolescents. Using a significance level of $p = 0.05$, differences were identified between the WhatsApp and Instagram groups in terms of knowledge, attitudes, and eating habits. These results suggest that Instagram serves as a more effective medium than WhatsApp for improving adolescents' knowledge, attitudes, and eating behaviors (21,22). A previous study (36) found that Instagram-based interventions improved adolescent girls' knowledge, attitudes, and behaviors regarding balanced nutrition, whereas WhatsApp interventions increased knowledge only. The effectiveness of Instagram was linked to its use of images and videos, direct messaging, and interactive features like GIFs, which enhanced engagement and information delivery.

Social media has brought about fundamental transformations in the lives of adolescents, marked by a shift in interaction patterns from face-to-face to digital interaction (37). Social media is a medium that is often used in health education and also plays an important role in preventing anemia by raising awareness, encouraging behavioral change, and promoting long-term compliance. Social media has now become the primary platform for adolescents to interact, express themselves, and build their social identity. Although not part of the systematic search, additional Indonesian studies (38,39) reported similar findings, with WhatsApp-based education improving knowledge only (38), while Instagram-based education improved both knowledge and attitudes (39).

Interpretation of Key Findings

Our findings reveal that anemia prevention interventions using digital media among adolescent girls in Indonesia have a consistent positive impact across various digital media interventions on behavior (knowledge, attitudes, and practices or actions). From animated videos, mobile health (m-health) applications, to websites, there is a significant correlation with improvements in at least one behavioral domain.

Specifically, media with high levels of interactivity and visual engagement, such as animated videos, mobile apps, and gamified quizzes, demonstrate strong and sustained effects on knowledge retention. These findings support the theoretical premise that multimodal and interactive content can increase user engagement and facilitate behavioral change through repeated exposure and active participation involving multiple senses such as sight and hearing.

Comparisons between studies indicate that while all types of digital media yield positive results, animated videos often emerge as the most effective medium in promoting behavioral improvement. This is likely due to their ability to convey complex messages in a more easily understandable and engaging manner, as well as their flexibility of use.

In addition, research conducted primarily in Indonesia highlights the importance of culturally and contextually relevant interventions, although this makes it somewhat difficult to apply the findings to a wider audience. Comparable evidence from other low- and middle-income countries, such as India and Bangladesh, has also demonstrated that mobile and video based education can effectively improve adolescents' nutritional knowledge and anemia prevention behaviors (40,41). Differences in how interventions are designed, how often materials are delivered, and how outcomes are measured also lead to variation in effect sizes, meaning that choosing the best type of media and delivery method will likely depend on the local context and characteristics of the target audience. In addition, research conducted primarily in Indonesia highlights the importance of culturally and contextually relevant interventions, although this makes it somewhat difficult to apply the findings to a wider audience.

Overall, the findings underscore the importance of employing engaging media in strategies to promote adolescent health and prevent anemia. At the same time, it also points to the need for more standardized protocols and multi-site evaluations to help strengthen the evidence base. The findings have strong relevance to Indonesian adolescent health policy, yet they may also inform similar initiatives in other low- and middle-income settings where digital media interventions are increasingly used to improve adolescent health outcomes. Comparable programs in countries such as India and the Philippines, supported by WHO's digital health initiatives, have likewise demonstrated the potential of technology-based education to enhance adolescent nutrition and behavior change (42,43).

Comparison with Previous Studies

The results of this study align with previous evidence showing that educational interventions can improve adherence to iron supplementation and hemoglobin levels among adolescent girls, both in individual intervention settings and at the synthesized level. An educational program implemented in remote areas improved iron-tablet adherence and self-efficacy, while a recent systematic review also confirmed that media-based anemia education effectively enhanced self-awareness and compliance behaviors across multiple studies (44). This finding is further supported by other research showing that animated videos were more effective than leaflets in improving adolescent girls' knowledge and attitudes toward anemia (45).Because the included studies are clustered in Indonesia, generalizability beyond this context is uncertain. However, evidence from other regions suggests that digital health education targeting adolescents can improve knowledge and related behaviors when platforms are tailored to local access and preferences (e.g., short-video or social-media delivery, mobile apps integrated with school programs). Differences in device ownership, data costs, school digital policies, and cultural norms may moderate effects; consequently, our findings are most transferable to settings with similar digital access and school environments.

Limitations and Cautions

This study has several limitations. First, all nine included studies were conducted in Indonesia, which constrains external validity and limits transferability to other settings. Second, there is a possibility of publication bias, as relevant full-text articles may not have been indexed in the databases searched, potentially leading to the exclusion of important studies. In addition to these review-specific limitations, the evidence base itself also presents certain gaps. The majority of interventions focused primarily on improving knowledge, with relatively less emphasis on changes in actual practice or behavior. Moreover, the scope of digital platforms examined was narrow, leaving unanswered questions regarding the effectiveness of newer or less commonly studied applications.

Recommendations for Future Research

Future research should not only compare the effectiveness of different types of digital media (e.g., animated videos, mobile applications, and social media platforms), but also evaluate and assess their impact on actual behavioral practices and biological outcomes such as hemoglobin levels. Longitudinal and randomized controlled trials are needed to establish causal relationships and assess long-term effectiveness. Expanding the scope of research to diverse cultural and geographical contexts would enhance external validity and global relevance. Standardized research protocols and outcome indicators should be developed to facilitate cross-study comparisons and meta-analyses. Finally, future studies should also explore how digital media interventions can be integrated into school-based health programs and national health systems to ensure sustainability and broader impact. These interventions have potential for integration into school health programs. However, their broader implementation may be influenced by cultural context, infrastructure readiness, and disparities in digital access.

CONCLUSION

This scoping review identified various digital media interventions such as animated videos, mobile applications, and social media that have been implemented to improve anemia prevention behaviors among adolescent girls. Overall, these interventions consistently demonstrated positive effects, with video-based approaches showing the strongest and most consistent improvements, particularly in knowledge outcomes. These findings add to the growing body of evidence on digital health education and align with behavioral frameworks such as the PRECEDE–PROCEED model, which emphasize the importance of predisposing and enabling factors in influencing

health-related behaviors. This theoretical alignment underscores the potential of interactive and multimedia tools to strengthen behavior change strategies.

Digital media, especially videos and animations, can therefore be adopted by health workers, educators, and adolescent health programs as engaging and effective educational tools to support anemia prevention. To ensure maximum effectiveness, interventions should be tailored to adolescents' cultural and contextual needs, ideally guided by a prior needs assessment.

Despite the valuable insights provided, this review is not without limitations, including the reliance on freely available full-text articles and the predominance of knowledge-focused outcomes. Future research should employ more rigorous study designs, such as randomized controlled trials and longitudinal approaches, and compare the effectiveness of different digital platforms while also evaluating behavioral and biological outcomes to build a stronger evidence base for digital interventions in adolescent health.

AUTHOR'S CONTRIBUTION STATEMENT

AAF developed the study concept, designed the methods, collected and analyzed the data, prepared figures and tables, and drafted the manuscript. MZR supervised the study and provided conceptual guidance. FA provided feedback and suggestions on the content and structure of the manuscript at various stages of development.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this manuscript. They have no financial or personal relationships, or affiliations with individuals or organizations, that could inappropriately influence (or be perceived to influence) the content of this article.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors declare that ChatGPT (OpenAI) was used to assist in grammar editing, translation, and idea refinement. Google Translate was occasionally used for quick translation checks. All outputs from these tools were reviewed and verified by the authors to ensure accuracy, integrity, and compliance with ethical publication standards.

SOURCE OF FUNDING STATEMENTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors. The study was conducted without external financial support.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to the Faculty of Public Health, Diponegoro University, for the support and guidance provided during the research and manuscript preparation.

BIBLIOGRAPHY

1. World Health Organization. Iron Deficiency Anaemia: Assessment, Prevention, and Control - A Guide for Programme Managers. Geneva; 2001.
2. World Health Organization. The Global Prevalence of Anaemia in 2023. Geneva; 2024.
3. GBD 2021 Anaemia Collaborators. Prevalence, years lived with disability , and trends in anaemia burden by severity and cause, 1990 – 2021 : findings from the Global Burden of Disease Study 2021. Lancet Haematol. 2023;3026(23). doi: 10.1016/S2352-3026(23)00160-6
4. Nabila PR, Samaria D, Rachmat SSM, Mauliya N, Zahra EA, Wulandari IP. Efektivitas Edukasi Anemia terhadap Tingkat Pengetahuan Siswi. J Abmas Negeri. 2024 Jun 30;5(1):86–95. doi: 10.36590/jagri.v5i1.740
5. Lubis DS, Adhi KT, Indraguna IGNP, Mahendra IGAA. Modul Pendidikan Kesehatan dan Pemenuhan Gizi Seimbang pada Remaja Putri. Bali: Panuduh Atma Waras; 2021.
6. Ningtyias F, Aryatika K, Mufidah L, Irmayanti S, Soleha S. Modul Edukasi Gizi Buku Saku Pencegahan Anemia pada Remaja Putri Strategi Cerdas Meode Tricky Card Games yang Menarik dan Edukatif dalam Mengatasi Darurat Anemia. 2022. 76 p.

7. Kemendikbud RI. Surat Edaran Gerakan Sekolah Sehat. Kemendikbud RI. Jakarta; 2024. Available from: https://drive.google.com/file/d/1TVkmxRQkKtyr5Rrjsl_FbvpB1veQBatR/view
8. Kemenkes. Petunjuk Teknis Penggerakan Aksi Bergizi di SMP/MTs/SMA/MA/SMK/MAK/Pesantren. Jakarta; 2023.
9. Nurcahyanti FD, Nurochim E, Rini SDW, Srimulti S, Setyadi AW. Efektivitas Media Digital Dalam Edukasi Pencegahan Anemia Pada Remaja Putri. JUKEJ J Kesehat Jompa. 2025 Jun 29;4(1):434–40. doi: 10.57218/jkj.Vol4.Iss1.1591
10. Winurini S. Anemia dan Kebiasaan Makan Remaja Putri di Indonesia. Analisis Strategi terhadap Isu Aktual Info Singkat. 2025;17(3):1–5.
11. Nauvan MZ, Zamzami R, Nafais M, Azmi Z, Afwan M. Dampak Teknologi Digital Terhadap Perilaku Sosial Generasi Muda. TECHSI - J Tek Inform. 2024;15(2):87–95. doi: 10.29103/techsi.v15i2.19443
12. Zuhri S, Fadil C. Peran Media Digital dalam Penegakan Hukum Dimasyarakat. Crossroad Res J. 2024;1(4):118–39. doi: 10.61402/crj.v1i4.182
13. Edoardo A, Lockwood C, Porrit K, Pilla B, Jordan Z. JBI Manual for Evidence Synthesis. Adelaide: Joanna Briggs Institute; 2024. Lockwood C, Porritt K, Pilla B, Jordan Z, editors. doi: 10.46658/jbimes-24-01
14. El-Mahmudiyah RNF, Kurniasari R. The Effect of Providing Educational Media on Anemia and Nutrition on the Prevention of Anemia in Young Women in Bekasi City. Media Gizi Indonesia. 2024;19(1):49–56. doi: 10.20473/mgi.v19i1.49-56
15. Aisah S, Ismail S, Margawati A. Animated educational video using health belief model on the knowledge of anemia prevention among female adolescents: An intervention study. Malaysian Fam Physician. 2022;17(3):97–104. doi:10.51866/oa.136
16. Alfiah E, Yusuf AM, Puspa AR. Development of Educational Video, Website, and E-Leaflet about Anemia and Halal Food Source of Iron. Media Publikasi Promosi Kesehatan Indonesia. 2024;7(1):177–84. doi: 10.56338/mppki.v7i1.4187
17. Madestria NPO, Moedjiono AI, Suriah, Tahir M, Masni, Suarayasa K, et al. Effect of education through video and packaging modifications of iron tablets on female adolescent behavior in the iron supplementation intake in SMPN 2 and SMPN 1 Parigi. Gac Sanit. 2021;35:S127–30. doi: 10.1016/j.gaceta.2021.10.011
18. Sari P, Herawati DMD, Dhamayanti M, Ma'ruf TLH, Hilmanto D. The Effect of Mobile Health (m-Health) Education Based on WANTER Application on Knowledge, Attitude, and Practice (KAP) Regarding Anemia among Female Students in a Rural Area of Indonesia. Healthc. 2022;10(10). doi: 10.3390/healthcare10101933
19. Magfirah AN, Citrakesumasari, Indriasari R, Syam A, Salmah AU, Taslim NA. Effectiveness of android-based educational media on knowledge, dietary intake and hemoglobin levels for prevention of anemia in adolescent females. J Public Heal Dev. 2023;21(2):212–22. doi: 10.55131/jphd/2023/210218
20. Firdawiyanti BS, Kurniasari R. The Effect of Using Tiktok Video Educational Media and Infographics on Anemia Knowledge in Young Women. Media Publikasi Promosi Kesehatan Indonesia. 2023;6(5):925–30. doi: 10.56338/mppki.v6i5.3166
21. Neherta M, Nurdin Y. Primary Prevention of Neglect in Children through Health Education for Adolescent Girls in West Sumatra, Indonesia. Open Access Maced J Med Sci. 2021;9(T4):359–63. doi: 10.3889/oamjms.2021.7556
22. Hernianti, Citrakesumasari, Jafar N, Indriasari R, Zulkifli A, Amqam H. Education using instagram on knowledge, attitudes and eating habits as prevention of anemia in adolescent girls in Makassar. J Public Heal Dev . 2023;21(2):82–90. doi: 10.55131/jphd/2023/210207
23. Marlinawati DA, Rahfiludin MZ, Mustofa SB. Effectiveness of Media-Based Health Education on Stunting Prevention in Adolescents : A Systematic Review. AgriHealth J Agri-food, Nutr Public Heal. 2024;4(2):102–11. doi: 10.20961/agrihealth.v4i2.71357
24. Berliana T, Aka KA. Media Pembelajaran Video Animasi pada Materi Bersatu Dalam Keberagaman. SEMDIKJAR (Seminar Nasional Pendidik dan Pembelajaran). 2023;581–6. doi: 10.29407/rnb28821

25. Maulina K, Yusni Y, Usman S, Saputra I, Zaman N. The Effect of Health Education on Improving Knowledge About Anemia Among Adolescent Girls in MTsN VI Pidie. Int J Public Health. 2023;6–11. doi: 10.62951/ijph.v2i2.453
26. Nuryana H, Rachmawati E, Khusun H, Mulyawati DA, Lestari H. The Effectiveness of Digital Pocketbook for the Transformation of the Knowledge and Attitude of Adolescent Girls about the Prevention of Anemia. Amerta Nutrition. 2025;9(1):161–8. doi: 10.20473/amnt.v9i1.2025.161-168
27. Dash S, Kamath U, Rao G, Prakash J, Mishra S. Audio-visual aid in teaching "fatty liver." Biochem Mol Biol Educ. 2016;44(3):241–5. doi: 10.1002/bmb.20935
28. Jihan Salsabila M. Pengaruh Edukasi Pencegahan Anemia Terhadap Pengetahuan Remaja Putri Menggunakan Media Video Animasi. J Kesehat Siliwangi. 2023;3(3):557–61. doi: 10.34011/jks.v3i3.1032 556
29. Spruijt-Metz D, Wen CKF, O'Reilly G, Li M, Lee S, Emken BA, et al. Innovations in the Use of Interactive Technology to Support Weight Management. Curr Obes Rep. 2015;4(4):510–9. doi: 10.1007/s13679-015-0183-6
30. Ghadam OS, Sohrabi Z, Mehrabi M, Fararouei M, Shahraki M, Hejazi N, et al. Evaluating the Effect of Digital Game-based Nutrition Education on Anemia Indicators in Adolescent Girls : A randomized clinical trial. Food Sci Nutr. 2023;(May 2022):863–71. doi: 10.1002/fsn3.3120
31. Saraswati RS, Kartini A, Agushybana F. Pengaruh Aplikasi Android Aneminfo terhadap Pengetahuan dan Sikap Remaja Putri terkait Anemia Defisiensi Besi. J Promosi Kesehatan Indonesia. 2020;15(2):65–9. doi: 10.14710/jpki.15.2.65-69
32. Muliana H, Hayati NF, Sidiq R, Novelasari N, Amos J, Doni AW. Perubahan Pengetahuan dan Sikap Remaja Putri terhadap Pencegahan Anemia melalui Media Aplikasi Berbasis Android di SMKN 9 Kota Padang. J Sehat Mandiri. 2023;18(2):48–59. doi: 10.33761/jsm.v18i2.1038
33. Unger JB, Reynolds KD, SpruijtMetz D. Chapter 40: Health Promotion Interventions and Research. In: MaxcyRosenauLast Public Health & Preventive Medicine. New York: McGraw-Hill; 2021.
34. Fitriyani YR, Iskandar R. Remaja, Media Sosial, dan Literasi Digital: Antara Ekspresi Diri dan Tanggung Jawab Digital. J Ilm Multidisiplin. 2025;2(5):595–601. doi: 10.62017/merdeka
35. Liah AN, Maulana FS, Aulia GN, Syahira S, Nurhaliza S, Abdul Rozak RW, et al. Pengaruh media sosial terhadap Degradasi Moral Generasi Z. Naut J Ilm Multidisiplin Indonesia. 2023;2(1):68–73. doi: 10.55904/nautical.v2i1.677
36. Rusdi FY, Rahmy HA, Helmizar. Pengaruh Edukasi Gizi Menggunakan Instagram Terhadap Perubahan Perilaku Gizi Seimbang Untuk Pencegahan Anemia Pada Remaja Putri di SMAN 2 Kota Padang. Fakultas Kesehatan Masyarakat Universitas Andalas Padang, 2020. 2020;10(November 2020):31–8. doi: 10.14710/jnc.v10i1.29271
37. Al Hidayah BCRS, Yaqinah SN, Hasbi UH. Penggunaan Media Sosial dan Perubahan Perilaku Sosial Remaja. J Humanit Katalisator Perubahan dan Inov Pendidik. 2025;11(1):57–70. doi: 10.29408/jhm.v11i1.29179
38. Ilham, Baiq NH, Salfarina AL, Romadonika F, Rusiana HP. Pengaruh Edukasi Melalui Media Whatsapp Terhadap Pengetahuan Dalam Pencegahan Anemia Remaja di SMAN 1 Kayangan. J Nurs Res Publ Media. 2022;1(2):89–96. doi: 10.55887/nrpm.v1i2.17
39. Hatijah H, Masithah S, Hasanah SU, Yusuf K, Wahyuni F. Pengaruh Edukasi Anemia dengan Media Instagram terhadap Pengetahuan dan Sikap Remaja Putri dalam Mencegah Anemia di SMPN 1 Turikale Maros. Ghidza J Gizi dan Kesehatan. 2024;8(1):87–92. doi: 10.22487/ghidza.v8i1.1159
40. Diamond-Smith N, Holton AE, Francis S, Bernard D. Addressing anemia among women in India-an informed intervention using Facebook Ad Manager. mHealth. 2020;6:39. doi: 10.21037/mhealth-19-237a
41. Rahman J, Rahman M, Habibur M, Sarker R, Matsuyama R. Impact of mobile health-based nutritional education on hemoglobin levels in anemic adolescent girls in rural Bangladesh : a randomized controlled trial. BMC Public Health. 2025; doi: 10.1186/s12889-025-23687-z
42. World Health Organization, United Nations Population Fund. Youth-centred Digital Health Interventions: A Framework for Action. Geneva; 2020.

43. World Health Organization. Global strategy on Digital Health 2020-2025. Geneva; 2021.
44. Septiana KS, Estiningtyas Q, Adnani S, Susiarno H. The Influence of Anemia Education Media on Increasing Self-Awareness and Compliance in Consuming Iron Supplements in Adolescent Girls: A Systematic Review. 2025;1411. doi: 10.2147/IJWH.S532950
45. Safitri ED, Aritonang I, Wirawan S, Sitasari A. Efektivitas Penggunaan Media Video Animasi tentang Anemia pada Remaja Putri. Ilmu Gizi Indonesia. 2024;07(02):183–92. doi:10.35842/ilgi.v7i2.443