ORIGINAL ARTICLES

Digital tobacco cessation interventions for adults and their effectiveness: A systematic review

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ABSTRACT

Objectives: 1) To describe digital tobacco cessation interventions that currently being utilized, 2) To evaluate the effective of digital tobacco cessation intervention in comparison to usual treatment/ no intervention.

Methods: A comprehensive search was conducted across multiple databases including PubMed, Scopus, and Google Scholar, to identify randomized controlled trials (RCTs) in which, the intervention group received digital tobacco cessation interventions, and the control group received usual treatment only. The quality of the included studies was assessed using the Risk of bias 2 (RoB 2) checklist. Effectiveness of the interventions was evaluated through self-reported or biochemically validated point prevalence of abstinence (PPA).

Results: Of the total 1,364 records identified in multiple databases, twelve RCTs were eligible for inclusion, with 41.6% of them having low risk of bias. Overall, 58.3% of the digital tobacco cessation interventions demonstrated superior effectiveness in promoting smoking abstinence among tobacco users compared to usual or standard treatment.

Conclusion: Our systematic review supported the effectiveness of delivering digital tobacco interventions to achieve higher smoking abstinence rates. However, future studies should recruit higher-quality studies and conduct a meta-analysis to better understand the efficacy of digital interventions for tobacco cessation worldwide.

Keywords: *Tobacco cessation, digital intervention, artificial intelligence, digital health.*

INTRODUCTION

Tobacco smoking remains one of the main preventable causes of chronic diseases (including asthma and chronic obstructive pulmonary disease) and premature death worldwide. The World Health Organization (WHO) estimated that there were still 1.3 billion people smoking tobacco globally, and 80% of them lived in low- and middle-income countries (1). It is predicted that tobacco use will be responsible for more than 8 million deaths worldwide per year by 2030 if effective interventions are not implemented (1). Despite the availability of various cessation methods, quitting smoking continues to be a significant challenge, especially in low-resource settings. Common barriers such as limited access to healthcare services, a shortage of trained professionals, and low self-efficacy have hindered tobacco users from achieving long-term cessation (2). Moreover, treatments as usual (TAU) for tobacco users, including brief advice, self-help material, or pharmacotherapy, were insufficient in addressing complex behaviors like tobacco use.

In recent years, digital health technologies have emerged as promising tools to support smoking cessation, offering potential for wide-scale implementation due to their accessibility, cost-effectiveness, and personalization capabilities. In

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2024, the WHO issued an updated guideline on tobacco cessation, emphasizing a comprehensive approach to tobacco control (3). In which, the term "Digital tobacco cessation intervention" was defined as "Tobacco cessation interventions delivered through digital technologies and can involve the following modalities: mobile text messaging, internet-based interventions, smartphone applications (apps) and AI-based software interventions" (3). Within these guidelines, digital tobacco cessation interventions are strongly recommended as effective self-management strategies for modifying smoking behavior. A study has demonstrated that artificial intelligence (AI) chatbots were significantly more likely to quit smoking at 6-month follow-up compared to the control group (4). Other text-based interventions were also found to be more effective in promoting tobacco cessation compared to usual care (5including the effects of dose (number of text messages). Despite these digital interventions having been globally performed, there is a lack of comprehensive assessment concerning their efficacy. Therefore, our systematic review was conducted to answer the two questions: 1- What types of digital tobacco cessation interventions for adults were utilized? 2-What were the effects of digital tobacco cessation interventions on quitting among adults compared with usual treatment or no intervention?

METHODS

Study design: Systematic review

Study site and time: A systematic search was conducted across PubMed, Scopus, and Google Scholar for studies published between 2020 and 2025.

Study subjects: Tobacco users who desired to quit smoking

Sample size and sampling methods: The study selection process of this systematic review was based on the description of Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P). A comprehensive search was conducted using Medical Subject Headings (MeSH) terms, including "Tobacco Cessation", "Digital intervention", "Artificial Intelligence", and "Digital health"

Eligibility criteria

Studies were included based on the PICOTS framework (See table 1).

Table 1. PICOTS framework to select eligible studies

Criteria	Inclusion	Exclusion
General	Original research that was peer-reviewed and written in English	Non-original research: Review papers, meta-analysis, study protocol, conference reports, opinion pieces. Studies not published in English
Population (P)	Individuals aged 18 years and above who reported smoking every day	Tobacco users who did not desire to quit
Intervention (I)	Digital tobacco cessation	Non-digital tobacco cessation
Comparison (C)	Treat as usual/ standard care	Active control
Outcome (O)	Self-reported 7-day PPA, or biochemically validated 7-day PPA	Number of cigarettes smoked per day
Timing (T)	Within 5 years (01/01/2020- 01/01/2025)	Out of that time
Study design (S)	Randomized controlled trials	Other study designs

Risk of bias assessment

The quality of included studies would be assessed by the Risk of bias 2 (Rob 2). An overall risk-of-bias judgement would be determined according to the following criteria: low risk of bias, assigned when

all domains are judged at low risk; some concerns, assigned when at least one domain raises concern without any being judged as high risk; and high risk of bias, assigned when at least one domain is judged as high risk or when multiple domains raise concerns.

Processing and analyzing data: Extracted data would be entered, managed, and calculated by using Microsoft Excel 2019. Digital tobacco cessation interventions would be categorized into three main types: mobile app-based interventions, conversational chatbots, and other digital interventions. One RCT would be rated "effective" as its results showed a statistically significantly higher PPA rate. The overall effectiveness was calculated as the percentage of effective interventions out of the total interventions.

RESULTS

Study selection

A total of 1,364 records were initially identified from three databases. After removing 360 duplicates, 1,004 records underwent title and abstract screening, of which 769 were excluded for reasons such as lack of full text, being outside the publication period (2020-2025), or not having a randomized controlled trial design. Of the remaining 235 full-text articles, after removing protocols, pilot studies, and those with inappropriate control groups, only 12 eligible studies were included in the review.

The characteristics of the included studies

The 12 studies included in the review were conducted across diverse geographical regions. Specifically, 33.3% were conducted in North America, all of which took place in the United States (6–9change in depression (Beck Depression Inventory-II). The other 41.6% were implemented in Europe, encompassing studies from England, Germany, Spain, and the Netherlands (10–14scalable delivery of interventions to promote smoking cessation.\nObjective: We aimed to evaluate the effectiveness of the offer of Smoke Free—an evidence-informed, widely used app—for smoking cessation versus no support.\nMethods: In this 2-arm randomized controlled trial, 3143 motivated adult smokers were recruited online between August 2020 and April 2021 and randomized to receive an offer of the Smoke Free app plus follow-up (intervention arm). The remaining 25.1% were conducted in Asia, with contributions from Japan, China, and Thailand (15–17). The systematic review encompassed 9,936 tobacco users, with 4,964 (49.9%) assigned to the intervention group and 4,972 (50.1%) to the control group. The mean age of participants across 12 studies was 40.5 years (See table 2).

Table 2. Basic characteristics of the included studies

	Category	Frequency (n)	Percentage (%)
Country	North America	4	33.3
	Europe	5	41.6
	Asia	3	25.1
Number of participants in the intervention group		4,964	49.9
Number of participants in the control group		4,972	50.1
Mean age (SD) of participants in years	n=12	40.5 (9.8)	

The characteristics of digital tobacco cessation interventions

Mobile app-based interventions were the most frequently implemented (7/12 studies), followed by conversational chatbot interventions in 2 studies (Table 3). The remaining 3 studies employed other formats, including web-based, text-based, and video-based interventions. The intervention durations ranged from 3 to 7 months, however, the majority of studies conducted follow-up assessments at 6 months (8/12 studies).

Table 3. The characteristics of the included interventions

Study	Intervention name	Intervention type	Duration in months
1	Goal2Quit	Mobile app	3
2	Quitbot	Conversational chatbot	3
3	Smoke Free	Mobile app	6
4	NichtraucherHelden®	Mobile app	6
5	Web-based tailored program	Web-based intervention	6
6	Dejal@bot	Conversational chatbot	6
7	AI-based tailored app	Mobile app	6
8	CASC smartphone app	Mobile app	6
9	This is Quitting (TIQ)	Text-based intervention	7
10	Quit with US	Mobile app	3
11	Decídetexto	Mobile app	6
12	WeChat video	Video-based intervention	6

Quality of the evidence

The quality assessment of the included full-text articles was illustrated in Figure 1. In our systematic review, we used the RoB2, which was developed by Cochrane, to assess the quality of eligible RCTs (18). In general, only 41.6% of the RCTs were assessed as having a low risk of bias. The randomized process (D1) was judged as "low risk of bias" in 75% of the total studies. Due to the nature of the digital intervention, blinding of participants and healthcare providers (a component of D2) was not feasible. Domain 4 indicated a risk of bias in outcome measurement, with five studies relying on self-reported PPA (7- or 30-day), resulting in high risk, while the remaining seven employed biochemical verification (CO or cotinine), enhancing reliability.

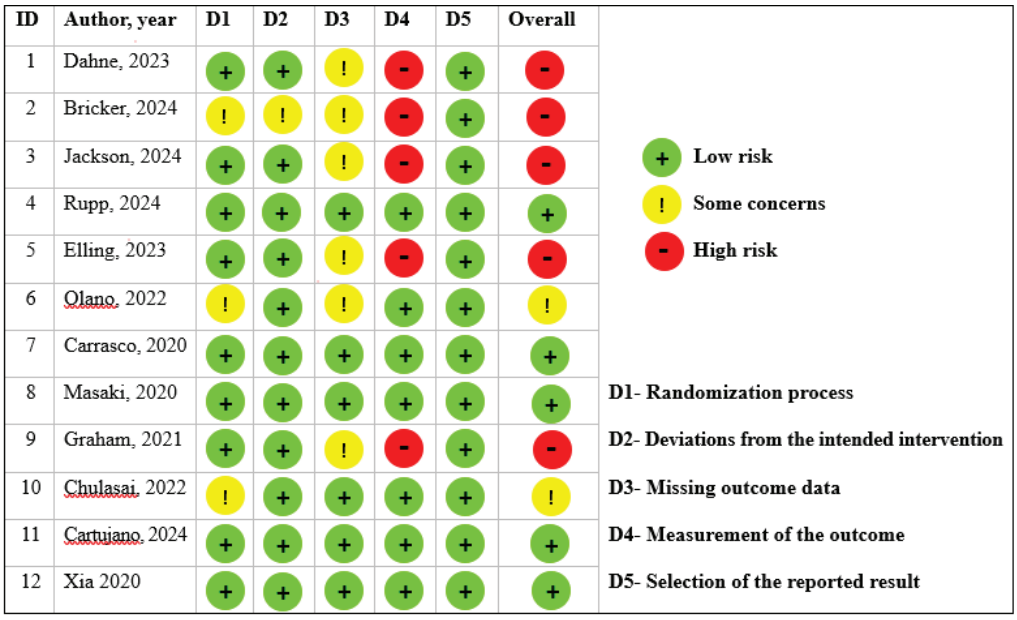

Figure 1. Evaluation of study quality by Risk of bias 2 (RoB 2)

The effectiveness of digital tobacco cessation interventions

Of the 12 studies included in our systematic review, seven out of twelve interventions (58.3%) were effective in primary outcomes measured (6,8,11,14–17change in depression (Beck Depression Inventory-II). Among the seven studies employing mobile app-based interventions, five demonstrated statistically significant improvements in smoking abstinence, indicating a 71.4% effectiveness rate for this category.

Table 4. Interventions, outcome measured, key findings, and their effectiveness

Study ID	Intervention	Control	Primary outcome	Key findings	Effectiveness of the intervention
1	Mobile app "Goal2Quit" which helped to quit smoking and improve the mood during tobacco cessation	TAU (a selfhelp booklet for quitting smoking)	Self-reported 7-day PPA	Goal2Quit participants reported significantly higher rates of 7-day PPA at weeks 4 (11% vs 0%; P=0.02), week 8 (12% vs 0%; P=0.02), and week 12 (16% vs 2%; P=0.02).	Effective
2	Conversational chat bot "Quitbot" for smoking cessation	TAU (Standard messaging text)	Self-reported 30-day PPA	Intention-to-treat (ITT) analysis showed that 30-day PPA rate in "Quitbot" was not different from TAU (31.1% versus 34.7%; OR= 0.81, 95%CI= 0.50-1.29).	Not effective
3	Mobile app "Smoke Free" to support tobacco cessation based on behavior change theory	No intervention	Self-reported 7-day PPA	No significant difference in 7-day PPA was observed between the intervention and control groups (6.8% vs 7.0%; RR = 0.97, 95% CI: 0.75–1.26)	Not effective
4	Guideline-based smoking cessation app (NichtraucherHelden®)	TAU (Brief advice)	Biochemically validated 7-day PPA (Cotinine test)	Significantly more smokers in the intervention group stopped smoking than in the control: 20.2% and 10.5% (OR = 2.2; 95%CI= 1.4–3.4)	Effective
5	A web-based computer-tailored smoking cessation	TAU (short message on smoking cessation)	Self-reported 7-day PPA	7-day PPA rate did not differ between the intervention condition (20.1%) and the control condition (24.6%) (OR= 0.77, 95%CI= 0.44–1.36)	Not effective
6	Conversational chatbot "Dejal@bot" based on the 5A (Ask, Advise, Assess, Assist, and Arrange)	TAU (Consultation/advice)	Biochemically validated 7-day PPA (CO test)	ITT analysis showed that the biochemically validated 7-day PPA rate was higher in the Intervention (26%) compared with the Control (18.8%); OR= 1.52, 95% CI= 1.00-2.31	Not Effective
7	A mobile app providing artificial intelligence–generated and tailored smoking cessation support messages	TAU (psychopharmacological treatment)	Biochemically validated 7-day PPA (CO + Urine test)	Intervention and control group participants achieved efficacy rates of 27.5% and 15.0%, respectively (OR=2.15, 95%CI= 1.13-4.08)	Effective
8	CASC smartphone app with digital and educational lectures	TAU (pharmacotherapy and counseling)	Biochemically validated 7-day PPA (CO test)	Abstinence rates at 6 months in the intervention group was significantly higher than that in the control group (63.9% vs. 50.5%; OR= 1.73; 95% CI=1.24 -2.42	Effective

Study ID	Intervention	Control	Primary outcome	Key findings	Effectiveness of the intervention
9	This is Quitting (TIQ) is a fully automated, tailored, interactive text message	TAU (receiving assessment message)	Self-reported 30-day PPA	Abstinence rates in the intervention and control were 24.1% and 18.6% respectively (OR=1.39; 95% CI=1.15-1.68; p < 0.001)	Effective
10	Smartphone Application "Quit with US" based on 5A model	TAU (Smoking cessation counseling)	Biochemically validated 7-day PPA (CO test)	ITT analysis showed that "Quit with US" achieved significantly greater PPA rate than the control group (58.4% vs. 30.9%, RR = 1.89, 95%CI = 1.42 to 2.52, p < 0.001).	Effective
11	Tablet-based program "Decídetexto" to guide smoking cessation quit plan	TAU (printed educational material)	Biochemically validated 7-day PPA (Cotinine test)	7-day PPA rate in the intervention and control group was 14.4% and 9.2%, respectively. (OR=1.66; 95% CI, 0.93-2.97, p = 0.09).	Not Effective
12	Providing videos for smoking fathers on various risks of smoking for maternal and child health via WeChat.	TAU (a leaflet with information on smoking cessation)	Biochemically validated 7-day PPA (CO test)	The rate of validated abstinence in the video group was 22.5%, compared to 9.2% in the control group; (OR=2.80; 95% CI= 1.79-4.37, P < 0.001)	Effective
	Overall effectiveness				**7/12= 58.3%**

DISCUSSION

The characteristics of digital tobacco cessation interventions

The strengths of delivering tobacco applications via smartphones were that these interventions can be delivered to a large number of users simultaneously, making them highly accessible across populations and regions. Meta-analysis has shown that digital smoking cessation therapy provided by mobile phones could reach more smokers than conventional face-to-face therapy (20). Despite some prominent features, mobile apps may lack the motivation that can easily lead to low engagement and adherence over time. The two chatbot interventions, on the other hand, could address the issue by providing adaptive responses and conversations based on personalized context. Other digital interventions differ from structure, user interaction, to content delivery. The web-based program, grounded in cognitive theories, offered sessions on quitting benefits, social influence, planning, and coping strategies. The SMS intervention delivered motivational messages to support young adults, while the video highlighted the harms of second-hand smoke on infants and pregnant women.

The effectiveness of digital tobacco cessation interventions compared to TAU

The overall effectiveness of digital tobacco cessation interventions in our systematic review was found to be 58.3%. Our findings supported the hypothesis that digital approach for tobacco users could achieve better results in PPA compared to usual treatment. Mobile app-based interventions represent one of the most effective tools for smoking cessation, representing 71.4% of effectiveness within the category. However, another systematic review by Guo did not support the effectiveness of delivering smartphone-based interventions (21). The difference might be because Guo included active control (already known,

effective treatments) in their analysis, making it more difficult to demonstrate superiority. Despite prominent advances in AI, these chatbots failed to demonstrate significant effectiveness in smoking cessation. This may be due to limited face-to-face interaction, lack of motivation, or insufficient intensity of the AI chatbot compared to human counseling in the real-world setting. The web-based program also failed to show effectiveness possibly due to low interactivity, user disengagement, or the absence of behavioral reinforcement mechanisms.

Limitation: This review has some limitations. First, there was the possibility that some relevant studies were not captured due to limited search database. Additionally, our search was restricted to studies published in English, which may have excluded relevant evidence published in other languages Next, the included interventions in our review varied significantly in terms of type, duration, and delivery methods. Therefore, the predicted high heterogeneity posed challenges in conducting a meta-analysis to estimate the pooled effect size and draw definitive conclusions.

CONCLUSION

This review found that digital smoking cessation interventions may increase cessation over short-term periods, with mobile app-based approaches demonstrating the greatest benefit. Therefore, healthcare practitioners should consider developing and integrating mobile app-based interventions into tobacco cessation service to enhance patient care and management. Future research should focus on recruiting higher-quality studies, expanding geographical coverage, and conducting meta-analyses to better understand the efficacy of digital tobacco cessation interventions for tobacco cessation worldwide.

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