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Updates on Behavioral Interventions for Smoking Cessation: A Systematic Review of Systematic Reviews

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Abstract

Introduction: In Malaysia, tobacco smoking is one of the leading causes of early and preventable mortality. The 'Clinical Practice Guidelines on Treatment of Tobacco Use Disorder 2016' is utilised to provide safe and effective smoking cessation services for smokers to quit successfully. Since the launch of the 2016 CPG, there have been several new pieces of evidence regarding behavioural interventions for tobacco smoking cessation with various outcomes. Therefore, the guidelines are expected to be updated to assist healthcare providers in helping smokers quit smoking. **Objectives**: This study aims to review the evidence from 2016 onwards for behavioural interventions in smoking cessation reported from published systematic reviews, and to update the CPG on tobacco use disorder by conducting a systematic review of systematic reviews methodology. **Methodology**: The Cochrane Library, PubMed, and Scopus databases were used to conduct a comprehensive literature search. Two reviewers performed the screening and study selection, with disagreements resolved by consensus or the involvement of another reviewer. Quality assessment and data extraction are performed by one reviewer and checked by another. AMSTAR-2 tool was used to perform the risk of bias assessment. A narrative synthesis of the data extracted was provided. **Result**: The searches resulted in a total of 276 articles and out of these, 23 systematic reviews were included. The included studies incorporated various smoking cessation interventions. Smokers of all ages and a small proportion of recent quitters are involved. They may be from the general or the special population. 14 reviews were rated as high quality, 2 were moderate, 4 were low and 3 were critically low by the AMSTAR-2 tool. The analysis found that counselling sessions, online interventions, self-help materials and motivational interviewing may increase cessation rates in the long term, if not, short term. Counselling sessions demonstrate the strongest evidence of benefit in smokers trying to quit. **Conclusion**: Findings that can be added to the updated CPG include app-based, incentives, feedback on spirometry results, exercise and behavioural interventions for people living with HIV and AIDS, COPD patients, and underprivileged older smokers.

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Introduction

Tobacco smoking is one of the biggest public health threats worldwide. Around 7 million died yearly from their smoking habit, while another 1.2 million perished from second-hand smoke exposure (WHO, 2022). In Malaysia, tobacco smoking is considered to be one of the leading causes of early and preventable mortality, with an estimated 20,000 deaths each year (MOH Malaysia, 2016). Long-term smoking causes cancer, heart disease, stroke, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis. Smoking also increases the risk of tuberculosis, certain eye diseases, and immune system problems, including rheumatoid arthritis (CDC, 2020). Most smokers are aware of the dangers of cigarette smoking and desire to quit. However, they may face difficulties, especially those attempting to quit without professional help.

In Malaysia, the 'Clinical Practice Guidelines (CPG) on Treatment of Tobacco Use Disorder 2016' by the Ministry of Health (MOH) Malaysia is utilised to provide safe and effective smoking cessation services for smokers to quit successfully. Tobacco use interventions consist of pharmacological or/and non-pharmacological (behavioural) interventions. This systematic review will only focus on behavioural interventions to assist smokers in quitting. Behavioural interventions are "interventions designed to affect the actions that individuals take concerning their health" as defined by Cutler (2004). Some behavioural interventions discussed in the 2016 CPG include individual or group counselling, quitlines, and online smoking cessation interventions (e.g., text messages, mobile phones, and web-based programmes). Counselling and quitlines aim to strengthen a person's ability to implement their plans to quit smoking and support their motivation to resist smoking. Online smoking cessation interventions delivered via text messaging or the internet show potential for helping smokers to quit because they can reach a large number of smokers and also low cost for the user (MOH Malaysia, 2016).

Since the launch of the 2016 CPG, there have been several new pieces of evidence on behavioural interventions for tobacco smoking cessation with various outcomes. Some behavioural interventions that are not discussed in the 2016 CPG include providing feedback on spirometry results (Westerdahl et al., 2019), incentives (Notley et al., 2019) and exercise-based interventions (Ussher et al., 2019) for smoking cessation. Therefore, the guidelines are expected to be updated to assist healthcare providers in helping smokers quit smoking.

The objective of this systematic review is to review the evidence for behavioural interventions in smoking cessation reported from published systematic reviews. Another objective is to update the clinical practice guidelines on tobacco use disorder by conducting a systematic review of systematic reviews methodology.

Materials and methods

Materials

This systematic review is done according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement guidelines (Page et al., 2021). The methodology in this systematic review includes developing inclusion criteria, designing a search strategy, searching through databases, articles screening and selection, quality assessment, data extraction and results presentation (V. Smith et al., 2011; Tawfik et al., 2019).

Eligibility Criteria

Types of studies

Full-text English systematic reviews published from January 2016 until November 2022 in online databases or peer-reviewed journals. Only systematic reviews with retrievable full-text articles are included. Primary studies, systematic reviews published in languages other than English or reviews that did not clearly define the behavioural intervention and/or its outcome measures are excluded.

Type of participants

Smokers from both general and special populations (e.g., pregnant women, psychiatric patients) who are willing to participate in the intervention. There are no restrictions on the participant's age, gender, or race.

Type of interventions

Any behavioural intervention for quitting conventional cigarette smoking; whether it is provided to individuals or groups, delivered face-to-face or online or both, tailored or not, regardless of the intervention provider or setting.

Type of comparators

Any comparator for the behavioural intervention may be - no intervention, another behavioural intervention type, usual or standard care, or different intensity of the intervention.

Type of outcome measures

Smoking abstinence is assessed at least 6 months from the start of intervention or quit date. Systematic reviews that emphasise other outcomes (e.g., smoking reduction) or do not specify the outcomes are excluded.

Search Strategy

A comprehensive literature search was conducted in the Cochrane Library, PubMed and Scopus databases. Key terms related to behavioural interventions (e.g., 'behavioural therapies', 'behavioural treatments', 'counselling'), and smoking cessation (e.g., 'tobacco cessation', 'tobacco smoking cessation', 'quit smoking') were combined using Boolean Operators. Filter for English language, type of study (systematic reviews) and the publication year (January 2016 to November 2022) is applied. The key terms for the search strategy are listed in **Appendix 1**.

Screening and Selection

Once articles were identified, duplicates were removed by the Mendeley software and manually. Two reviewers (NS, AN) screened the title and abstract of the identified articles. In the screening phase, publications other than systematic reviews will be excluded. The same two reviewers (NS, AN) also reviewed the full texts for eligibility. For inclusion, the systematic reviews must meet all the eligibility criteria mentioned previously. Disagreements are settled by discussion and, if necessary, a third reviewer (NA) is involved. After the full-text review, the systematic reviews remaining are included.

Assessment of Methodological Quality

AMSTAR-2 tool was used to assess the quality of methodology from the eligible systematic reviews (Shea et al., 2017). A reviewer (NS) conducted the

assessment, and another reviewer (AN) checked the result of the assessment. The results for all AMSTAR-2 items and the overall ratings for each eligible review are tabulated.

Data Extraction & Synthesis

A reviewer (NS) performed data extraction, and another reviewer (AN) cross-checked the data extracted. An Excel spreadsheet was used to record all the extracted data. The data include the publication details (e.g., authors, year of publication), population characteristics (e.g., adult smokers), type of behavioural interventions, details regarding

comparator (e.g., no intervention, other behavioural intervention), the outcome of interest, and study findings. The data were tabulated, and a narrative synthesis of the data was provided.

Results

Search Outcomes

PRISMA 2020 flow diagram **(Figure 1)** is used to visualise the screening findings and the selection of eligible reviews (Page et al., 2021). 246 studies were identified and 185 references were excluded based on titles and abstracts, resulting in 61 full-text to retrieve. However, only 57 studies can be retrieved and assessed for eligibility, then another 34 articles were excluded for not meeting the criteria hence the remaining 23 studies are included in the review.

Study Characteristics

Study populations are very diverse. Tobacco smokers of all ages and a small proportion of recent quitters were included. The smokers are either from the general or special population. In most studies, the outcome measure is smoking abstinence, assessed at a minimum of 6 months from the start of the intervention. However, some studies also assessed short-term abstinence (< 6 months). As for pregnant smokers, smoking cessation is assessed at the longest follow-up. **Table 1** summarises the study characteristics of the included review.

The included studies incorporated various behavioural smoking cessation interventions such as mindfulness (Jackson et al., 2022), incentives (Notley et al., 2019), competitions (Fanshawe et al., 2019), telephone counselling (Matkin et al., 2019), real-time video counselling (Tzelepis et al., 2019), individual counselling (Lancaster & Stead, 2017), group therapy (Stead et al., 2017), motivational interviewing (Lindson et al., 2019), print-based self-help materials (Hartmann-Boyce et al., 2014), mobile phone text messaging (Whittaker et al., 2019), app-based

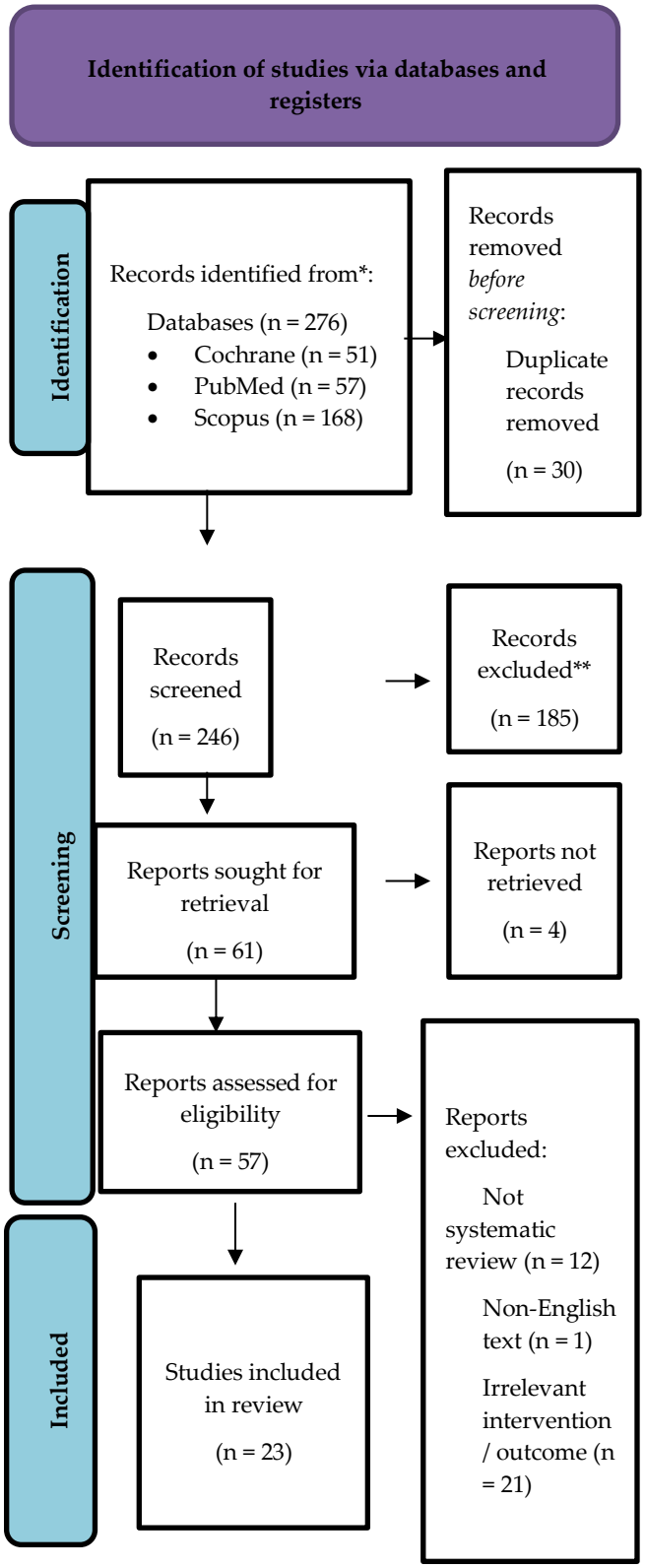

Fig.1. PRISMA 2020 diagram of included studies

intervention (Barroso-Hurtado et al., 2021; Whittaker et al., 2019), internet- or web-based intervention (Do et al., 2018; Taylor et al., 2017)

, feedback on spirometry results (Westerdahl et al., 2019), exercise (Ussher et al., 2019), and hypnotherapy (Barnes et al., 2019).

7 studies focus on providing behavioural interventions for special populations which include pregnant women (Chamberlain et al., 2017), people with severe mental illness (SMI) (Hawes et al., 2021; Spanakis et al., 2022), people living with HIV and AIDS (PLWHA) (Pool et al., 2016), people with chronic obstructive pulmonary disease (COPD) (van Eerd et al., 2016), underprivileged older smokers (Smith et al., 2019), and smokers with substance use disorder (SUD) (Thurgood et al., 2016).

Quality Assessment

The quality assessment for each eligible review is summarized in **Table 2**.

Discussions

A quitter is defined as a smoker who has successfully quit smoking or been abstinent without even a single puff of a cigarette for at least six months from the last cigarette. Six months is a typical period for measuring successful smoking cessation (MOH Malaysia, 2016). Experts also reached a consensus that prolonged or continuous abstinence for at least 6 months is important to measure smoking cessation (Cheung et al., 2017). Hence, this review focuses on behavioural interventions with smoking abstinence for at least six months. The 23 studies included in this review were very heterogeneous in terms of treatment given, comparison groups and outcome measurement; thus, a meta-analysis could not be conducted. The first part of the discussion will review the evidence on the effectiveness of available interventions for smoking cessation.

According to Lancaster & Stead (2017), there is high-quality evidence that individual counselling helps increase the cessation rate with or without pharmacotherapy after at least 6 months. The RR for individual counselling versus non-active controls (i.e., brief advice or self-help materials) was 1.57 (95% CI 1.40 to 1.77) in smokers not receiving pharmacotherapy, and 1.24 (95% CI 1.01 to 1.51) in smokers receiving pharmacotherapy. More intensive counselling moderately has a small relative benefit compared to a brief counselling session. The RR for more intensive versus less intensive counselling was 1.29 (95% CI 1.09 to 1.53).

Stead et al. (2017) found that there is reasonable evidence that group counselling is better in helping people stop smoking than non-active controls. The RR for group therapy versus self-help materials was 1.88 (95% CI 1.52 to. 2.33) while the RR for group therapy versus brief advice was 1.25 (95% CI 1.07 to 1.46). The study also found that there is no evidence that group counselling is superior to intensive individual counselling, whether or not the number of sessions was matched. The RR for group therapy versus individual counselling was 0.99 (95% CI 0.76 to 1.28). Most of the counselling sessions, whether individual or group, included repeated contact but it differs whether face-to-face or telephone contact was used after the initial meeting. However, studies suggest that it may not be important which contact is maintained.

Table 1. Study characteristics summary.

Authors (Publication year)	Number of studies included	PICO				Findings
		Participants	Interventions	Comparator	Outcome measure	
Lancaster & Stead (2017)	49	Any smokers.	Face-to-face encounter between a smoker and a counsellor trained in assisting smoking cessation.	No interventions, non-active interventions (i.e. brief advice or self-help), different counselling intensity.	Smoking cessation at the longest reported follow-up (6 months or more).	There is high-quality evidence that individual counselling can assist smokers in quitting. There is consistent evidence that individual counselling increases the likelihood of cessation compared to less intensive support. There is moderate-quality evidence of a smaller relative benefit when counselling is used in addition to pharmacotherapy, and of more intensive counselling compared to a brief counselling intervention. • Individual counselling versus non-active controls: RR 1.57 (95% CI 1.40 to 1.77) • Individual counselling + pharmacotherapy versus non-active controls: RR 1.24 (95% CI 1.01 to 1.51) • Individual counselling versus non-active controls: RR 1.29 (95% CI 1.09 to 1.53)
Stead et al. (2017)	66	Adult smokers.	Smokers met for scheduled meetings and received some form of behavioural intervention (i.e., information, advice, encouragement or cognitive behavioural therapy) over at least two sessions.	No intervention, non-active interventions (i.e. brief advice or self-help), individual counselling sessions.	Abstinence from cigarettes at follow-up at least six months after the start of treatment.	There is reasonable evidence that group therapy is better than non-active controls in helping people stop smoking, although it may be no better than advice from a healthcare provider. There is not enough evidence to determine how effective they are compared to intensive individual counselling. • Group therapy versus no intervention: RR 2.60 (95% CI 1.80 to 3.76) • Group therapy versus self-help programmes: RR 1.57 (95% CI 1.40 to 1.77) • Group therapy versus brief support: RR 1.25 (95% CI 1.40 to 1.77) • Group therapy versus face-to-face individual intervention: RR 0.99 (95% CI 0.76 to 1.28)
Matkin et al. (2019)	104	Current smokers.	Proactive or reactive telephone counselling to assist smoking cessation. The number, duration and content of the telephone calls varied.	Any intervention without telephone counselling (i.e. self-help materials, standard advice or different counselling interventions).	Long-term smoking cessation (i.e. at least six months after the start of intervention).	There is moderate-certainty evidence that proactive telephone counselling aids smokers who seek help from quitlines and increases quit rates in smokers in other settings. There is insufficient evidence that a higher number of calls would result in a more significant effect, although limited evidence suggests interventions offering additional calls may be more effective than those offering one call only. Due to limited studies, evidence was inconclusive on the effect of reactive telephone counselling. • Additional proactive calls for smokers calling quitlines: RR 1.38 (95% CI 1.19 to 1.61) • Proactive calls for smokers not calling quitlines: RR 1.25 (95% CI 1.15 to 1.35)
Tzelepis et al. (2019)	2	Current tobacco smokers.	Real-time video counselling via telemedicine video conferencing technology or other platforms (i.e., Skype, FaceTime, Facebook Messenger, etc.) or alternative forms of video communication.	Telephone counselling for smoking cessation.	Primary outcome: Smoking cessation (e.g. point prevalence, continuous or prolonged abstinence) measured at least six months from baseline.	There is no evidence of a difference in smoking cessation between video counselling and telephone counselling. There is insufficient evidence to draw conclusions regarding the effectiveness of integrating real-time video counselling into the routine practices of quitlines and other smoking cessation services. • Real-time video counselling versus telephone counselling: RR 2.15 (95% CI 0.38 to 12.04)
Whittaker et al. (2019)	26	Current smokers.	Mobile-based programmes (i.e. text messaging, smartphone apps) for smoking cessation.	Text messaging versus minimal smoking cessation support, text messaging in addition to other smoking cessation support, and smartphone app versus less intensive smoking cessation support.	Smoking abstinence at the longest follow-up, and at least six months from baseline.	There is moderate-certainty evidence that text message improves smoking cessation rates, either delivered on their own or as an add-on to other treatments. There is no evidence comparing different intensity text messages on long-term abstinence. There is insufficient evidence to evaluate the effect of mobile app interventions and low-certainty evidence comparing smartphone apps with less intensive support. There is no evidence for a benefit of high-intensity smartphone apps when compared with lower-intensity apps or minimal non-app smoking cessation support. • Text message versus minimal cessation support: RR 1.54 (95% CI 1.19 to 2.00) • Text message + other support versus other support alone: RR 1.59 (95% CI 1.09 to 2.33) • Smartphone app versus lower-intensity support: RR 1.00 (95% CI 0.66 to 1.52)
Barroso-Hurtado et al. (2021)	24	Adult daily smokers (aged 18 and over).	Smartphone apps for smoking cessation. (1) general apps for smoking cessation, which do not include face-to-face contact (GSC-Apps) (2) smoking cessation apps combined with face-to-face intervention (FFSC-Apps)	Other interventions (ie. face-to-face treatment, other mobile apps, brief advice, etc.)	Primary outcome: the effect of smartphone apps for smoking cessation on tobacco use, abstinence, and relapse rates.	Most studies showed that mHealth apps are at least as useful as the control conditions (e.g., brief advice). FFSC-Apps could increase the intensity of smoking cessation treatments because combining an app with face-to-face contact offers more tools to quit. As for GSC-Apps, these kinds of apps can reach more people, increasing the number of people who have access to smoking cessation treatments because they are offered anywhere and at any time. Both kinds of apps could play an important role in the smoking cessation field.
Taylor et al. (2017)	67	Current smokers.	Internet interventions in all settings and from all types of providers.	Non-active controls (i.e. self-help or usual care), active control arm (e.g. telephone or face-to-face counselling), evaluated the addition of an Internet programme plus behavioural support and compared one Internet intervention to another.	Smoking cessation at least six months after the start of the intervention, and longer.	Interactive, tailored Internet-based interventions with or without additional behavioural support are moderately more effective than non-active controls (i.e. printed self-help, usual care) at six months or longer, but there was no evidence that these interventions were better than other active controls (i.e. phone or face-to-face counselling). Non-tailored and interactive Internet interventions appeared no better than non-active controls. Treatment effectiveness in younger people is unknown. • Interactive, tailored Internet intervention versus non-active controls: RR 1.15 (95% CI 1.01 to 1.30) • Internet + behavioural support versus non-active controls: RR 1.69 (95% CI 1.30 to 2.18) • Text message versus minimal cessation support: RR 1.54 (95% CI 1.19 to 2.00)

Do et al. (2018)	108	Adult smokers, followed by youth and other special subpopulations.	Web-based programs, mobile phone-based intervention, computer-assisted intervention, mobile health (mHealth) platforms, and others.	No intervention, usual practice, non-active control, other smoking cessation methods, other eHealth control groups, and interactive tailored web-based compared to an active control group.	Levels of smoking abstinence.	Web-based and mHealth apps may moderately increase smoking cessation rates over short-term periods. Compared to active control groups or other eHealth modes, there is no evidence of the effectiveness of internet-based cessation programs. Tailored web-based and text messaging supports may increase cessation while computer-assisted interventions alone have little impact on smoking abstinence. • Web-based intervention versus non-active controls: RR 2.03 (95% CI 1.70 to 2.03) • mHealth platform versus non-active controls: RR 1.71 (95% CI 1.35 to 2.16) • Computer-assisted interventions versus non-active controls: RR 1.16 (95% CI 1.06 to 1.26)
Livingstone-Banks et al. (2019)	75	Any smokers.	Written materials (i.e. booklets and leaflets), audio or video.	No intervention, tailored self-help programmes versus non-tailored, provision of additional materials to other interventions.	Sustained abstinence, or point prevalence, with a minimum follow-up of six months.	There is moderate-certainty evidence that written self-help materials help more people to stop smoking than no intervention. There is moderate-certainty evidence showing that tailored self-help materials are more effective than no intervention. There is no evidence of benefit comparing tailored self-help materials with untailored materials delivered. • Non-tailored self-help materials versus no materials: RR 1.19 (95% CI 1.03 to 1.37) • Tailored self-help materials versus no materials: RR 1.34 (95% CI 1.19 to 1.51)
Lindson et al. (2019)	37	Tobacco smokers from the general and special populations.	Interventions labelled as either motivational interviewing (MI) (e.g. evoking motivation and confidence to quit, eliciting 'change talk' and supporting self-efficacy) or Motivation Enhancement Therapy (MET), for tobacco smoking cessation.	No intervention, another smoking cessation intervention, lower intensity of MI, and comparison of MI in addition to another smoking cessation treatment versus that smoking cessation treatment alone.	Primary outcome: Smoking cessation at the longest follow-up.	There is insufficient evidence to assess whether MI increases the cessation rate compared with no intervention. MI may modestly increase the likelihood of long-term smoking cessation when used in addition to other interventions or when compared with non-MI cessation interventions. Higher-intensity MI may improve smoking cessation rates compared to lower-intensity MI. • Motivational interviewing versus no intervention: RR 0.84 (95% CI 0.63 to 1.12) • Motivational interviewing versus other intervention: RR 1.24 (95% CI 0.91 to 1.69) • MI + other intervention versus other intervention only: RR 1.24 (95% CI 0.91 to 1.69) • Higher-intensity MI versus lower-intensity MI: RR 1.23 (95% CI 1.11 to 1.37)
Notley et al. (2019)	43	Adult smokers.	Incentive schemes to reward participants for validated cessation and abstinence in smoking cessation programmes.	Any intervention without incentives.	Long-term smoking cessation is assessed at least six months from the start of the intervention.	There is high-certainty evidence that incentives boost long-term cessation rates (≥ 6 months) compared to no incentives. This effect appears to persist following their discontinuation, suggesting that even a short incentive intervention may have long-term benefits. There is moderate-certainty evidence that incentives also boost the long-term cessation rates of pregnant women who smoke, which continues post-partum. • Incentives versus no incentives: RR 1.49 (95% CI 1.28 to 1.73) • Incentives versus no incentives (in pregnant women): RR 2.38 (95% CI 1.54 to 3.69)
Fanshawe et al. (2019)	20	Current adult smokers.	Contests, competitions, lotteries, including Quit & Win contests, to reward cessation or continuous abstinence.	No intervention or non-competition based smoking cessation intervention.	Primary outcome: smoking cessation rate at longest follow-up at least six months from the start of the intervention.	At present, it is impossible to draw any firm conclusions about the effectiveness, or a lack of it, of smoking cessation competitions. This is due to a lack of well-designed comparative studies. Smoking cessation competitions have not been shown to enhance long-term cessation rates. It is also unclear whether the value or frequency of possible cash reward schedules influences the success of competitions.
Jackson et al. (2022)	21	Current tobacco smokers of any age.	Interventions include mindfulness training, acceptance and commitment therapy (ACT), distress tolerance training, or yoga.	No intervention, other smoking cessation intervention, other type of mindfulness intervention (e.g. mindfulness of lower intensity).	Smoking cessation at least six months from the start of the intervention.	There is no clear, long-term benefit of mindfulness-based smoking cessation interventions for increasing smoking quit rates or changing mental health and well-being. However, the evidence was of low and very low certainty due to risk of bias, inconsistency, and imprecision, meaning future evidence may very likely change the interpretation of the results.
Barnes et al. (2019)	14	Smokers who wish to stop smoking.	Hypnotherapy for smoking cessation.	Other approaches to help people stop smoking (i.e. brief advice, or more intensive stop-smoking counselling), or no treatment.	Abstinence from smoking assessed at least six months from the start of treatment.	There is insufficient evidence to support the use of hypnotherapy as a specific treatment for smoking cessation. This review does not demonstrate evidence of a greater long-term benefit of hypnotherapy when compared to other interventions, or to no intervention, for smoking cessation. Most studies did not detect significant differences in quit rates at six months or longer.
Westerdahl et al. (2019)	7	Adult (>18 years) smokers who participate in smoking cessation, respiratory disease screening, or health monitoring programmes.	All interventions in which spirometry results are used to increase motivation to quit smoking.	No intervention or interventions other than those incorporating spirometry results.	Percentage smoking cessation, measured short-term (1 to 6 months) and long-term (more than 6 months).	There is currently only limited evidence to support the use of feedback from spirometry results in addition to smoking cessation counselling with the aim of increasing smoking quit rates. The best way to provide this feedback to the smoker and who should provide the information remains unclear.
Ussher et al. (2019)	24	Tobacco smokers wishing to quit, or recent quitters.	Exercise programme alone or as an adjunct to a smoking cessation intervention.	Non-exercise smoking cessation programme.	Smoking cessation measured after at least six months, using the most rigorous definition available, on an intention-to-treat basis.	There is insufficient evidence to support exercise as a specific aid to smoking cessation. There is no evidence of benefit comparing exercise to other smoking cessation treatments and no evidence of different effects by the type of exercise. Future trials may change these conclusions. • Exercise versus other interventions: RR 1.08 (95% CI 0.96 to 1.22)

Chamberlain et al. (2017)	102	1. Women who are currently smoking or have recently quit smoking and are pregnant, in any care setting. 2. Women who are currently smoking or have recently quit smoking and are seeking a pre-pregnancy consultation.	1. Counselling interventions 2. Health education interventions 3. Feedback interventions 4. Incentive-based interventions 5. Social support (peer, professional and/or partner) 6. Others	Usual care, less intensive interventions, different intervention of the same intensity.	Primary outcome: Smoking abstinence in late pregnancy (point prevalence abstinence): a. self-reported or biochemically validated; b. biochemically validated only	Psychosocial interventions can support women to stop smoking during pregnancy. Evidence from this review suggests that health education and risk advice alone is not sufficient, and any psychosocial support should include additional components, such as counselling, incentives or feedback. The effect of partner support is unclear, and care is needed when including peer- or partner-support components as it may be unhelpful, and may potentially expose vulnerable women to increased risk. • Incentives versus other interventions: RR 2.36 (95% CI 1.36 to 4.09) • Counselling versus usual care: RR 1.44 (95% CI 1.19 to 1.73) • Feedback versus usual care: RR 4.39 (95% CI 1.89 to 10.21)
Spanakis et al. (2022)	12	Adults with severe mental illness and no substance abuse problems (other than nicotine addiction) or learning disability, dementia, other neurocognitive disorders or terminal illness.	Behavioural smoking cessation and reduction interventions (i.e. motivational interviewing, CBT, self-help booklets, advice, etc.).	Any type of behavioural smoking cessation and reduction strategies to each other, usual care or no intervention.	Primary outcome: biochemically verified smoking cessation.	Tailored face-to-face smoking cessation interventions for adults with severe mental ill health appear to be effective when compared with usual care across all time points, but the evidence is equivocal when compared with other active interventions. There is limited evidence comparing tailored online interventions with non-tailored online interventions, and the authors found no studies comparing them with usual care. • Tailored face-to-face intervention versus usual care: RR 2.29 (95% CI 1.38 to 3.81) [medium-term] • Tailored face-to-face intervention versus usual care: RR 1.58 (95% CI 1.09 to 2.30) [long-term] • Tailored online interventions versus non-tailored online interventions: RR 0.87 (95% CI 0.17 to 4.46)
Hawes et al. (2021)	18	Cigarette smokers with schizophrenia or bipolar disorder, or severe mental illness (SMI).	Psychosocial smoking cessation intervention.	Usual care, any type of psychosocial intervention to each other.	Smoking abstinence, smoking reduction, nicotine dependence & quit attempts; with follow-up lengths of less than 6-month, 6-to-11 months, 12 months or longer.	The most promising psychosocial smoking cessation interventions seemed to be initiated in inpatient psychiatric units and employed either a transtheoretical approach (i.e., stage- tailored, decisional balance) or individually-tailored telephone behavioral smoking counseling using a motivational-interviewing framework.
Thurgood et al. (2016)	17	Adult (>18 years) smokers who had recently completed or were currently receiving treatment for a substance use disorder (drugs or alcohol).	Smoking cessation interventions - pharmacological and nonpharmacological approaches.	Usual care.	Primary outcome: biochemically verified (carbon monoxide) self-reported continuous abstinence from smoking, at the 6- or 12-month follow-up.	Smoking cessation interventions using NRT and behavioural support combination appear to increase smoking abstinence in those treated for substance use disorders and have no effect on other substance use treatment outcomes. Continuous abstinence differed significantly between groups at 6 and 12 months, with both intervention groups achieving higher rates than the usual care group. Some studies did not find treatment effective at 6 or 12 months and observed significant effects at shorter-term follow-ups.
Pool et al. (2016)	14	Smokers over 18 years who were HIV-positive.	Interventions include both behavioural and pharmacological elements.	Less intensive control, typically comprising a brief behavioural intervention plus pharmacotherapy.	Primary outcome: tobacco abstinence at least six months after the start of the intervention.	Intense combined pharmacotherapy and behavioural support interventions were effective in achieving abstinence in the short-term (4 weeks to less than 6 months) compared to a control group (i.e. a single brief intervention and pharmacotherapy). However, this effect was not observed for long-term abstinence (> 6 months). The authors could not assess whether interventions combining pharmacotherapy and behavioural support were more effective than either type of support alone. The effects of tailoring, number of contacts and total duration of contact of behavioural support remain unclear.
van Eerd et al. (2016)	16	Smokers with a diagnosis of COPD.	Any pharmacological or/and behavioural treatment as an aid to smoking cessation in participants with COPD.	No treatment or usual care, or one form of behavioural treatment versus a different form of behavioural treatment.	Primary outcome: Percentage of participants with continuous or prolonged abstinence over a period of six months or longer.	Evidence showed higher abstinence rates for high-intensity behavioural treatment over usual care or low-intensity. There is high-quality evidence that a combination of behavioural and pharmacotherapy is effective in helping smokers with COPD quit. Furthermore, the authors conclude that there is no convincing evidence for preferring any particular form of behavioural or pharmacological treatment. • Behavioural intervention versus no intervention or usual care: RR 25.38 (95% CI 8.03 to 80.22)
Smith et al. (2019)	11	Smokers from socioeconomically deprived groups, defined through either individual (eg, educational level, income) or area level indicators (eg, postcode).	A range of interventions including pharmacological and behavioural interventions.	All study types with a pre-intervention/ post-intervention and/or a control group.	Primary outcome: smoking abstinence.	Tailored counselling delivered in a community setting demonstrates the benefits of smoking cessation. The optimal mode and duration of intervention were unclear with findings suggesting varying success for both group and individual behavioural support. The current review demonstrates that certain aspects of behavioural interventions (i.e. incentives, peer facilitators, more intensive counselling) are promising for encouraging cessation in older, deprived smokers.

Table 2. Quality assessment summary.

Article	Items																Quality rating
	1	2*	3	4*	5	6	7*	8	9*	10	11*	12	13*	14	15*	16	
Jackson et al. (2022)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Notley et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Fanshawe et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Matkin et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Tzelepis et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Lindson et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Livingstone-Banks et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Whittaker et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Ussher et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Barnes et al. (2019)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Taylor et al. (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Chamberlain et al. (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Pool et al. (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
van Eerd et al. (2016)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	High
Stead et al. (2017)	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Moderate
Do et al. (2018)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	PY	Moderate
Lancaster & Stead (2017)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Low
Spanakis et al. (2022)	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Low
Thurgood et al. (2016)	Y	N	Y	Y	Y	Y	Y	Y	Y	N	NC	NC	Y	Y	Y	Y	Low
Barroso-Hurtado et al. (2021)	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	NC	NC	Y	N	N	Y	Low
Westerdahl et al. (2019)	Y	N	Y	Y	Y	Y	N	Y	Y	N	NC	NC	Y	N	N	Y	Critically low
Hawes et al. (2021)	Y	Y	Y	Y	Y	Y	N	Y	Y	N	NC	NC	N	Y	Y	Y	Critically low
Smith et al. (2019)	Y	Y	N	Y	N	N	N	Y	Y	N	NC	NC	N	Y	N	Y	Critically low

Indicator - N: No, Y: Yes, PY: Probably Yes, NC: Not conducted

* Critical items that have critical effect on the overall quality of systematic reviews.

Item 1. Did the research questions and inclusion criteria for the review include the components of PICO?

Item 2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?

Item 3. Did the review authors explain their selection of the study designs for inclusion in the review?

Item 4. Did the review authors use a comprehensive literature search strategy?

Item 5. Did the review authors perform study selection in duplicate?

Item 6. Did the review authors perform data extraction in duplicate?

Item 7. Did the review authors provide a list of excluded studies and justify the exclusions?

Item 8. Did the review authors describe the included studies in adequate detail?

Item 9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?

Item 10. Did the review authors report on the sources of funding for the studies included in the review?

Item 11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?

Item 12. If meta-analysis was performed, did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?

Item 13. Did the review authors account for RoB in primary studies when interpreting/discussing the results of the review?

Item 14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?

Item 15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?

Item 16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

As for telephone counselling or quitlines, there are two types of quitlines which are the 'proactive quitlines' and 'reactive quitlines'. In proactive quitlines, healthcare providers call smokers on a pre-arranged basis; while in reactive quitlines, smokers contact the helpline to ask for assistance or support. Proactive quitlines have received more evaluation compared to reactive quitlines as they are more easily controlled (MOH Malaysia, 2016). Matkin et al. (2019) conclude that proactive quitlines help increase quit rates in smokers in the long term. Smokers who were provided with more than one call may have more chance of quitting than those with only a single session. Currently, there is limited evidence of the effectiveness of reactive quitlines hence conclusion cannot be made. Providing additional proactive calls in reactive quitlines may help increase smoking cessation rates in which the RR was 1.38 (95% CI 1.19 to 1.61). People who have not contacted quitlines but receive other cessation interventions also can be given proactive telephone counselling, and these individuals may or may not be motivated to try to quit. The RR for providing proactive telephone counselling for smokers not contacted quitlines was 1.25 (95% CI 1.15 to 1.35).

The counselling approaches go in line with the CPG in which individual, group and telephone counselling are effective and should be used in smoking cessation interventions. On the other hand, Tzelepis et al. (2019) assessed the effectiveness of real-time video counselling for smoking cessation. There is very little evidence on the effectiveness of real-time video counselling compared to telephone counselling in which the RR was 2.15 (95% CI 0.38 to 12.04). Since the systematic review found only two RCTs and both studies use the same comparator, there is insufficient evidence from which to draw valid conclusions about the effectiveness of incorporating real-time video counselling into the standard practices of other smoking cessation services.

According to Whittaker et al. (2019), there is moderate-certainty evidence that text messages, with or without additional intervention improve long-term abstinence rates. The RR for text message alone versus minimal support was 1.54 (95% CI 1.19 to 2.00) and the RR for text message in addition to other smoking cessation interventions versus other interventions alone was 1.59 (95% CI 1.09 to 2.33). There is no evidence that different intensities of text messages affect the long-term cessation rate. There is insufficient evidence to evaluate the effect of mobile app-based intervention for smoking cessation. The RR for smartphone app versus lower-intensity smoking cessation intervention was 1.00 (95% CI 0.66 to 1.52) but the evidence was of very low certainty.

Barroso-Hurtado et al. (2021) also reviewed the evidence on the effectiveness of smoking cessation apps and found that these apps produced abstinence rates ranging from 36% to 100% at the end of treatment, making them at least as effective as the control intervention (i.e., brief advice). The study classified available app-based intervention as general smoking cessation apps (GSC-Apps) which has no face-to-face contact with healthcare professional, and smoking cessation app combined with face-to-face contact (FFSC-Apps). The authors find both kinds of mHealth apps are promising tools as they may complement established conventional cessation therapy, although FFSC-Apps could provide more intensity. However, only a few studies in this review included a 6-month or longer follow-up hence the evaluation of long-term abstinence from the treatment is limited.

Taylor et al. (2017) noted that non-interactive, non-tailored Internet interventions were no better than non-active controls. There is moderate-certainty evidence that interactive, tailored Internet-based interventions, either delivered on their own or as an adjunct to other interventions, are more effective than non-active controls at six months or longer. The RR for Internet intervention alone versus non-active controls was 1.15 (95% CI 1.01 to 1.30) and the RR for Internet intervention added to other behavioural support versus non-active control was 1.69 (95% CI 1.30 to 2.18). Interactive, tailored Internet-based interventions appear slightly better than non-interactive, non-tailored Internet interventions. However, tailored Internet-based interventions appeared no better than active controls (i.e., counselling) in which the RR for this comparison was 0.92 (95% CI 0.78 to 1.09). The pieces of evidence found are mostly on adults while effects on younger people are unknown or limited.

Electronic-based (eHealth) interventions for smoking cessation were assessed by Do et al. (2018) which include web-based, phone-based, mobile-based (mHealth) and computer-assisted interventions. The findings support that interactive and tailored web-based, mHealth platforms and text messaging may increase the smoking cessation rate. Evidence shows the approaches led to six-month or longer quit rates compared to non-active control. The RR for web-based intervention versus non-active controls was 2.03 (95% CI 1.70 to 2.03). The RR for the mHealth platform versus non-active control was 1.71 (95% CI 1.35 to 2.16). Computer-assisted interventions alone do not have much of an effect on smoking abstinence compared to non-active control in which the RR was 1.16 (95% CI 1.06 to 1.26). Little to no benefit was found regarding the effectiveness of internet-based interventions when compared to active control or other eHealth interventions.

To summarise online smoking cessation interventions such as text messages, web-based, internet-based, and mobile-based are effective in assisting smokers to quit smoking, which aligns with the 2016 CPG. As for app-based interventions, there is currently limited evidence of their effectiveness for long-term abstinence but is considered a promising tool in the future. Interactive and tailored Internet interventions for smoking cessation appear to have better effects than non-interactive and non-tailored ones.

Self-help materials are commonly provided to all smokers seeking help to quit smoking. Livingstone-Banks et al. (2019) evaluated that printed self-help materials help people to quit smoking compared to no intervention in the medium to long term. The RR for non-tailored materials versus no materials was 1.19 (95% CI 1.03 to 1.37), meanwhile, the RR for tailored materials versus no materials was 1.34 (95% CI 1.19 to 1.51). However, there is no evidence that self-help materials provide additional benefits to other smoking cessation interventions.

Aside from self-help materials, MI techniques also have already been incorporated into the CPG as one of the standardised behavioural approaches (MOH Malaysia, 2016). Lindson et al. (2019) reported that there is not enough evidence to evaluate whether motivational interviewing (MI) increases the smoking cessation rate compared to no intervention, however, this was of low-certainty evidence. The RR for MI versus no intervention was 0.84 (95% CI 0.63 to 1.12). When compared to other interventions or used in conjunction with them, MI may modestly increase the potential for long-term smoking cessation. The RR for MI

versus other intervention was 1.24 (95% CI 0.91 to 1.69) while the RR for MI added to other intervention versus other intervention only was 1.07 (95% CI 0.85 to 1.36). Evidence is also in favour of more intensive MI compared to the less intensive ones in which the RR was 1.23 (95% CI 1.11 to 1.37).

As per Notley et al. (2019), there is high-certainty evidence that incentives may improve long-term smoking cessation rates compared to no incentives. The RR for this comparison was 1.49 (95% CI 1.28 to 1.73). The author focuses mainly on the financial incentives (i.e. money, vouchers). There were concerns regarding the financial implications on the provider in which the author discussed the reported costs from his gathered pieces of evidence. It was found that the cost per quitter from the incentive intervention is lower compared to quitting with other interventions (e.g. nicotine gum, varenicline, free cessation aids). One even noted that in Thailand, the intervention complies with the WHO's ranking of "very cost-effective". Still, the affordability of this intervention may vary across different countries and should be studied in the future. There were also concerns that the long-term smoking cessation effect might not last long once the rewards were discontinued. However, incentives can support the initiation cessation within individuals, and they may adapt to this change over time. This also moderately applies to pregnant smokers in which the effect continues post-partum (10 to 24 weeks). The RR for incentives versus no incentives in smoking pregnant women was 2.38 (95% CI 1.54 to 3.69). This suggests that incentives have a significant impact on sustained smoking cessation and long-term effects can be maintained. The authors however cannot conclusively link the incentives' value or frequency to the efficiency of the intervention.

On the other hand, smoking cessation competitions such as Quit & Win contests, have not been shown to enhance long-term cessation rates. As for the incentive, it is unclear whether the value or frequency of the reward affects the outcome measure (Fanshawe et al., 2019). As for mindfulness-based interventions, clear evidence of the long-term effect of the intervention on increasing the smoking cessation rate also were not found. The evidence was of low and very low certainty due to the risk of bias, imprecision and inconsistency (Jackson et al., 2022). Same as Barnes et al. (2019), the authors found no evidence of a specific effect in providing hypnotherapy for long-term smoking cessation. The authors reported that if hypnotherapy was able to increase the smoking quit rate compared to no intervention or brief advice, it may be because of nonspecific factors such as prolonged contact with a therapist.

Westerdahl et al. (2019) reviewed the benefit of including feedback on spirometry results (FEV1 and/or lung age) in smoking cessation counselling. A small proportion of the evidence shows that it demonstrated a benefit, suggesting the potential for its inclusion as a future intervention. The effect of incorporating spirometry results in counselling should be tested more in real-life settings and explored in future studies to enhance the quality of evidence.

Another intervention that has limited evidence of its effectiveness for smoking cessation is exercise interventions. The RR for exercise intervention alone or in conjunction with other interventions versus other interventions alone was 1.08 (95% CI 0.96 to 1.22. It was demonstrated that acute bouts of exercise may be beneficial in reducing craving and withdrawal symptoms. The author remarked that if exercise plays a role in helping individuals quit smoking, a continuous commitment is likely essential for

sustaining smoking cessation (Ussher et al., 2019). Exercise does not appear to be superior to other smoking cessation therapies, however, its potential should not be completely dismissed as an adjunct intervention alongside other treatments.

Findings from most studies suggest that behavioural interventions of any type or component are effective in increasing long-term smoking cessation rates compared to no intervention. However, it is difficult to determine which intervention or components are the most effective. As discussed by Stead et al. (2017), a few problems should be noted in conducting a systematic review of behavioural interventions. One of them is the choice of an appropriate control condition for behavioural intervention, which may cause difficulties in evaluating the efficacy of the intervention. However active interventions such as counselling and online interventions appear to be more effective than non-active interventions such as printed self-help materials and brief advice. For better outcomes, interactive, tailored and high-intensity interventions using a single or a combination of treatments may be required.

The next part of the discussion will focus on findings from studies that discuss the interventions for special populations as extra care should be given when treating certain special populations.

One of the special populations focused on is pregnant women and some psychosocial interventions recommended from the 2019 CPG were advice, self-help materials, and counselling sessions. Evidence from Chamberlain et al., (2017) reveals that providing advice regarding health-related risks or health education alone is not enough. Any psychosocial assistance should include elements like incentives, counselling, or feedback. There is high-certainty evidence that incentives had a large effect and the RR for incentives compared to alternative interventions was 2.36 (95% CI 1.36 to 4.09). Counselling or providing feedback (i.e., fetal health, carbon monoxide) works best when tailored or combined with other approaches. Compared to usual care, the RR for counselling was 1.44 (95% CI 1.19 to 1.73) while the RR for feedback was 4.39 (95% CI 1.89 to 10.21). The effect of social support (partner, peer, healthcare provider) on smoking cessation in pregnant women is unclear.

Spanakis et al. (2022) and Hawes et al. (2021) analysed behavioural smoking cessation interventions for smokers with serious mental illness (SMI). It is important that all psychiatric patients who smoke be asked to quit when seen in psychiatric services (MOH Malaysia, 2016). Hawes et al. (2021) also acknowledged this by pointing out that the most promising behavioural interventions for smoking cessation appear to be the ones that were initiated in inpatient psychiatric facilities. Findings from this review showed that there is insufficient evidence to support any particular durations, intensities or modes of psychosocial interventions for smokers with SMI (Hawes et al., 2021).

However, tailored, face-to-face intervention for adult smokers with SMI is effective when compared with usual care but appears to be indefinite when compared with other active interventions. The RR value for tailored face-to-face intervention versus usual care was 2.29 (95% CI 1.38 to 3.81) in the medium term and 1.58 (95% CI 1.09 to 2.30) in the long term. There is no evidence of benefit found comparing tailored online interventions with non-tailored online interventions, in which the RR was 0.87 (95% CI 0.17 to 4.46) in the medium term (Spanakis et al., 2022).

Thurgood et al. (2016) noted that pharmacotherapy and behavioural support combinations were beneficial in adult smokers receiving treatment for substance use disorder (SUD). Combination smoking cessation intervention increases the abstinence rate and does not affect other substance use treatment outcomes. Smokers receiving behavioural support for 6-months and 12-months have significant differences in continuous abstinence, but both groups achieve higher abstinence rates than the usual care. Evidence that did not find treatment effective in the long-term also observed significant effects at follow-ups of less than 6-months. This demonstrates that behavioural interventions can increase the abstinence rate among smokers with SUD.

Pool et al. (2016) assessed smoking cessation interventions in people living with HIV and AIDS (PLWHA). Compared to the control group which typically consisted of a single brief intervention and pharmacotherapy, this review found that more intensive, combined behavioural and pharmacological interventions were effective in increasing the chance of achieving abstinence in the short-term (4 weeks to 6 months). However, this effect was not observed for long-term abstinence (greater than six months). The authors were unable to assess whether combined pharmacotherapy and behavioural interventions were more effective than either type of support alone. They also did not discuss any specific intervention that is best for PLWHA. It is unclear on the effects of tailoring, total amount and duration of contact of behavioural support.

Van Eerd et al. (2016) found high-quality evidence that smokers with chronic obstructive pulmonary disease (COPD) can successfully quit when provided a combination of pharmacotherapy and behavioural treatment. The RR for behavioural intervention versus no treatment or usual care was 25.38 (95% CI 8.03 to 80.22). Behavioural interventions of high-intensity increased abstinence rates compared to usual care and low-intensity behavioural intervention. Evidence that compared one high-intensity behavioural treatment with another did not provide sufficient data to draw clear conclusions. The authors also conclude that there is little support for favouring any specific pharmacological or behavioural treatment.

According to Smith et al. (2019), underprivileged older smokers may benefit from tailored counselling delivered in the community setting. The author defines underprivileged older smokers as smokers aged 40 years and above who are socioeconomically deprived (i.e. their income or educational level). Findings reveal that both group and one-to-one behavioural support have varied degrees of success, making it unclear what the best duration and components of intervention should be. The study demonstrates that several behavioural intervention components such as incentives, peer facilitators and intensive counselling, are promising for helping older, underprivileged smokers quit. There is a clear lack of evidence from large-scale trials on effectiveness in a lung screening context for this population. The review highlights the lack of solid evidence for behavioural smoking cessation interventions that are effective for the lung screening eligible population of older, deprived smokers.

From the evidence, smokers in special populations have more chance to quit smoking when provided behavioural interventions than pharmacotherapy alone. Same as in the general population, it is not sure which intervention is best for them, but tailored or higher-intensity interventions appear to have better effects than non-tailored or lower-intensity ones.

Conclusion

Counselling sessions, online interventions, self-help materials and MI may increase cessation rates in the long term, if not, short term. It is unclear which type of intervention is best for the general and special populations. However, counselling sessions of any form do demonstrate the strongest evidence of benefit in smokers trying to quit; may it be individual, group, face-to-face or online counselling. Some findings on interventions that can be updated in the CPG include app-based interventions, incentives, providing feedback on spirometry results, and exercise. As for behavioural interventions for special populations, updates may include people living with HIV and AIDS, smokers with COPD, and underprivileged older smokers.

Authors Contributions

Conceptualization, N.S. and M.H.; methodology, N.S. and A.N.; writing, N.S.; supervision, M.H. and S.Z. All authors have read and agreed to the updated version of the manuscript.

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Conflict of Interest

None declared.

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Appendix 1. Syntax or keywords for search strategy

#1, Behavioural interventions:

("behavioural intervention*"[Title/Abstract] OR "behavioural therap*"[Title/Abstract] OR "behavioural treatment*"[Title/Abstract] OR "behavioural approach*"[Title/Abstract] OR "behavioural therap*"[Title/Abstract] OR "cognitive behavioural therapy"[Title/Abstract] OR CBT [Title/Abstract] OR "online smoking cessation intervention*"[Title/Abstract] OR "online intervention*"[Title/Abstract] OR "telephone-based intervention*"[Title/Abstract] OR "webbased intervention*"[Title/Abstract] OR "internet-based intervention*"[Title/Abstract] OR "app-based intervention*"[Title/Abstract] "media intervention*"[Title/Abstract] OR "mobile phone"[Title/Abstract] OR "text messaging"[Title/Abstract] OR counselling[Title/Abstract])

#2, Smoking cessation:

("tobacco smoking"[Title/Abstract] OR "cigarette smoking"[Title/Abstract] OR "smoking cessation"[Title/Abstract] OR "tobacco cessation"[Title/Abstract] OR "cigarette cessation"[Title/Abstract] OR "nicotine cessation"[Title/Abstract] OR "smoking abstinence"[Title/Abstract] OR "tobacco abstinence"[Title/Abstract] OR "cigarette abstinence"[Title/Abstract] OR "nicotine abstinence"[Title/Abstract] OR "stop smoking"[Title/Abstract] OR "quit smoking"[Title/Abstract] OR "quitting smoking"[Title/Abstract])

#3, Final search strategy:

#1 AND #2

Filter: Systematic review; English language; date of publication (January 2016 – November 2022)