REVIEW

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Mobile Health Interventions for Adolescent Smoking Prevention: A Scoping Review

La Ode Reskiaddin[1,2], Ismil Khairi Lubis[1,3], Denny Agustiningsih[4], Yayi Suryo Prabandari[5]*

Abstract

Background: Smoking behavior among adolescents is a significant global public health concern. Despite the implementation of numerous conventional interventions, their effectiveness remains variable, highlighting the need for more adaptive and individualized strategies. In this context, technological innovations via mobile health (mHealth) have emerged as a potentially effective approach for smoking prevention. However, evidence regarding their implementation, effectiveness, and impact specifically among adolescents remains scarce and fragmented. **Objective:** To identify the types, forms of implementation, and effects of mHealth interventions aimed at preventing smoking behavior among adolescents. **Methods:** A scoping review was conducted following the JBI and PRISMA-ScR guidelines. Articles were selected based on eligible criteria using the electronic databases PubMed, Scopus, Embase, Web of Science, and Cochrane Library. Eligible studies included experimental quantitative studies utilizing mHealth interventions targeting adolescents aged 13–18 years. Data processing was conducted using Rayyan.ai. The data were narratively analyzed and presented in tabular form. **Result:** The literature search identified 1,028 records, of which 16 studies met the eligibility criteria and were subsequently included in the analysis. The mHealth interventions identified included gamification-based apps, text messaging (SMS), and educational chatbots. Intervention platforms varied, ranging from smartphone applications to SMS-based programs. Most studies indicated that mHealth was effective in preventing smoking initiation, increasing risk perception, and reducing smoking intensity, although results varied by gender, age, and participants' social backgrounds. **Conclusion:** mHealth interventions show promise as innovative strategies for smoking prevention among adolescents. Integrating mHealth into school and community programs, as well as tailoring interventions to local social and cultural contexts, is key to enhancing program effectiveness and reach. Further research is needed to evaluate long-term impacts and effectiveness across diverse populations.

Keywords: adolescents- mHealth- smoking- scoping review

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Introduction

Smoking behavior remains a global public health challenge faced by many countries. Smoking habits are usually formed during adolescence, and most smokers have their first cigarette or become addicted by the age of 18 [1]. The initiation of smoking predominantly occurs during adolescence, and early onset is significantly associated with an increased likelihood of continued tobacco use in adulthood [2]. Globally, it is estimated that between 80,000 and 100,000 children are exposed to and initiate tobacco use each day [3]. Analysis of 498,981 school-going adolescents across 97 countries revealed that the prevalence of current smoking was 10.24%. Among current smokers, 15.59% were daily smokers, and of these daily smokers, 20.64% were classified as heavy smokers, indicating a substantial intensity of smoking behavior among adolescents [4].

Adolescents who start smoking at an earlier age are more likely to become lifelong smokers, consume more cigarettes, and have higher levels of nicotine dependence compared to their peers [5, 6]. Smoking is a behavior often associated with a range of health problems, including chronic obstructive pulmonary disease (COPD), interstitial lung disease, cancer, heart disease, stroke, respiratory infections, and pulmonary tuberculosis [7, 8]. Various smoking prevention programs for adolescents have been implemented, including school-based programs, the enforcement of smoke-free school policies, interventions involving teachers, parents and mass media interventions

*[1]Doctoral Program in Medicine and Health Science, Universitas Gadjah Mada, Yogyakarta, Indonesia. [2]Public Health Study Program, Universitas Jambi, Jambi, Indonesia. [3]Public Health Study Program, Universitas Sumatera Utara, Medan, Indonesia. [4]Department of Physiology, Universitas Gadjah Mada, Yogyakarta, Indonesia. [5]Department of Health Behavior, Environment, and Social Medicine, Universitas Gadjah Mada, Indonesia. *For Correspondence: yayisuryo@ugm.ac.id*

[9–11].

Various interventions to prevent smoking among adolescents have been developed through curriculum-based education and mass media campaigns, yet their effectiveness remains inconsistent. Several studies have reported reductions in smoking prevalence, initiation, and habitual use, alongside improvements in knowledge, attitudes, and intentions to quit smoking [12–14]. The school-based curricula generally demonstrated limited short-term impact, except for programs integrating social competence and social influence, which proved effective in preventing smoking initiation both in the short and long term [11]. Kristin et al. [10] noted that only a minority of mass media campaigns achieved significant reductions in smoking prevalence. Their effectiveness appears more likely when conducted for a minimum of three years, grounded in theoretical frameworks, supported by formative research, and disseminated repeatedly across multiple media channels.

The innovation of modern communication technologies, particularly through mobile health (mHealth) interventions, presents strategic opportunities for smoking prevention among adolescents. Mobile based platforms such as applications, text messaging, and social media enable the delivery of personalized and real time health messages that are embedded in adolescents' everyday lives [15, 16]. mHealth also integrates effective elements of traditional approaches, including social reinforcement, theory-based education, and sustained engagement, into an accessible digital system. MHealth can enhance user engagement, reinforce anti-smoking messages, and support positive behavioral change. Thus, combining curriculum based and mass media strategies with the innovative potential of mHealth offers the prospect of more adaptive, personalized, and sustainable interventions [17]. Zhou et al. [18] highlighted the need for future research to identify the most effective mHealth approaches and develop strategies to improve adoption and user intention. However, most prior studies have targeted general populations, often emphasizing serious games. This study seeks to comprehensively review diverse forms of mHealth interventions specifically aimed at adolescents.

This scoping review aims to describe and map the types of mHealth interventions used in previous studies for preventing smoking behavior among adolescents. The review also maps the implementation of mHealth, including the platforms used and message content, based on the type of prevention. In addition, the study maps the findings regarding the effects of mHealth in preventing smoking behavior.

Materials and Methods

Study Design

This review was conducted based on the methodological guidelines for scoping reviews recommended by the Joanna Briggs Institute (JBI) and reported in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) guidelines. This scoping review has been registered in the Open Science Framework https://doi.org/10.17605/OSF.IO/25AE6.

Eligibility Criteria

The studies must involve adolescents aged 13–18 years and the intervention must be mobile-based, including smartphone applications, short message service (SMS), video games, gamified digital health tools, or mobile based telemedicine designed to prevent smoking initiation or reduce smoking behavior among adolescents. The study design must be quantitative, primarily encompassing all types of experimental designs. Eligible studies must report primary outcomes such as smoking status, tobacco use, smoking initiation rate, and smoking prevalence. In addition, secondary outcomes may include behavioral aspects and biomarker measurements related to smoking. Only articles published in English were considered, with no restriction on location or country as long as the studies met the predefined inclusion criteria. Furthermore, only articles published up to March 2025 were included.

Exclusion Criteria

Excluded studies comprised non-experimental quantitative research, all qualitative studies, and grey literature, including theses, letters to the editor, conference abstracts, and other commentaries.

Search Strategy

The databases screened included Medline (PubMed), Scopus, Embase (Elsevier), Web of Science, and the Cochrane Library. Article searches were conducted using databases subscribed to by Universitas Gadjah Mada, accessed through ezproxy.ugm.ac.id. The keywords used were a combination of terms aligned with the framework applied in this scoping review, which adopted the Population, Intervention, Comparison, and Outcome (PICO) approach. Keywords used "adolescent" OR "adolescence" OR "youth" OR "teen" OR "teenager" AND "digital health" OR "digital health technologies" OR "mobile application" OR "mobile app" OR "portable electronic app" OR "portable electronic application" OR "portable software app" OR "portable software application" OR "smartphone apps" OR "mhealth" OR "mobile health" OR "video games" OR "video game" OR "text messaging" OR "text message" OR "texting" OR "short message service" OR "telehealth" OR "virtual healthcare" OR "video consultation" OR "telemedicine" OR "telehealth" OR "virtual healthcare" OR "video consultation" AND "smoking prevention" OR "anti-smoking campaign" OR anti-smoking education".

Selection process of article

A comprehensive search across five electronic databases yielded 1,028 records, which were imported into Rayyan.ai for duplicate removal and screening. The selection process proceeded in two stages: (1) title and abstract screening, and (2) full-text review. Initial screening was performed independently by the primary reviewer (L.R.) and a secondary reviewer (I.K.), with eligible studies subsequently assessed in full text according to the predefined inclusion criteria and research question.

Any discrepancies were resolved through discussion or, when necessary, by consultation with additional reviewers (Y.S. and D.A.).

Extracting and charting the results

The extracted data is compiled in Microsoft Excel and Google Sheets. The extraction focused on four main components: (1) Study characteristics, (2) Type of mHealth intervention implemented for smoking prevention, (3) Implementation details, such as the platform used and the content of the health messages, categorized according to the type of prevention approach, and (4) Impact of the mHealth intervention on smoking prevention behaviors among adolescents. The results were then narratively synthesized and presented in tabular form to map the distribution and key characteristics of the included studies.

Results

Based on data from 16 studies, mobile health (mHealth) interventions for smoking prevention among adolescents have been implemented across multiple countries, including Germany [19–21], Switzerland [22–24], Sweden [25, 26], Finland [27], Portugal, United States [28, 29], Brazil [30], Mexico [31] and China [32]. The studies included a range of sample sizes, from small scale studies with 144 participants [33] to large-scale trials involving 9,851 adolescents [19]. Most interventions were delivered in school-based settings, either integrated into the curriculum or provided as supplementary technology-based programs (Figure 1).

Types of mHealth in Adolescent Smoking Prevention

Various mobile health (mHealth) interventions have been developed to support smoking prevention among adolescents (Table 1). Gamification based applications such as Photoaging (Smokerface) [20, 30], Fume and What Happens if You Go Too Far? [27, 31, 33], chatbot-based interventions such as ready4life (22–24,26), text message intervention [25, 28, 29, 32]. Mobile application based interventions are generally free and globally accessible, offering broader reach compared to SMS and chatbot-based interventions, which are often restricted to specific research populations or institutions. Follow-up periods ranged from short-term assessments (1–2 weeks) to long term monitoring at 3, 6, 12, or 24 months, while intervention duration varied from brief 5 day text messaging programs to extended formats such as 16 week digital modules or 6 month interactive SMS interventions (Appendix 1).

The Impact of mHealth on Adolescent Behavior

Several studies have demonstrated that mobile health (mHealth) interventions contribute significantly to smoking prevention among adolescents. Brinker et al.

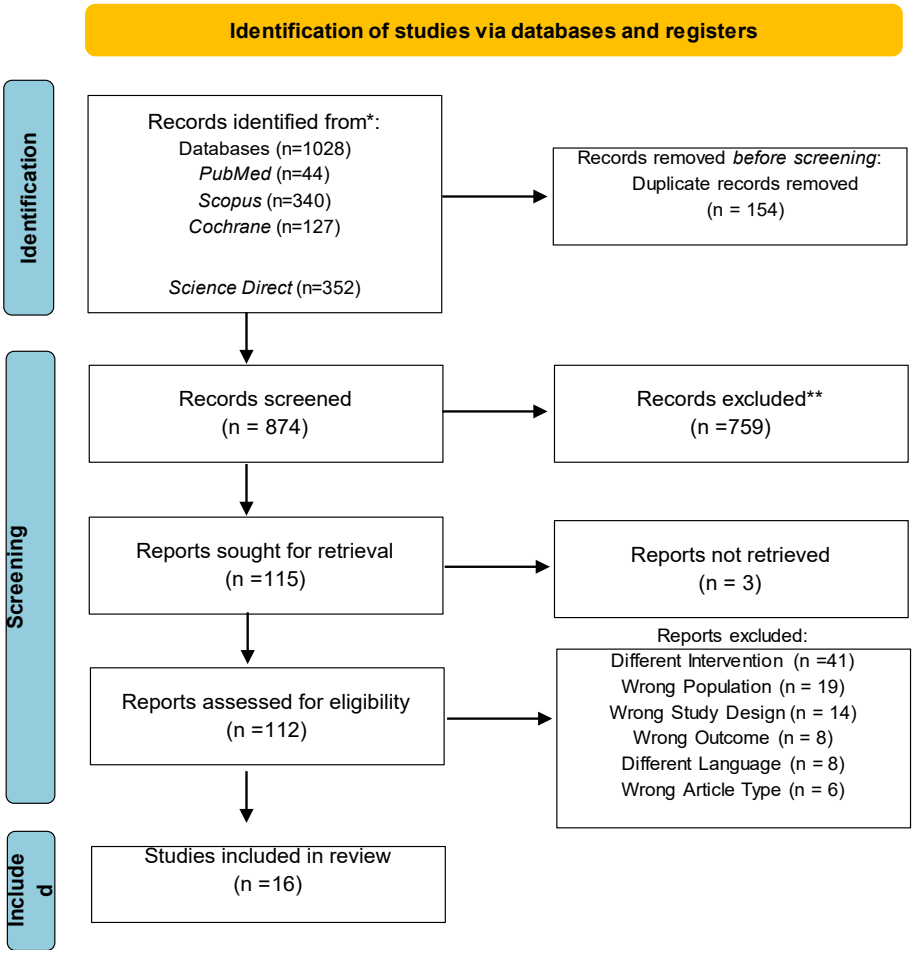

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses Diiagram of Study Selection

Table 1. Types and Messages of mHealth Interventions Based on Smoking Behavior Prevention

Type of Prevention	Type of mHealth Intervention	Platform/Format	Key Messages/Content
Smoking initiation prevention (primary prevention)	Gamification-Based Mobile Apps	Photoaging (Smokerface)	The effects of smoking on premature aging and skin health, along with explanations of these effects provided to users
		"Fume"	Knowledge related to tobacco, the positive impacts of living tobacco-free, and the negative consequences of its use
		"What Happens if you Go TooFar?"	Life skills (decision-making, the ability to resist peer pressure, problem-solving, future planning, and assertiveness), explanations of basic emotions, and the relationship between life skills and the presence or absence of emotions
	Chatbox	"ready4life"	Self-management skills (e.g., coping with stress, emotional regulation, or managing feelings of anger and frustration), social skills (e.g., making requests, refusing unreasonable demands, and meeting new people), as well as substance refusal skills (e.g., recognizing and resisting media influence, correcting normative misconceptions about substance use, or understanding the relationship between self-management and social skills with substance use)
Relapse Prevention and Smoking Cessation (secondary prevention)	SMS	N/A	Health impacts of smoking, the development of rational attitudes toward tobacco, guidance on initiating smoking cessation, behavior change strategies, the development of quitting skills, as well as strategies for refusing cigarettes and preventing relapse, along with other supporting activities.

[20] identified the potential to prevent smoking initiation particularly among females and individuals with lower educational attainment. In addition, it can lead to a reduction in smoking prevalence, an increase in cessation rates, and a decline in initiation, especially among male adolescents]21, 30]. Moreover, mHealth interventions have been shown to enhance life skills, reduce other addictive behaviors such as alcohol consumption and excessive internet use [22, 24], and strengthen risk perception regarding addictive substances as well as negative expectancies toward smoking [31,3 3].

Overall, mHealth interventions have demonstrated their ability to influence adolescent attitudes, behaviors, and health outcomes. Parisod et al. [27] reported positive changes in smoking-related attitudes and outcome expectations, with higher levels of user engagement compared to website based interventions, while Hedin et al. [26] highlighted a significant mediating effect on smoking cessation efforts. Effectiveness has also been observed in digital life skills training programs [23], changes in smoking prevalence and attitudes [19, 32], as well as reductions in cigarette consumption and the influence of stress on smoking urges (28,29). Furthermore, text message based interventions have been proven to increase short-term cessation success, particularly when combined with motivational interviewing techniques and peer network based counseling [25, 28].

Discussion

This review highlights that mobile health (mHealth) interventions play a positive role in both preventing smoking initiation and supporting smoking cessation efforts among adolescents. Emerging evidence demonstrates that digital media including SMS, social media, mobile applications, online support communities, and personalized coaching can effectively facilitate behavior change [34, 35]. mHealth represents a particularly strategic tool given adolescents' strong attachment to mobile phone use, with younger populations and females showing higher preferences for internet-based services compared to other demographic groups [36]. Schools also provide a critical context, as they systematically reach the target population and serve as a primary social environment where attitudes, beliefs, and norms related to tobacco use and broader health behaviors are shaped [37]. School-based prevention programs have been shown to improve knowledge about the harms of smoking and contribute to reducing smoking behavior among adolescents [38, 39]. Nevertheless, their effectiveness is likely to be enhanced when integrated with information and communication technologies (ICT). Uribe-Madrigal et al. [40], recommend that public health professionals incorporate ICT particularly mobile-based platforms into traditional school programs to promote health, prevent disease, and optimize digital tools for delivering health messages.

Mobile health plays an important role in preventing behaviors such as smoking. Mobile health applications utilize a visual approach based on photoaging to increase risk awareness and prevent smoking initiation. The use of technology that applies effective feedback visualization design principles can influence the process of behavior change [41]. Design principles are developed to ensure that visualizations are easily recognized, understood, and interpreted, with the addition of motivational elements aimed at encouraging action [42]. Users tend to rely on mobile-based health applications as a means of support because these apps have proven effective in delivering initiatives and interventions for health promotion and impact on improving knowledge, attitudes, and intentions

related to smoking prevention [43].

SMS and chatbot based interventions are designed to strengthen life skills, stress management, and resistance to peer influence, with evidence indicating reductions in substance use and increased readiness to quit smoking. The intensive interaction with smartphones offers opportunities for mHealth intervention to support healthy lifestyle adoption [44]. In addition, perceived ease of use exerts a significant positive effect on users' behavioral intention toward continued use of wearable health management devices [45]. Nonetheless, the effectiveness of such interventions remains heterogeneous, influenced by variations in methodology, settings school and community, and participant characteristics such as age, gender, and socioeconomic background. Some interventions reported positive changes in attitudes and perceptions, yet no significant effects on self efficacy or smoking prevalence. Overall, users generally perceive mobile technologies as beneficial for achieving health goals. However, this perceived utility does not always translate into measurable behavioral outcomes, underscoring a persistent challenge in mHealth interventions [33, 46] .

This review highlights several key implications that mHealth holds promise as a complementary tool in school-based health education, particularly when integrated with participatory strategies such as peer education and gamification. Future applications should address gender and cultural differences by incorporating feedback mechanisms and personalized content. Community based interventions need greater emphasis on parental, community, and institutional engagement. Finally, aligning mHealth initiatives with broader public health policies such as regulating digital tobacco advertising and ensuring technological access in schools will be essential for achieving sustainable and widespread impact, supported by strong public backing for policy implementation [47].

Several limitations also emerged from the reviewed studies. Many focused only on the short term, with limited follow-up periods, making it difficult to assess the long-term effects of interventions. The majority of studies originated from high income countries, with limited representation from low and middle income countries. In addition, the database used did not include grey literature, resulting in limited data being obtained. Consequently, research findings from other countries were not captured in this study.

In conclusion, mobile health (mHealth) interventions hold substantial potential in the prevention and reduction of smoking behaviors among adolescents. Evidence indicates that gamification-based applications, text messaging, and chatbot platforms are effective modalities for enhancing risk perception, fostering essential life skills, and mitigating cigarette consumption. The efficacy of these interventions is contingent upon participant-specific characteristics, the duration of the intervention, and the extent of social and contextual engagement. Collectively, these findings underscore the role of mHealth as a scalable, evidence-informed approach to adolescent smoking prevention and health promotion . Although most studies originate from high income countries, these findings highlight the critical importance of integrating technology into adolescent health education for broad application, including in developing countries. Further longitudinal studies and participatory approaches are necessary to better understand the long term impacts and cross cultural effectiveness of these interventions.

Author Contribution Statement

Conceptualization; Reskiaddin, L.O., Methodology: Reskiaddin, L.O., Prabandari, Y.S., Agustiningsih, D., Review and Data Curation: Reskiaddin, L.O., Lubis, I.K., Supervision : Prabandari, Y.S., Agustiningsih, D., Writing-Original draft: Reskiaddin, L.O., Writing-review & editing ; Reskiaddin, L.O., Lubis, I.K.

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Ethical Declaration

This study did not involve the participation of human subjects or the use of animal models. Consequently, it was exempt from the requirement for ethical clearance in accordance with prevailing research ethics guidelines.

Study Registration

It has been registered in the Open Science Framework

Conflict of Interest

The author(s) declare there is no conflict of interest.

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