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RESEARCH

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Effectiveness of nurse-initiated smoking cessation intervention: a systematic review and meta-analysis

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Abstract

Background Smoking is a major preventable cause of death, associated with cancers and chronic diseases. Nurse-initiated smoking cessation programs have proven effective, providing counseling, education, and mental health support. These interventions increase quit rates by tackling nicotine addiction, emphasizing the important role of nurses and the need for targeted training. Systematic reviews and meta-analyses are essential for gaining a deeper understanding of the effectiveness of various cessation strategies.

Methods A literature search was conducted using eight electronic databases (CINAHL, EMbase, MEDLINE, Cochrane, RISS, KMbase, KISS, and NDSL). The literature search was conducted from March, 27, 2024, to August 1, 2024. All included studies were randomized controlled trials (RCTs). Quality assessment was conducted using the Risk of Bias (ROB) tool. RevMan 5.4 was used for qualitative analysis, with effect sizes measured as odds ratios (ORs) and 95% confidence intervals (CIs).

Results Thirteen studies, all published after 2005, were included in the evidence assessment of nurse-initiated smoking cessation programs. The interventions examined comprised 11 intensive or personalized counseling programs and 3 telephone-based approaches. The OR for self-reported quit success 7-day smoking cessation rate at 6-month follow-up was 1.43 (95% CI [1.08, 1.90]), indicating a significant difference in quit effectiveness ($Z = 2.27$, $p = .01$), with moderate heterogeneity observed across studies ($I^2 = 67.0\%$, $p = .001$). A meta-analysis of 7-day point abstinence rate at 12-month follow-up revealed a pooled OR of 1.18 (95% CI [0.96, 1.44]), showing no significant difference in quit effectiveness ($Z = 1.58$, $p = .11$) and moderate heterogeneity among the studies ($I^2 = 55.0\%$, $p = .02$).

Conclusions A comprehensive approach by trained nursing professionals is essential in addressing the complexities of smoking cessation. Further clinical trials are needed to assess intervention methods and follow-up strategies. Future research should emphasize long-term outcomes and ongoing support to sustain behavior change, contributing to more effective, tailored cessation programs and improved public health outcomes.

Introduction

Smoking continues to be a major cause of preventable illness and death worldwide. The World Health Organization (WHO) reports that tobacco use accounts for nearly 8 million deaths annually, including over 1 million nonsmokers who are exposed to secondhand smoke [1–4]. Despite ongoing public health efforts, very many smokers still exist and continue to smoke, highlighting the urgent need for effective smoking prevention and intervention

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strategies [2–4]. Also, smoking is associated with various cancers, including lung cancer, as well as numerous chronic diseases affecting the respiratory, cardiovascular, and gastrointestinal systems, making it one of the most preventable causes of premature death and disability [2–4]. Harmful substances from smoking increase oxidative stress in the body and trigger inflammatory responses, leading to tissue damage and genetic mutations, which are key factors in cancer development [5, 30]. Additionally, smoking impairs endothelial cell function in blood vessels, promoting cardiovascular diseases such as atherosclerosis and significantly raising the risk of stroke and myocardial infarction [6]. Not only does smoking have a detrimental impact on physical health, but it also negatively affects mental health [7]. Various studies indicated that smoking is associated with high levels of anxiety, depression, and stress [7–11].

Considering the relationship between these diseases and smoking, it is clear that quitting smoking is a crucial factor in improving the smoker's health and quality of life [12]. According to the "Supporting smoking & vaping cessation: A guide for health professionals", published by the Royal Australian College of General Practitioners', all healthcare providers-including medical doctors and nurses are encouraged to ask, advise, and help when encountering patients who smoke [13]. It has been shown that smoking cessation interventions are more effective when there are multiple counseling sessions, when healthcare providers are adequately trained in cessation methods, when counseling durations are longer, and when various types of healthcare professionals are involved in the counseling process, leading to higher quit rates among participants [14, 15].

Many smokers express a desire to quit; however, the addictive nature of nicotine makes overcoming this dependency solely through willpower challenging. As a result, professional assistance is crucial in facilitating smoking cessation [16, 17, 42]. Nurse-initiated tobacco cessation programs are increasingly recognized for their effectiveness in addressing this public health issue. This research explores the importance of these programs, highlighting their benefits, efficacy, and potential for broader public health impact [18]. Nurse-initiated smoking cessation programs are especially significant in various aspects, including continuous patient contact, holistic approaches, education provision, promotion of behavior change, interdisciplinary collaboration, and mental support [19]. These elements contribute to increasing patients' success rates in quitting smoking and improving overall health. Therefore, it is essential to strengthen the role of nurses and expand smoking cessation programs [19]. While numerous experimental and descriptive studies, both domestically and internationally, have emphasized the importance of smoking cessation and raised awareness about its benefits, the variability of individual responses and sporadic relationships among these findings have made it difficult to generalize conclusions [20]. To address this gap, there is a pressing need for systematic literature reviews and meta-analyses that integrate diverse studies, allowing for comprehensive insights into the effectiveness of different cessation interventions.

This research aims to verify the effectiveness of smoking cessation programs led by nurses, who play a vital role in supporting individuals seeking to quit. By examining the evidence surrounding nurse-initiated interventions, this study will highlight the significance of healthcare providers, particularly nurses, in cessation efforts and accentuate the necessity for targeted training in this area. Such training is believed to enhance the prevention and treatment of smoking dependence.

Research methods

Literature search strategy

The study was conducted according to the methods outlined in the Cochrane Alliance's Handbook for Systematic Reviews of Interventions. We have followed the updated PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (version 2020) [21].

a) Key Questions (PICO-SD)

- Population (P): Smokers, nicotine-dependent subjects
- Intervention (I): A nurse-initiated and implemented smoking cessation intervention programs (e.g., typical components such as motivational interviewing, education, and behavioral support)
- Comparator programs (C): Usual care or smoking cessation intervention program by other personnel, Non-intervention group
- Smoking cessation outcomes (O): Outcomes: Self-reported 7-day point cessation rate (cotinine or saliva confirmed)
- Study design (SD): RCT.

b) Literature Search Database

The protocol for the review has been registered on the International Platform of Registered Systematic Review and Meta-analysis Protocols (INPLASY) with the registration INPLASY202490063.

We utilized electronic databases (DBs) using the Internet. The domestic databases were the Research Information Sharing Service (RISS), an academic information sharing platform operated by the Korean Education Research and Information Service (KERIS); the Korean Medical database (Kmbase), which includes more than 900 journals published in medicine, nursing, dentistry, and public health; the Korean studies Information Service System (KISS); and the National Discovery for Science Library (NDSL), operated by the Korean Institute of Science and Technology Information (KISTI). The international databases were searched for literature through systematic searches of MEDLINE (via PubMed), EMBASE (Emtree terms), CINAHL (CINAHL subject headings), and Cochrane CENTRAL databases, which mainly contain references and abstracts on life sciences and biomedical topics, with search dates up to March 27, 2024. Keywords (title/abstract), Medical Subject Headings (MeSH), and EMTREE terms searched were nurses, smoking cessation interventions, and literature related to smoking cessation. Publications identified from the electronic search were imported into EndNote (Clarivate, London, UK) to remove duplicates.

c) Search terms

Considering the search function of Korean databases, we utilized simple search terms. We tried to include smoking cessation therapy, motivational interviewing, cognitive behavioral therapy, and pharmacotherapy, which are mainly used in smoking cessation interventions in Korea. During the review process for literature analysis, we did not find any studies that included nurses as the main participants of the intervention, so we decided to exclude the results of the search through domestic databases as they were not the subject of the study, and since there were many nurse-initiated smoking cessation interventions in overseas databases, we limited the study to the literature in overseas databases.

The final search terms were'smoker','nicotine dependence','smoking cessation', and'smoking cessation intervention', combined with'nurse','nurse practitioner','quit smoke','abstinence', and'biochemical validation'. In the Cochrane Library, we performed a MeSH search using the above terms. The final search was limited to studies published in Korean and English since 2005, when the Framework Convention on Tobacco Control (FCTC) was adopted by the WHO to collectively address the harmful effects of tobacco on human health (See Appendix 1).

d) Literature selection (Inclusion and Exclusion criteria)

Two authors (EHL and HJY) independently screened the titles and abstracts of identified publications for eligibility using pre-specified inclusion and exclusion criteria; potentially eligible citations were retrieved for full-text screening, and discrepancies were resolved by consensus. We limited our review to randomized controlled trials published in Korean and English that reported at least one quit rate among nurse-initiated or nurse-facilitated smoking cessation interventions for patients and adults in the general population. Where possible, we endeavored to extract intention-to-treat analysis data for all outcomes. Abstracts, conference papers, observational studies, qualitative studies, case reports, case series, and editorials were also excluded, as were studies that did not clearly report cessation rates for specific populations, such as people with mental illness, pregnant women, and people living with HIV.

Literature selection process flow chart

A total of 136 articles were retrieved from domestic databases, including 40 from RISS, 38 from Kmbase, 31 from KISS, and 27 from NDSL. 9,429 articles were retrieved from international databases, including 1322 from PubMed, 1609 from Embase, 20 from CINAHL, and 6,478 from Cochran. Of the articles retrieved from international databases, 1,987 (21.1%) were excluded due to articles being published before 2005, leaving 7,578 articles. After removing duplicates, 7,424 articles remained. The articles retrieved from each database were indexed for duplication, and 59 (43.4%) articles from domestic databases and 95 (0.01%) from international databases were excluded due to duplication.

Data extraction (literature screening)

Figure 1 describes the PRISMA Flow chart of study selection process. The selection process was iterative. In the first step, inclusion and exclusion criteria were applied based on abstracts (abstract screening). In cases where it was difficult to select studies based solely on abstracts, the decision was deferred until the full text was available. This process eliminated 7,312 studies that met the exclusion criteria. In the second step, we retrieved the full text of 112 studies and excluded 26 studies that did not meet our criteria and were not retrieved. Eighty-six studies were assessed for eligibility. We excluded 73 studies that were nurse-initiated cessation programs but either lacked accurate cessation rates, did not meet our criteria for the timing of cessation rate measurements, or had more than three experimental arms. This process was conducted over four researcher meetings based on the inclusion and exclusion criteria, resulting in 7,403 articles out of 7,424 that were de-duplicated, and the final selection of 13 articles. Gray literature including Dissertation was omitted.

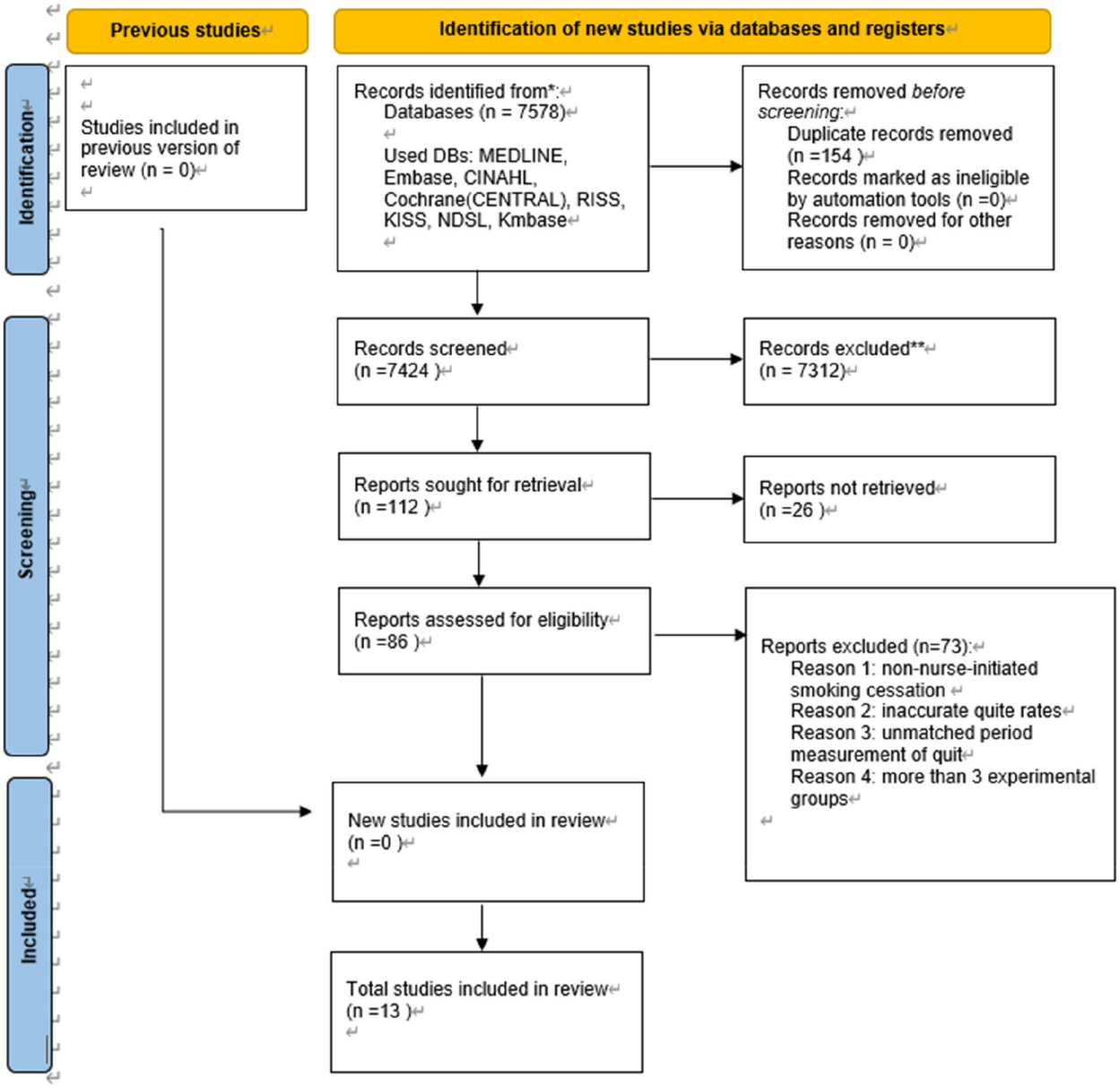

Fig. 1 PRISMA Flow chart of study selection process

In cases where two researchers (EHL & HJY) held differing opinions, discussions were conducted to achieve consensus. If a consensus could not be reached, the discrepancy was addressed through consultation with an expert to ensure an objective resolution.

Data analysis methods

The outcomes of all smoking cessation programs were described in terms of proportions and corresponding numbers of subjects, with units where possible, and if the number of subjects was not described in the article, it was recalculated from the proportions. A total of 13 studies were included in the analysis and meta-analyzed using RevMan 5.4. Outcomes of dichotomous variables were measured as odds ratios (ORs). The odds ratio is calculated as the odds of the event occurring in the control group versus the odds of the event occurring in the intervention group. The primary outcome was analyzed by evaluating smoking cessation rates at the 6- and 12-month follow-ups. Sub-group analyses were conducted based on the smoking cessation confirmation method (saliva vs. cotinine), intervention method

(face-to-face vs. telephone), and participant type (patient vs. non-patient). If the primary outcome was presented with only partial statistics, it was not included in the meta-analysis. The 95% CIs for each outcome variable were analyzed with a random-effects model using the Mantel–Haenszel method. The presence of statistical heterogeneity between studies was assessed using the Higgins' I-squared (I^2) test at a significance level of less than 5%, with the I^2 threshold for heterogeneity being greater than 50% [22]. In the case of heterogeneity in the meta-analysis, we rechecked the extracted values to investigate the cause and performed additional analysis (sub-group analysis). Publication bias was presented as a funnel plot.

Findings

Characteristics of the literature

A total of 13 studies were selected for the evidence assessment of nurse-initiated smoking cessation programs, all published after 2005 (Table 1). The nurse-initiated smoking cessation interventions studied included 11 intensive or tailored counseling programs and 3 telephone approach programs. The studies were published in the United States ($n = 2$), Australia ($n = 2$), Denmark ($n = 1$), Taiwan ($n = 1$), Spain ($n = 1$), Holland ($n = 2$), Canada ($n = 2$), Hong Kong ($n = 2$), and the number of participants in the interventions ranged from over a 100 to more than 500. The populations served by the nurse-initiated smoking cessation programs included university students, community members, people with COPD (Chronic obstructive pulmonary disease), and people with coronary artery disease, and the settings included schools, hospitals, communities, and primary healthcare clinics.

The outcomes of the intervention programs were presented as quit rates and sustained abstinence over time as the primary outcomes, with other outcomes including quit attempts and reduced smoking. Abstinence rates were reported as self-reported abstinence from smoking for at least 7 days or confirmed by CO (carbon oxide), saliva, or cotinine testing, and sustained abstinence over time.

Smoking cessation effects (6-month abstinence vs. 12-month abstinence)

A total of 13 studies analyzed smoking cessation outcomes in nurse-initiated tobacco cessation programs, of which 10 evaluated 6-month cessation rates [23–32], and 10 studies evaluated 12-month smoking cessation rates [21, 25, 26, 28–30, 32–35] (Fig. 2A). The OR for self-reported quit success 7-day smoking cessation rate at 6-month follow-up was 1.43 (95% CI [1.08, 1.90]), indicating a difference in quit effectiveness ($Z = 2.27$, $p = 0.01$), with moderate heterogeneity across studies ($I^2 = 67.0\%$, $p = 0.001$) and no publication bias. A self-reported 7-day cessation at 12-month follow-up found a pooled odds ratio (OR) of 1.18 (95% CI [0.96, 1.44]) with no difference in quit effectiveness ($Z = 1.58$, $p = 0.11$) and moderate heterogeneity between studies ($I^2 = 55.0\%$, $p = 0.02$) with no publication bias.

Physiological markers (saliva vs. cotinine)

Six studies have identified physiological markers of smoking cessation effectiveness in nurse-initiated cessation programs, including two biochemical verifications using saliva [27, 33] and 4 biochemical verification studies using cotinine [24, 27, 29, 34, 35] (Fig. 2B). In the biochemical verification meta-analysis of saliva, the pooled odds ratio (OR) was 1.06 (95% CI [0.76, 1.47]), with no difference in smoking cessation effectiveness ($Z = 0.33$, $p = 0.74$) and moderate heterogeneity among studies ($I^2 = 34.0\%$, $p = 0.22$), indicating no publication bias. In a meta-analysis of biochemical verification with cotinine, the pooled odds ratio (OR) was 0.72 (95% CI [0.66, 4.51]), with no difference in smoking cessation effectiveness ($Z = 1.10$, $p = 0.27$), high heterogeneity ($I^2 = 84.0\%$, $p < 0.000$), and no publication bias.

Differences in cessation intervention methods (face-to-face counseling vs. phone)

Differences in the effectiveness of smoking cessation interventions in the literature on nurse-initiated tobacco cessation programs were found in 11 intensive/tailored (face-to-face) counseling programs [23, 24, 26–31, 33–35] and in 3 studies that utilized telephone approach programs [25, 28, 32] (Fig. 2C). The pooled odds ratio (OR) for the intensive/tailored counseling program meta-analysis of nurse-initiated smoking cessation interventions was 1.34 (95% CI [1.03, 1.73]), with a difference in cessation effectiveness ($Z = 2.22$, $p = 0.03$), high heterogeneity among studies ($I^2 = 73.0\%$, $p < 0.001$), and no publication bias. In addition, a meta-analysis of telephone approach programs in nurse-initiated smoking cessation interventions found a pooled odds ratio (OR) of 1.33 (95% CI [0.98, 1.80]) with no difference in cessation effectiveness ($Z = 1.86$, $p = 0.06$) and very low heterogeneity between studies ($I^2 = 0\%$, $p = 0.89$) with no publication bias. Meta-analysis of the difference in effectiveness between intensive/tailored counseling programs and telephone approach programs showed a pooled odds ratio (OR) of 1.32 (95% CI [1.07, 1.62]) for smoking cessation ($Z = 2.56$, $p = 0.01$) with moderate heterogeneity ($I^2 = 66.0\%$, $p < 0.001$) and no publication bias.

Table 1 Descriptive summary of included studies ($N = 13$)

Study	Sample Size (*N*)	Participants	Age (Mean + SD)	Intervention 1. Mode of Therapy 2. Duration/No. of Sessions 3. Min/Session 4. Country	Control	Follow-up times	Measured outcomes
1. Lu (2019) [23]	197	Patient (Coronary Heart disease or Diabetes)	56.41 ± 8.20	1. face-to-face 2. six sessions 3. about 30 to 45 min 4. Taiwan	Standard smoking cessation education	1,3,6 months	smoking cessation rates, participant satisfaction with the intervention, and changes in knowledge about smoking
2. Nagle (2005) [33]	1422	Patient (Hospital Patients)	55.00 ± 12.0	1. face-to-face 2. 3 3. 15 to 20 min 4. Australia	Standard Card	3,12 months	cessation rates, which were verified through biochemical tests (e.g., carbon monoxide levels), as well as self-reported abstinence
3. Pardavila-Belio (2015) [24]	255	Non-patient	20.0 ± 1.7	1. face-to-face 2. 6 3. 50 min 4. Spain	Brief smoking cessation advice	6 months	smoking cessation rates through self-reports and biochemical validation (e.g., carbon monoxide levels), changes in participants'knowledge, attitudes toward quitting, and self-efficacy related to smoking cessation
4. Pbert (2011) [34]	1068	Non-patient	16.1 ± 1.1	1. face-to-face 2. 5 3. 30 min 4. USA	Standard school-based health education	3, 12 months	smoking cessation rates verified through self-reports and biochemical validation (e.g., cotinine levels)
5. Rossem (2017) [26]	295	Patient (Primary Healthcare Center patients)	48.0 ± 13.2	1. face-to-face and telephone 2. 10 3. maximum 120 min contact time 4. Holland	Brief general practitioner advice combined with varenicline	3,6,12 months	Smoking cessation, rates, changes in nicotine dependence, quit attempts, quality of life, adverse effects
6. Smith (2011) [27]	643	Patient (Community Hospital Patients)	49.0 ± 14.0	1. face-to-face 2. 4 3. 30 min 4. Canada	Usual care	1, 3, 6, 12 months	Outcome measures included smoking cessation rates verified by self-reports and biochemical assessments (e.g., carbon monoxide levels), along with changes in participants'attitudes and self-efficacy related to quitting smoking
7. Snaterse (2019) [35]	338	Patient (Coronary Artery Disease)	55.6 ± 8.78	1. face-to-face 2. 4 sessions 3. 30 min 4. Holland	Usual care	12 months	Self-reported smoking status, biochemical validation(cotinine level in saliva), behavioral outcomes

Table 1 (continued)

Study	Sample Size (*N*)	Participants	Age (Mean + SD)	Intervention **1. Mode of Therapy** **2. Duration/No. of Sessions** **3. Min/Session** **4. Country**	Control	Follow-up times	Measured outcomes
8. Tonnesen (2006) [28]	370	Patient (COPD)	61 ± (N/A)	1. face-to-face and telephone 2. 4 3. 30 min 4. Denmark	Usual care	6, and 12 months	smoking cessation rates verified by biochemical validation (e.g., carbon monoxide levels), as well as assessments of lung function, quality of life, and participant satisfaction with the intervention
9. Wewers (2009) [29]	302	Patient (Clinic Patients)	41.3 ± 10.4	1. face-to-face 2. 5 3. 30 to 60 min 4. USA	Usual care	3,6,12 months	Smoking cessation rates(cotinine), daily cigarette consumptions, participants satisfaction
10. William, Li (2018) [30]	528	Patient (Cancer)	59.0 ± 12.8	1. face-to-face 2. 1 primary session & 2 F/U sessions 3. 15 to 30 min 4.Hong Kong	Standard care	1wk, 1,3, 6,9,12 months	Smoking cessation rates, biochemically validated cessation(CO levels), changes in smoking-related knowledge and attitudes
11. William, Li (2020) [31]	1517	Patient		1. face-to-face 2. 1 3. about 1 min 4.Hong Kong	Smoking cessation leaflet	6,12 months	Biochemically validated smoking abstinence, self-reported 7-day point prevalence of abstinence, and the percentage of participants achieving a significant reduction in daily cigarette consumption
12. Reid (2019) [25]	440	Patient (Coronary Heart Disease)	54.2.0 ±8.9	1. Telephone 2. 5 3. 15 min 4. Canada	Usual care	6,12 months	Smoking cessation rates, biochemically validated cessation(CO levels), quit attempt duration
13.Young (2018) [32]	318	Patient (Clinic Patients)	37.5 ± 12.0	1. Telephone 2. 5 3. 15 min 4. Australia	Usual care	6, 12and months	The primary outcome measures included smoking cessation rates (self-reported), the acceptability of the referral process, and participants'satisfaction with the intervention. Biochemical validation (like carbon monoxide levels) was also used to confirm cessation where applicable

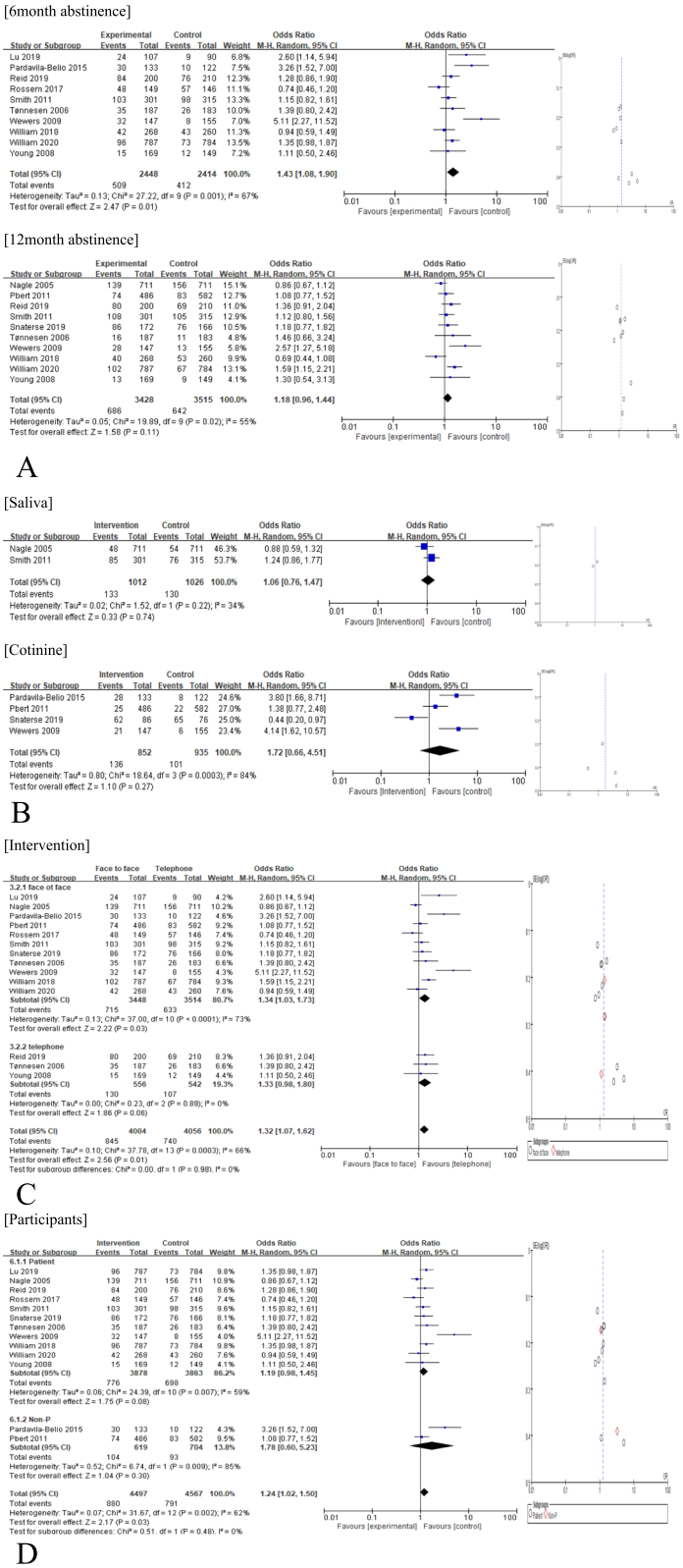

Fig. 2 **A** forest plots of the effectiveness of nurse-initiated smoking cessation intervention: 6 months vs. 12 months. **B** Forest plots of the effectiveness of nurse-initiated smoking cessation intervention: saliva vs. cotinine. **C** Forest plots of the effectiveness of nurse-initiated smoking cessation intervention: face to face vs. telephone. **D** Forest plots of the effectiveness of nurse-initiated smoking cessation intervention: patients vs. non-patients

Differences in eligibility for smoking cessation interventions (patients vs. non-patients)

Nurse-initiated Tobacco Cessation Interventions in the Literature: 11 Patient-Subject Differences in Program Effectiveness [23–25, 25, 26, 28, 29, 29, 30, 33, 35], 2 non-patient literature [23, 33] (Fig. 2D). The meta-analysis of nurse-initiated smoking cessation interventions for patients showed a pooled odds ratio (OR) of 1.19 (95% CI [0.98, 1.45]) with no difference in smoking cessation effectiveness (Z = 1.75, $p = 0.08$) and moderate heterogeneity between studies ($I^2 = 59.0\%$, $p < 0.001$) with no publication bias. A meta-analysis of nurse-initiated smoking cessation interventions for non-patients found a pooled odds ratio (OR) of 1.78 (95% CI [0.60, 5.23]) with no difference in cessation effectiveness (Z = 1.04, $p = 0.30$), high heterogeneity between studies ($I^2 = 85.0\%$, $p < 0.001$), and no publication bias. A meta-analysis of the difference in effectiveness of nurse-initiated smoking cessation interventions in patients versus non-patients found a pooled odds ratio (OR) of 1.24 (95% CI [1.02, 1.50]) for smoking cessation (Z = 2.17 $p = 0.03$) with moderate heterogeneity between studies ($I^2 = 62.0\%$, $p = 0.002$) and no publication bias.

Evaluate the quality of the literature

The risk of bias of the included RCTs was assessed independently by two reviewers using the Cochrane Collaboration's revised Cochrane risk of bias tool for randomized trials (RoB 1) [43], and disagreements were resolved by consensus. The RoB tool provides an overall structured assessment of the quality of randomized trials, consisting of five domains: randomization process, deviation from the intended intervention, missing outcome data, outcome measurement, and selection of reported outcomes [43]. Figure 3 presents the overall quality of studies assessed by RoB and the results of each individual literature quality assessment. The quality of the literature was found to be at a low risk of over 75% for randomization sequence generation, incomplete outcome data, and selective outcome reporting, and at a low risk of bias of about 50% for blinding of participants, researchers, and outcome assessors. Other areas of the RoB assessment were mostly unclear risk of bias, with high risk of bias identified in the allocation order area and participant, investigator, and outcome assessor blinding.

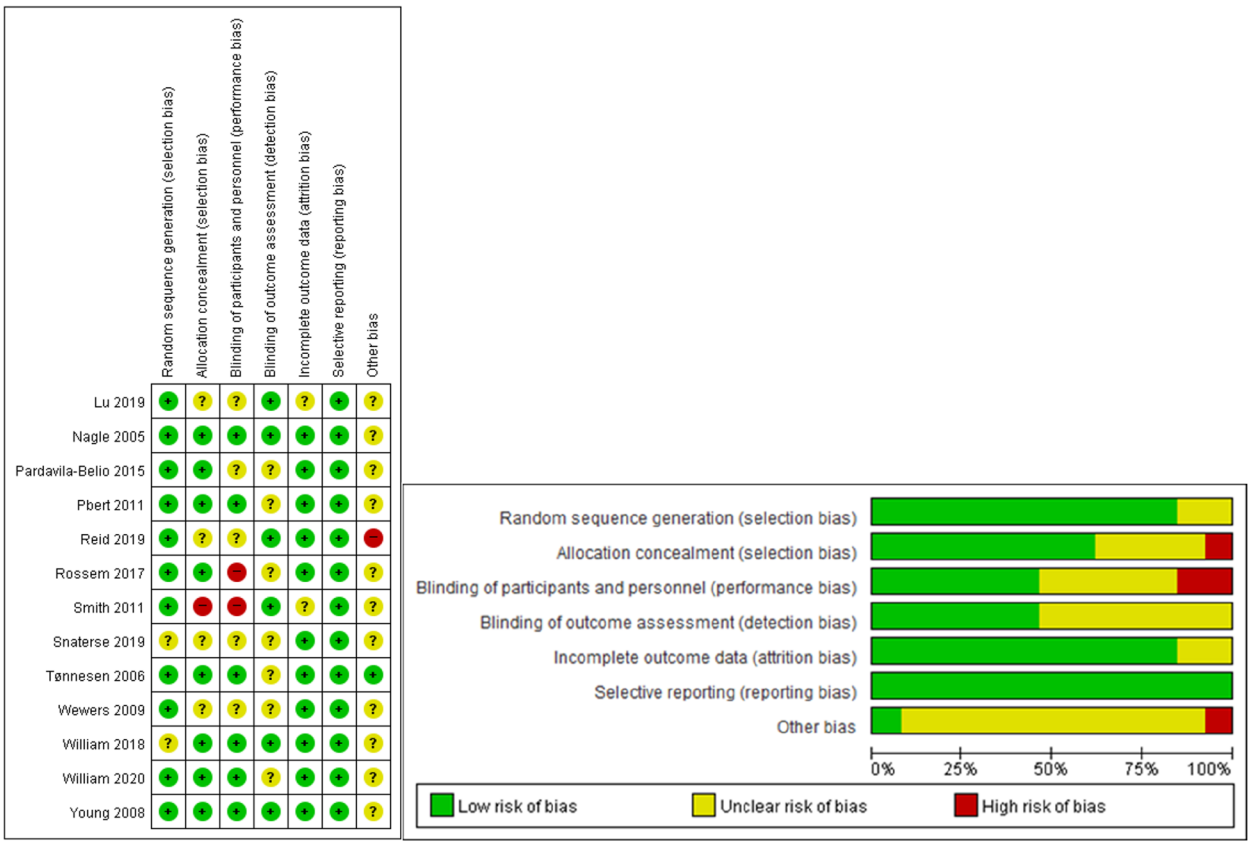

Fig. 3 Risk of bias summary

Discussion

We identified thirteen randomized controlled trials (RCTs) that examined the effects of nurse-initiated smoking cessation interventions, involving a total of 7,693 smokers from eight different countries. Our meta-analysis revealed a statistically significant in abstinence of smoking at 6-months. All thirteen trials were assessed for risk of bias and were rated as having moderate overall quality. In terms of heterogeneity, both 6 and 12-month follow-up outcome showed medium to high heterogeneity, therefore we conducted subgroup analysis.

In our study, we found that smoking cessation interventions showed significant results at the six-month follow-up, but the effects were notably diminished at the twelve-month follow-up. This discrepancy highlights the complexities involved in evaluating long-term smoking cessation rates [36]. A twelve-month assessment may not adequately capture the enduring effects of interventions, especially in the absence of ongoing support and reinforcement. The difficulty of long-term smoking cessation is consistently highlighted in a previous study, demonstrating that many smokers tend to relapse after attempting to quit [37]. These findings reflect the complexity of maintaining cessation and the interplay of various influencing factors. Therefore, the argument for the necessity of regular nurse-initiated interventions at six-month intervals is crucial. Continuous support and feedback from nurses can enhance individual motivation and provide the resources needed to overcome challenges. If such interventions are systematically implemented, they could significantly contribute to improving long-term smoking cessation success rates. Evaluating the effectiveness of these interventions through follow-up studies is essential.

Our findings align with results from a previous systematic review [38] conducted by physicians and pharmacists, which emphasize the need for continuous engagement and periodic interventions to effectively promote smoking cessation. Maintaining motivation and proactively addressing potential relapses are critical components for achieving long-term success. This suggests that while brief interventions may be beneficial in the short term, they may not be sufficient for fostering lasting behavioral change [39]. To enhance long-term outcomes, it is essential to integrate ongoing support and follow-up into smoking cessation strategies.

Our findings indicated that both biochemical indices (cotinine and saliva) demonstrated a small effect size and were not statistically significant. Several factors may contribute to this outcome. Firstly, the limited data collection of biochemical measures across only a subset of studies reduces the overall robustness of our findings. This restricted sample size may have hindered our ability to detect significant effects, emphasizing the need for more comprehensive data collection in future research. Additionally, to assess smoking cessation rates, there is a need for the development of simple and stable indicators. Existing self-report methods can be unreliable, so scientific and convenient methods such as biochemical validation or data collection through mobile apps should be considered. These approaches can provide a more accurate evaluation of cessation success and contribute to enhancing the effectiveness of the programs. Addressing these issues will be essential for enhancing our understanding of how biochemical indicators can be effectively utilized in future studies, ultimately contributing to improved smoking cessation outcomes.

In this study, we found that face-to-face intervention methods were more effective and statistically significant compared to telephone interventions in smoking cessation programs. These results accentuate the importance of personal interaction in smoking cessation efforts. Our findings align with previous systematic reviews and meta-analyses that emphasize the superiority of face-to-face interventions in smoking cessation programs. For instance, Efraimsson et al. (2015) [44] demonstrated that personal interactions significantly enhance participant outcomes compared to remote methods. This highlights the essential role of trust and immediate feedback in facilitating behavior change, as established in our study. Face-to-face interventions led by nurses facilitate the establishment of trust between the participant and the counselor, allowing for immediate feedback, which can positively impact motivation and behavior change [45]. Face-to-face interventions conducted by nurses are particularly effective due to their extensive interaction with patients. The bedside approach employed by nurses is essential in smoking cessation programs, as it cultivates trust and facilitates tailored interventions that address individual patient needs [17, 41]. Their proactive involvement significantly enhances the likelihood of successful cessation while ensuring that patients receive ongoing support and critical information throughout their cessation journey.

In face-to-face settings, counselors can observe non-verbal cues and assess the emotional state of participants, enabling a more tailored approach. In contrast, telephone interventions lack this level of direct interaction, which can affect participants'engagement and motivation [42]. Thus, face-to-face interventions may be more effective in fostering deeper consultations that promote sustained behavior changes, such as Ask-Advise-Refer (AAR) programs, motivational interviewing, nurse-led interventions, stage-matched approaches, tailored smoking cessation programs, and brief advice, all of which emphasize nurse-patient communication.

Therefore, it is essential to strengthen the components of face-to-face counseling and integrate personalized approaches in the design of smoking cessation programs.

Furthermore, our study results show that telephone interventions were also effective in promoting smoking cessation. Based on these findings, we suggest a hybrid approach for nurse-initiated smoking cessation programs to optimize the use of time and resources. A hybrid approach, combining face-to-face counseling with telephone-based interventions, allows for continuous, personalized support to a larger number of smokers, potentially improving quit rates. This strategy offers a flexible solution, maximizing the efficiency of cessation programs while minimizing the waste of resources [40].

Despite the significantly lower number of studies focused on non-patient groups compared to patient-related research, the effect size of smoking cessation interventions was observed to be higher in non-patient groups. Non-patient groups may exhibit greater receptiveness to health interventions like smoking cessation programs. General individuals who wish to quit smoking are often aware of their health issues and are more willing to seek external help, making them more likely to engage with effective interventions. This suggests that non-patient groups recognize the necessity and importance of the intervention and tend to participate actively.

In contrast, patient groups may be influenced by more complex psychological and physical factors due to existing health problems [41]. These factors can diminish the effectiveness of the intervention, as patients often experience stress and anxiety during treatment, which may lower their receptiveness to smoking cessation efforts [41]. Furthermore, smoking cessation programs for the general population can be more generalized and easily tailored to various individual circumstances, maximizing their effectiveness. For example, non-patient groups can receive interventions that better fit their lifestyle, leading to more favorable outcomes [25, 28, 32]. Conversely, interventions for patient groups may be limited or complicated due to specific health issues, reducing the overall effectiveness of the intervention. Therefore, there is a need for tailored interventions that reflect the unique characteristics of patient groups, as this could have a significant impact on public health. In this context, it is crucial to enhance the effectiveness of smoking cessation programs through individualized approaches rather than relying solely on existing clinical guidelines. We suggest that targeted interventions tailored to patient groups should address their unique psychological and physical challenges. By focusing on factors such as stress and anxiety, these programs may improve receptiveness and enhance smoking cessation outcomes.

Limitations

In this study, there are several limitations to point out. Firstly, our review focused exclusively on studies published in English, which may have resulted in the exclusion of relevant research conducted in other languages that met the inclusion criteria. Additionally, the decision to omit gray literature could increase the likelihood of publication bias.

Secondly, most of the smoking cessation intervention studies included in this meta-analysis targeted patients, while studies aimed at the general population were considerably fewer. This discrepancy suggests limitations in applying our findings to the broader public, indicating a need for further research to determine whether the effectiveness of these interventions extends beyond specific patient groups.

Lastly, a limitation of this study is the potential risk of bias due to unclear or incomplete blinding of outcome assessments. While randomization ensures initial comparability between groups, the lack of blinding may have allowed unconscious bias to influence the interpretation of results, particularly for outcomes that are not objectively measurable. This could lead to an inflation of perceived benefits of the intervention or a minimization of its adverse effects.

Conclusion

In conclusion, when it comes to nurse-initiated smoking cessation, while short-term follow-ups offer valuable insights into immediate outcomes, they also highlight the critical need for continuous intervention and support in smoking cessation efforts. Our findings, supported by the systematic review, indicate that a comprehensive approach led by trained healthcare professionals, particularly nursing professionals, is essential for improving long-term smoking cessation outcomes. This integrated strategy is vital for addressing the diverse challenges of smoking cessation and ultimately enhancing public health. Further clinical trials are required to assess the effectiveness of various intervention modalities and follow-up strategies. Future research should focus on long-term outcomes, the impact of different delivery methods, and the role of ongoing support in sustaining behavior change that led by nurses. By expanding the evidence base, researchers can develop more effective, tailored programs that meet the needs of diverse populations, ultimately contributing to higher success rates in smoking cessation and improved public health outcomes.

Abbreviations

RCT	Randomized Controlled Trial
ROB	Risk of Bias
COPD	Chronic Obstructive Pulmonary Disease

WHO World Health Organization
FCTC Framework Convention on Tobacco Control

Supplementary Information

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Supplementary Material 1

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Authors' contributions
EHL and HJY; Conceptualization and data curation, EHL and HJY; formal analysis, EHL and HJY; investigation, EHL and HJY; methodology, EHL and HJY; visualization, EHL and HJY; writing original draft, review & editing. EHL; Funding. All authors contributed to final review/approved of the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
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Consent for publication
No individual data is included in this manuscript.

Competing interests
The authors declare no competing interests.

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