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Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds

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ABSTRACT

Introduction

The associations between smoking prevalence, socioeconomic group and lung cancer outcomes are well established. There is currently limited evidence for how inequalities could be addressed through specific smoking cessation interventions (SCIs) for a lung screening eligible population. This systematic review aims to identify the behavioural elements of SCIs used in older adults from low socioeconomic groups, and to examine their impact on smoking abstinence and psychosocial variables.

Method

Systematic searches of relevant databases were conducted. Included studies examined the characteristics of SCIs and their impact on outcomes of interest including smoking abstinence, quit motivation, nicotine dependence, perceived social influence and quit determination. Included studies were restricted to deprived older adults who are at (or approaching) eligibility for lung cancer screening. Narrative data synthesis was conducted.

Results

Eleven studies met the inclusion criteria. Methodological quality of the studies was variable, with the majority using self-reported smoking cessation and varying length of follow-up. There were limited data to identify the optimal form of behavioural SCI for the target population; however, behavioural counselling that is delivered in a community setting and tailored to individual needs demonstrated a positive impact on smoking outcomes.

Conclusion

Tailored, multimodal behavioural interventions that can be embedded within disadvantaged communities could potentially support cessation among older, deprived smokers. Further

rigorous, high quality research is needed to understand the effectiveness of SCIs for the target population.

Keywords: Smoking, smoking cessation, older, deprived, lung cancer

Article summary

- The associations between smoking prevalence, socioeconomic group and lung cancer outcomes are well established
- There is a current gap in knowledge about the most suitable form of behavioural smoking cessation intervention for older, deprived smokers who are most likely to be eligible for lung screening
- The review suggests that tailored, multimodal interventions could support smoking cessation for those most likely to be eligible for lung screening however the studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence
- There is a lack of rigorous, high quality research and randomised controlled trials should be conducted to test the effectiveness of SCIs for this population

INTRODUCTION

Smoking is the leading global cause of death and disease (1). Data show that there are approximately 7.4 million adult cigarette smokers in the United Kingdom (2, 3). The associations between smoking prevalence, socioeconomic group and lung cancer outcomes are well established, with higher smoking rates and greater lung cancer incidence and mortality (4-6) among people living in deprived areas.

Twenty-six percent of smokers in the UK are aged 50 years or older (3); these individuals tend to have long standing smoking histories, are often from deprived communities and are a population that are likely to be eligible for future lung screening implementation. The US Preventive Services Task Force recommends annual Low-Dose Computed Tomography (LDCT) screening for those who are high-risk heavy smokers, including adults aged 55-80 years old, with a 30 pack-year history (7). LDCT lung cancer screening has the potential to prompt a smoking cessation attempt and evidence for integrated smoking cessation support is growing (8-11), with research demonstrating promising results for quit rates when using a combined approach of smoking cessation support in a lung screening setting (9).

In order to implement appropriate smoking cessation intervention (SCIs) in a lung screening context, it is important to understand the factors that influence cessation attempts in older, deprived smokers who may be eligible for lung screening. Known barriers to smoking cessation in this population include higher nicotine dependence, less motivation to quit, more life stress, lack of social support and differences in perceptions of smoking (12-14). Smokers from a low socioeconomic background may find quitting more difficult due to lack of support from their family members or community with quit attempts (15), partly due to higher smoking prevalence and normalisation of smoking in their social network (16). Studies

suggest that cessation attempts in older smokers are more likely to fail due to heavy nicotine dependence and insufficient motivating factors such as self-efficacy to quit (17, 18).

Using pharmacotherapy with structured behavioural support to assist smoking cessation has shown promise with disadvantaged smokers (19, 20). Intensive SCIs involving tailored pharmacotherapy and behavioural counselling to increase self-efficacy are most effective for deprived smokers (21). However further research is needed to understand specific aspects of behavioural SCIs, such as mode of delivery, setting, intensity and duration, that could be used in the LDCT screening context for deprived smokers.

A recent review by Iaccarino (22) attempted to identify the best approach for delivering SCIs in a LDCT screening setting and concluded that the optimal strategy remains unclear. There is a need to identify gaps in the evidence surrounding the optimal models for integrated smoking cessation in a lung screening setting, focusing specifically on a disadvantaged lung screening eligible population, as well as gain a better understanding of what form of SCI may work best for this population.

The aims of this systematic review were to identify the behavioural aspects of SCIs for older, deprived adults who are eligible (or approaching eligibility) for lung cancer screening, and to explore which elements of the interventions were most effective in reducing smoking abstinence and modifying psychosocial variables. The findings from the systematic review will contribute to further understanding of optimal SCIs for individuals who are a target population for lung cancer screening.

METHODS

The systematic review was registered on PROSPERO (CRD42018088956) and followed the PRISMA guidelines (23). Throughout all stages of the search, data extraction and quality

appraisal, 20% of studies were double-checked for consistency by another member of the team (RP). All discrepancies were resolved through discussion.

Search strategy

The literature was searched until November 2018 on electronic databases: Medline, EMBASE, PsychInfo and CINAHL. Search terms related to smoking cessation, SCIs and socioeconomic status were used (Table 1). To limit restricting the search in relation to age, papers were manually screened to identify studies that used a relevant sample.

Table 1: PICO tool

PICO	Description	Equation used for search
Population	Individuals from socioeconomically deprived groups, defined through either individual or area level indicators	(Depriv* or disadvantage* or inequit* or socioeconomic or socio-economic or sociodemographic or socio-demographic or social class or deprivation group or poverty or low income or social welfare).tw.
Intervention	A range of interventions including individual and group counselling, self-help materials, pharmacological interventions (e.g. NRT), social and environmental support, comprehensive programmes and incentives	Smoking Cessation/ and (intervention* or initiative* or strategy* or program* or scheme* or outcome* or approach*).tw.
Comparison	All study types with a pre/post intervention and/or a control group	-
Outcome	Primary outcome: smoking abstinence Secondary outcome: Moderating variables (e.g. nicotine dependence, quit motivation, self-efficacy, social support and influences)	((nicotine or tobacco or smok* or cigarette) adj (quit* or stop* or cess* or cease* or cut down or "giv* up" or reduc*)).tw.

Study eligibility criteria

All searches were restricted to high-income countries (24). Included publications reported on *'Socioeconomically deprived groups'* that defined their sample through individual level

indicators (e.g. educational level, income) or area level indicators (e.g. postcode). *'Older adults',* defined as aged 50 years + (or when the majority of the sample was aged 40+), were included to represent a sample at or approaching lung cancer screening age (25). The review included studies that examined behavioural aspects of SCIs and outcomes including smoking abstinence and psychosocial variables such as quit motivation, nicotine dependence, perceived social influence and quit determination.

Data extraction and synthesis

Study outcomes and selected study features were extracted. Where relevant, statistical associations between variables are described in order to examine relationships within and between the included studies. Due to the heterogeneity of included studies, a narrative synthesis was performed using guidance outlined by Popay (26) and organised under relevant behavioural intervention elements.

Critical Appraisal

The methodological quality of included studies and risk of bias was assessed using an adapted Critical Appraisal Skills Programme (CASP) tool (27). Quality was assessed according to each domain on the checklist including rationale, study design, recruitment, sample size, data collection and analysis, ethical issues, reporting of findings and contribution to research. The CASP tool was adapted to address quality of methods for verifying smoking abstinence, intervention type, and socioeconomic and age variation within the sample. Overall quality was categorised as high, medium or low.

Patient and Public Involvement

Patient and public involvement was not adopted for the review.

RESULTS

Eleven studies met the inclusion criteria (Figure 1). Nine of the 11 studies were quantitative (28-36) and two were mixed-methods design (37, 38). Three of the 11 studies were randomised control trials, with the remaining using a range of non-randomised designs. Two of the included studies (28, 34) were conducted in a lung-screening context. Quality of studies was high (n=2), medium (n=5) and low (n=4). Limitations of lower quality studies included measuring but not reporting a subgroup analysis of age and/or deprivation, study design, limited description of the intervention and statistically underpowered results. Where available, relevant statistical values are presented in Table 2.

Nine studies used a combination of nicotine replacement therapy (NRT) and behavioural counselling (28-30, 32-37). One study used only NRT (31) and one used behavioural counselling without NRT (38). Results are presented in relation to intervention elements including the behavioural content, setting, intervention provider and mode and duration of delivery. A sub-heading under each intervention element presents data on smoking outcomes. Further study characteristics and findings are also presented in Table 2.

Table 2: Study Characteristics

Study (Country)	Study design	Sample	Intervention	Measure of smoking abstinence	Summary of findings	Quality appraisal
Bade et al (2016) (Germany)	Randomised controlled trial	4052 participants from the German lung cancer screening intervention trial. 1535 (62%) male, 950 (38%) female. 1737 (70%) aged 50-59 years, 748 (30%) 60-69 years old. 1823 (73%) 'low' in education and 1594 (65%) 'low' in vocational training.	Low-dose multislice CT (MSCT) and smoking cessation counselling (SCC) delivered by a psychologist in a radiology department. 20 minute counselling followed by at least one telephone call.	Self-report at 12 and 24 months	Proportion of current smokers decreased among screenees (3.4%, p<0.0001), controls (4.5%, p<0.0001), and entire cohort (4.0%, p<0.0001). The magnitude of decrease in smoking rate was larger in SSC participants (screenees 9.6%, p<0.0001; controls 10.4%, p<0.0001) compared to non-SSC attendants (screenees 0.8%, p=0.30; controls 1.6%, p=0.03).	High
Bauld et al (2009) (United Kingdom)	Observational study	1785 pharmacy service users. 762 (56%) in the Starting Fresh (SF) group and 311 (76%) in the Smoking Concerns (SC) group were aged 41 years or older. 796 (58%) from SF were in the lowest deprivation quintile, 187 (46%) from SC were in the lowest quintile.	Behavioural support delivered by a trained adviser in a group-based community setting (SC) or individually in a pharmacy setting (SF), with access to nicotine replacement therapy.	Biochemical validation at 1 month	146 (36%) quit rate in SC versus 255 (19%) in SF (OR[1]=1.98; 95% CI 1.90 to 3.08). SC and SF deprived smokers had lower cessation rates (OR=0.677; p=0.015). Cessation rate for pharmacy clients increased sharply with age from 13.4% for age 16–40 to 30.7% for age 61 and over ($P < 0.00$). The increase for group clients statistically insignificant ($P = 0.25$).	Medium
Celestin Jr et al (2016) (United States)	Retrospective cohort study	8, 549 tobacco users in Louisiana's public hospital facility. 1531 (68%) in the intervention group were aged 45 years and over. 1,196 (57%) were from the lowest 'financial class' .	Standard care plus group behavioural counselling in a hospital classroom. 4 one-hour sessions, once a week within a 1-month period.	Self-report at 12 months	Intervention participants had greater odds of sustained abstinence than non-attendees (aOR[2]=1.52; 95% CI 1.21 to 1.90). Higher 12-month quit rate in patients over age 60 (22%) compared to 18-30 year olds (11%) (aOR 2.36; 95% CI[3] 1.58 to 3.52).	Low

[1] *Odds ratio*
[2] *Adjusted odds ratio*
[3] *Confidence interval*

Copeland et al (2005) (United Kingdom)	Observational cohort study	101 patients from a disadvantaged area of Edinburgh	GP consultation and subsequent prescription of nicotine replacement therapy	Self-report at 3 months	Post intervention 35 (35%) smoked the same, 46 (45%) were smoking less and 20 (20%) had stopped smoking. Older participants were more likely to have stopped or to be smoking less (p<0.00).	Low
Lasser et al (2017) (United States)	Prospective, randomised trial	352 participants randomised (177 intervention, 175 control). 197 (56%) aged 51-74. 193 (55%) with a household yearly income <$20,000.	Patient navigation and financial incentive (intervention) versus enhanced traditional care (control). Intervention received 4 hours of support over 6 months. Delivered by patient navigators over the phone or in-person.	Biochemical validation at 12 months	21 (12%) intervention participants quit smoking compared to 4 (2%) control participants (OR=5.8, 95% CI 1.9 to 17.1, p<0.00). In the intervention arm (n=177), participants aged 51-74 had higher quit rates compared to those aged 21-50 (19 [19.8%] vs 2 [2.0%]; p< 0.00). Household yearly income of <$20,000 had higher quit rates compared to >$20,000 (15 [15.5%] vs 4 [8%]; p= 0.00)	Medium
Neumann et al (2013) (Denmark)	Observational prospective cohort study	20,588 disadvantaged patients (low level of education and receiving unemployment benefits). 15,244 (74%) aged 40 years or over.	6-week manualised Gold Standard Programme in hospitals and primary care facilities (e.g. pharmacies). Delivered in 5 meetings over 6 weeks by a certified staff member. Both group and individual counselling was offered.	Self-reported continuous abstinence at 6 months	34% of responders reported 6 months of continuous abstinence. Continuous abstinence was significantly lower in those with less education (30%) versus more education (35%) (p<0.00). For participants with a lower educational level, individual counselling was a predictor of success in smoking cessation (OR=1.31, 95% CI 1.05 to 1.63).	Medium
Ormston et al (2015) (United Kingdom)	Mixed-methods, quasi-experimental study	2042 smokers living in deprived areas of Dundee. 70 (54%) aged 45 years and over. 119 (92%) from the two most deprived areas.	Financial incentive and behavioural support based on Scottish national guidelines, with pharmacotherapy (Quit4u Scheme) delivered in group (practice nurses) and one-to-one settings (community pharmacists) for up to 12 weeks.	Biochemical validation at 1, 3 and 12 months	Intervention was responsible for 36% of all quit attempts in the three most deprived areas. 12 month quit rate (9.3%) was significantly higher than other Scottish stop smoking services (6.5%) (relative difference 1.443, 95% CI 1.132 to 1.839, p=0.00).	Medium

Park et al (2015) (United States)	Matched case control study	3336 National Lung Screening Trial participants. Aged 55 to 74 years old. No report of deprivation at baseline. Subgroup analysis performed for education.	Brief SCI delivered by a primary care clinician using the 5As.	Self-report at 12 months	Assist was associated with a 40% increase in quitting (OR=1.40, 95% CI 1.21 to 1.63). Arrange was associated with a 46% increase in quitting (OR=1.46, 95% CI 1.19 to 1.79). Higher educational level was significantly associated with quitting after delivery of each of the 5As (ORs=1.14 to 1.26 for college degree or higher versus high school education).	Medium
Sheffer et al (2013) (United States)	Observational study	7267 smokers in telephone treatment participants: 30% aged >50 years, 35% aged 36-49 years. In-person participants: 38% aged >50 years, 38% aged 36-49 years. No report of deprivation at baseline. Subgroup analysis performed for deprivation.	Behavioural counselling-manual driven sessions delivered weekly in-person (healthcare settings) or over the telephone, with free nicotine patches for 6 weeks. Delivered by a health care provider trained in brief evidence-based tobacco dependence interventions.	Self-report at 3 and 6 months	Abstinence rates were higher for in-person counselling (37.7%) versus telephone counselling (30.8%) (p<0.00). No significant difference at 3 months (p=0.73) and 6 months (p=0.27) between in-person (28.2%; 27.2%) and telephone (28.7%; 28.7%). The highest socioeconomic (SES) group was more likely to be abstinent with telephone treatment (SES3: P =0.03; OR = 1.45; 95% CI = 1.04, 2.01). No significant differences between the in-person and telephone for the two lower SES groups (SES1: OR=1.02, 95% CI 0.88 to 1.18, p=0.82; SES2: OR=0.91, 95% CI 0.72 to 1.15, p=0.41).	Low
Sheikhattari et al (2016) (United States)	Randomised controlled trial	409 (52%) were aged 48 years and over. Targeted communities where more than 40% of the households earn less than $25,000. 531 (72%) were unemployed.	Peer-led community based intervention over three phases. Phase 1 (n=404) – the American Cancer Society's 4-week Fresh Start smoking cessation curriculum expanded to 12 weeks at health centres and delivered by a doctor, nurse or social worker. Phase 2 (n=398) and Phase 3 (n=163) – tailored group counselling in community venues, delivered by trained peer motivators.	Self-report and biochemical validation at 3 and 6 months	Delivery of services in community settings was a predictor of quitting (OR=2.6, 95% CI 1.7 to 4.2). Smoking cessation increased from 38 (9.4%) in Phase 1 to 84 (21.1%) in Phase 2, and 49 (30.1%) in Phase 3. Phases 2 and 3 were associated with higher odds compared to Phase 1, with adjusted ORs of 2.1 (95% CI 1.3 to 3.5) and 3.7 (95%CI 2.1 to 6.3) respectively. Older age (>48 years versus <48 years) was associated with higher quit rate (13.3% vs 19.1%, p=0.028).	High

Stewart et al (2010) (Canada)	Pilot evaluation of a before and after study	44 women, aged 25-69, living on low income in urban areas of Western Canada. 23 (52%) aged 40 years or older. 18 (39%) participants unemployed, 26 (62%) on welfare/income support.	Facilitated group support supplemented with one-to-one support from a mentor. Once a week, duration of 12 weeks minimum. Groups facilitated by professionals and former smokers with the option of one-to-one from peers in community centres.	Self-report at 3 months	The mean number of cigarettes smoked daily decreased from pre to post-test (p=0.00). Among women completing all data collection (n=22), the mean number of cigarettes consumed daily decreased from 0.95 pre-intervention to 0.32 immediately after the intervention, then increased to 0.64 at 3 months post-intervention. Four women reported sustained cessation.	Low

Behavioural intervention content

Ten studies focused on meeting the individual participant's needs using education and motivational techniques including support and encouragement (28-30, 32-38). In all ten studies, the interventions involved using motivational techniques with varying levels of intensity (Table 2).

Nine studies used interventions that were of higher intensity (28-30, 32, 33, 35-38). These studies involved incorporating specific action planning by quit motivation (28), using a combination of manual-based teaching and patient education sessions including relapse prevention modules (36), motivational interviewing techniques (32), discussions on the benefits and costs of smoking versus cessation (33), empowering strategies to enhance self-efficacy (38) and cognitive behavioural content (35).

Three studies used financial incentives as part of their intervention (32, 36, 37). A randomised control trial conducted by Lasser et al (32) offered participants $750 for abstinence at 12 month follow-up. This element of the intervention was combined with patient navigation in which trained navigators identified and discussed salient social contextual factors using motivational interviewing. Ormston et al (37) combined behavioural support with financial incentives to participants upon biochemically verified cessation.

Outcomes

One study found that the 'assist' and 'arrange follow-up' elements of a brief SCI based on the 5As (ask, advise, assess, assist and arrange follow-up) alongside lung cancer screening significantly increased the odds of quitting (34). Results showed that the decrease in smoking rate was larger for those who received behavioural support compared to those that did not. Findings from this study demonstrated that abstinence was lower in those with a lower

educational level and individual counselling was a predictor of cessation for those with a lower educational level (Table 2).

Interventions using financial incentives found that older participants and those with the lowest income had higher quit rates (Table 2); however, it is difficult to infer findings from this trial as it was underpowered with a small sample size at follow-up (Table 2). Ormston et al (37) found that quit rates for the intervention group were significantly higher compared to other stop smoking services (Table 2). Seventy-one percent of participants reported that the incentive component was '*very*' or '*quite useful'* in helping them quit, with participants describing it as a '*bonus*' or '*reward*' to motivate them.

Stewart et al (38) reported smoking self-efficacy from qualitative data and found that participants thought the education they gained increased their awareness of their smoking habits, reasons why they are smoking and the importance of quitting. Participants also reported an increase in the number of available support sources (e.g. parents, spouse and friends) along with a significant increase in perceived social support (38).

Setting

Two studies took place in a lung screening setting (28, 34) and used contrasting forms of interventions. Park (34) offered a brief SCI delivered by a primary care clinician, whereas Bade (28) used a more intensive intervention delivered by a psychologist who was trained in tobacco treatment. The latter study was an RCT design with a large sample size and took place in the radiology department before or after the participant's screening.

Five studies were delivered in a variety of easily accessible community settings including community pharmacies (29, 33, 37) and community venues such as centres and churches (29, 36-38) (Table 2). Five studies took place at primary care facilities such as a medical/health

centres (31, 32, 35) and hospitals (30, 33). One study delivered the intervention in both community and primary care settings (33).

Outcomes

Stewart (38) used a community-based intervention that took place in an easily accessible community centre, familiar to participants. Findings from this small-scale pilot study of female smokers suggested that the amount of cigarettes smoked decreased post-intervention (Table 2). Ormston et al (37) compared intervention delivery in community pharmacies and cessation groups to other stop smoking services and demonstrated significantly higher quit rates in deprived communities (Table 2).

Bauld et al (29) showed that specialist-led group-based services have higher quit rates compared to one-to-one services that are provided by pharmacies. Cessation rates for pharmacy clients increased with age, and more deprived smokers had lower smoking cessation rates in both the pharmacy-led and one-to-one services (Table 2). Sheikhattari (36) found higher quit rates for community-based intervention in comparison to clinic-based delivered in phase 1 of the intervention (Table 2). Results from this study also found that old age was associated with higher quit rates for participants. Older age in the case of this study was defined as more than 48 years of age.

Provider

Interventions were delivered by a range of providers (Table 2). Seven studies employed healthcare professionals such as general practitioners, primary care practice nurses, psychologists and pharmacists (28, 30, 31, 33-35, 38). Two studies employed trained peer motivators to deliver their intervention. Sheikhattari (36) used peer motivators who were former smokers to deliver the behavioural sessions. Peer motivators lived or worked in the community and were trained in delivering the intervention.

Outcomes

Smoking abstinence outcomes varied according to SCI provider (Table 2). A small scale observational study by Copeland et al (31) examined the use of nicotine replacement theory and a brief GP consultation. Results showed that older smokers were more likely to have stopped smoking (Table 2).

Sheikhattari et al (36) demonstrated that subsequent phases of the intervention delivered by trained peer facilitators were associated with higher odds of quitting compared to the first phase where intervention delivery was conducted by a doctor, nurse or social worker (Table 2). Lasser et al (32) used patient navigators who had completed 10 hours of training in motivational interviewing techniques and had experience of working in community settings. Findings demonstrated that older participants and those with a lower household yearly income had higher quit rates (Table 2).

Qualitative data from Stewart et al's study (38) involving a small sample of female participants demonstrated that participants felt peer facilitators helped to clarify their cessation efforts as they were able to share experiences and strategies and learn from each other.

Mode and duration

Studies varied in the mode and duration of delivery of SCIs (Table 2). Seven studies examined both individual and group behavioural counselling sessions (29, 30, 32, 33, 35, 37, 38) (Table 2) and four studies used only one-to-one behavioural support (28, 31, 32, 34).

Outcomes

Bauld et al (29) showed that participants accessing group-based services were almost twice as likely as those who used individual pharmacy-based support to have quit smoking at 4-weeks

(Table 2). Similarly, Celestin (30) showed that attendees of group behavioural counselling had significantly higher long-term quit rates compared to non-attendees, however this study was rated as lower in quality. Sheikhattari et al (36) used a six-week group-counselling module followed by a six-week relapse prevention module. Higher odds of quitting were associated with phases 2 and 3 of the intervention in which community-based group counselling was delivered (Table 2).

Lasser and colleagues (32) delivered their one-to-one behavioural support over 6 months either in-person or over the telephone, with a goal of four hours per participant. Results demonstrated that 12% from the intervention group had quit smoking in comparison to 4% from the control (Table 2). Bade (28) also employed behavioural counselling in-person, with at least one subsequent telephone call for those who had specified a quit date. Participants were offered four telephone calls that lasted around 20 minutes in duration and findings demonstrated a larger decrease in smoking for screening attendees compared to non-attendees (Table 2).

Sheffer et al (35) delivered both telephone and in-person behavioural counselling. Smoking abstinence rates were higher for in-person counselling and smokers of higher socioeconomic status were more likely to have quit after having had telephone treatment compared to lower socioeconomic smokers. Neumann et al (33) offered either group or individual counselling and demonstrated that for those with a lower educational level, individual counselling was a predictor of smoking cessation (Table 2)

Moderating variables

Seven studies reported limited data on moderating variables (28-30, 32, 34-36). Three RCTs demonstrated that participants who had a lower Fagerstrom score (36), who were in the

contemplation stage (32) and had reported high readiness to quit (28) at baseline were more likely to have abstained from smoking post-intervention.

DISCUSSION

To our knowledge, the current systematic review was the first to explore the influence of behavioural SCIs for a population at high-risk of developing lung cancer due to smoking and sociodemographic factors (22). The findings indicate a clear lack of evidence from large-scale trials of effectiveness in a lung screening context as well as a lack of data reporting psychosocial moderators of cessation for older, deprived smokers. The majority of included studies used a combination of pharmacotherapy and a form of behavioural counselling, supporting previous evidence that a combined approach is the most effective for older, deprived smokers (21). However, findings relating to the provider, mode, duration and setting of behavioural counselling are encouraging. Behavioural counselling delivered in a community setting and tailored to individual needs appeared to demonstrate a positive impact on smoking cessation outcomes.

Behavioural interventions identified in the current review used a range of approaches and although none of the included studies explicitly described their intervention as "tailored", many used a form of behavioural counselling that was implicitly flexible according to the needs of the individuals. Interventions were implemented in locations that addressed barriers to access, such as local community centres, and intervention content was driven by the individual's psychological needs (29, 36-38). Previous research suggests that in order for people to access stop smoking services, the appointments should be flexible and accessible (39).

The optimal mode of intervention was unclear from the current review, with findings suggesting varying success for both group and one-to-one behavioural support. However,

certain aspects of behavioural interventions such as incentives, the use of peer facilitators and more intensive counselling show some promise for the target population. Smith et al (40) found that although smokers from deprived backgrounds were more likely to access a smoking cessation service, they were less likely to be successful in their quit attempt. Future research should aim to understand the needs and preferences of these smokers and focus on psychosocial mechanisms that can be targeted in more holistic level interventions.

The eleven studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence. Only three were RCTs, of which one was underpowered (32), thus the effectiveness results across the studies were modest. Chen and Wu (41) identified the need for controlled trials of SCIs for older smoker, in order to better understand the most suitable form of intervention for this population. Similarly to findings from Pineiro et al's review (42), the studies currently presented did not consistently use biochemical verification of smoking cessation, with most relying on self-reported smoking cessation (Table 2). Various design aspects of the included studies, including the use of non-randomised methods, limited the extent to which firm conclusions can be drawn about the effectiveness of behavioural SCIs for older, deprived smokers. Only two studies included qualitative process evaluation data, therefore there was limited ability to explore the reasons why certain intervention characteristics were more or less likely to have a positive effect on smoking outcomes. Evidence suggests that smokers from disadvantaged backgrounds have specific obstacles to quitting successfully (20) and further mixed-methods research is warranted to understand why some forms of SCI support are more able to mitigate these barriers.

We also acknowledge methodological limitations of the present systematic review. By restricting the inclusion criteria for age and socioeconomic group, a number of potentially relevant studies were excluded. For example, telephone-based counselling for smokers

undergoing lung cancer screening, involving messages about risks of smoking in the context of LDCT scan results, can improve self-efficacy for quitting and the likelihood of a successful quit attempt (43). However, our review highlights the current absence of robust evidence regarding behavioural SCIs that are effective for the lung screening eligible population of older deprived smokers.

CONCLUSION

The current systematic review demonstrates the potential for tailored, multimodal SCIs for older, deprived smokers that can be embedded within disadvantaged communities. With the prospect of lung cancer screening being implemented in the UK and Europe in the near future, this research adds to the evidence base regarding promising SCIs for high-risk disadvantaged populations who will benefit most from lung screening and integrated smoking cessation support. However, rigorous, high quality research is needed in order to conclude the overall effectiveness of SCIs for older, more deprived smokers.

DECLARATION

Competing Interests

The authors declare that they have no competing interests.

Authors' contribution

Pamela Smith, Prof Kate Brain, Mala Mann, Prof Annmarie Nelson and Dr Graham Moore were responsible for the concept, overall design and conduct of the review. MM gave additional support and advice on methodology including the search strategy. PS was responsible for collection of data and manuscript preparation. Dr Ria Poole double-checked 20% of included abstracts and full-texts. RP, MM, AN, GM and KB reviewed the edited manuscript preparation. All authors were involved in the interpretation of the results and approved the final version of the manuscript. RP is funded by a Cancer Research UK Population Research Committee Post-Doctoral Fellowship. AN's and MM's posts are supported by Marie Curie core grant funding (grant reference: MCCCFCO-11-C).

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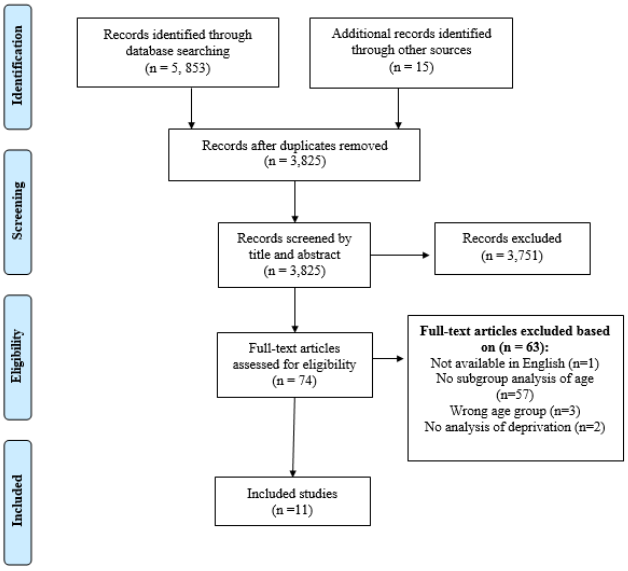
Figure 1: PRISMA Flow Diagram



PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3,4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3,4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6,7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Supp. File, 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	13-18
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13-18
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	n/a
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	18-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18-20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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BMJ Open

Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds

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Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds

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ABSTRACT

Introduction

The associations between smoking prevalence, socioeconomic group and lung cancer outcomes are well established. There is currently limited evidence for how inequalities could be addressed through specific smoking cessation interventions (SCIs) for a lung cancer screening eligible population. This systematic review aims to identify the behavioural elements of SCIs used in older adults from low socioeconomic groups, and to examine their impact on smoking abstinence and psychosocial variables.

Method

Systematic searches of Medline, EMBASE, PsychInfo and CINAHL up to November 2018 were conducted. Included studies examined the characteristics of SCIs and their impact on relevant outcomes including smoking abstinence, quit motivation, nicotine dependence, perceived social influence and quit determination. Included studies were restricted to socioeconomically deprived older adults who are at (or approaching) eligibility for lung cancer screening. Narrative data synthesis was conducted.

Results

Eleven studies met the inclusion criteria. Methodological quality was variable, with most studies using self-reported smoking cessation and varying length of follow-up. There were limited data to identify the optimal form of behavioural SCI for the target population. Intense multimodal behavioural counselling that uses incentives and peer facilitators, delivered in a community setting and tailored to individual needs indicated a positive impact on smoking outcomes.

Conclusion

Tailored, multimodal behavioural interventions embedded in local communities could potentially support cessation among older, deprived smokers. Further high-quality research is needed to understand the effectiveness of SCIs in the context of lung screening for the target population.

Keywords: Smoking, smoking cessation, older, deprived, lung cancer, lung cancer screening

Article summary

- There is a current gap in knowledge about the most suitable form of behavioural smoking cessation intervention (SCI) for older, deprived smokers who are most likely to be eligible for lung screening
- This systematic review suggests that tailored, multimodal behavioural SCIs could support smoking cessation for those most likely to be eligible for lung screening; however, the studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence
- There is a lack of rigorous, high quality research for the target population

INTRODUCTION

Smoking is the leading global cause of death and disease (1) and data show that there are approximately 7.4 million adult cigarette smokers in the United Kingdom (2, 3). Twenty-six percent of smokers in the UK are aged 50 years or older (3); these individuals tend to have long standing smoking histories, are often from deprived communities and are a population that are likely to be eligible for future lung screening implementation. The associations between smoking prevalence, socioeconomic group and a range of chronic disease outcomes, including lung cancer outcomes are well established, with higher smoking rates and greater lung cancer incidence and mortality (4-6) among people living in deprived areas.

The US Preventive Services Task Force recommends annual low-dose computed tomography screening for those who are high-risk heavy smokers, including adults aged 55-80 years old, with a 30 pack-year history (7). LDCT lung cancer screening has the potential to prompt a smoking cessation attempt and evidence for integrated smoking cessation support is growing (8-11), with research demonstrating promising results for quit rates when using a combined approach of smoking cessation support in a lung screening setting (9).

Prior to implementing appropriate smoking cessation intervention (SCIs) in a lung screening context in the UK, it is important to understand the factors that influence cessation attempts in older, deprived smokers who may be eligible for lung cancer screening. Known barriers to smoking cessation in this population include higher nicotine dependence, less motivation to quit, more life stress, lack of social support and differences in perceptions of smoking (12-14). Smokers from a low socioeconomic background may find quitting more difficult due to lack of support from their family members or community with quit attempts (15), partly due to higher smoking prevalence and normalisation of smoking in their social networks (16).

Studies suggest that cessation attempts in older smokers are more likely to fail due to heavy nicotine dependence and insufficient motivating factors such as self-efficacy to quit (17, 18).

Using pharmacotherapy with structured behavioural support to assist smoking cessation has shown promise with disadvantaged smokers (19, 20). Intensive SCIs involving tailored pharmacotherapy and behavioural counselling to increase self-efficacy are most effective for deprived smokers (21). However further research is needed to understand specific characteristics of behavioural SCIs, such as mode of delivery, setting, intensity and duration, that could be used for older, deprived smokers.

A recent review by Iaccarino (22) attempted to identify the best approach for delivering SCIs in a lung cancer screening setting and concluded that the optimal strategy remains unclear. There is a need to identify gaps in the evidence surrounding the optimal models for integrated smoking cessation in a lung screening setting, focusing specifically on a disadvantaged lung screening eligible population, as well as gain a better understanding of what form of SCI may work best for this population in the UK.

The aims of this systematic review were to identify the behavioural aspects of SCIs for older, deprived adults who are eligible (or approaching eligibility) for lung cancer screening, and to explore which elements of the interventions were most effective in reducing smoking abstinence and modifying psychosocial variables. The findings from the systematic review will contribute to further understanding of optimal SCIs for individuals who are a target population for lung cancer screening.

METHODS

The systematic review was registered on PROSPERO (CRD42018088956) and followed the PRISMA guidelines (23). Throughout all stages of the search, data extraction and quality appraisal, 20% of studies were double-checked for consistency by another member of the

team (RP). All discrepancies were resolved through discussion. Data duplication was managed by removing duplications using a reference management software package (EndNote X9), which were then manually checked.

Search strategy

The literature was searched from 1900 to November 2018 on electronic databases: Medline, EMBASE, PsychInfo and CINAHL. Search terms related to smoking cessation, SCIs and socioeconomic status were used (Table 1). To limit restricting the search in relation to age, papers were manually screened to identify studies that used a relevant sample.

Table 1: PICO tool

PICO	Description	Search terms and connectors
Population	Individuals from socioeconomically deprived groups, defined through either individual or area level indicators	(Depriv* or disadvantage* or inequit* or socioeconomic or socio-economic or sociodemographic or socio-demographic or social class or deprivation group or poverty or low income or social welfare).tw.
Intervention	A range of interventions including individual and group counselling, self-help materials, pharmacological interventions (e.g. nicotine replacement therapy), social and environmental support, comprehensive programmes and incentives	Smoking Cessation/ and (intervention* or initiative* or strategy* or program* or scheme* or outcome* or approach*).tw.
Comparison	All study types with a pre/post intervention and/or a control group	-
Outcome	Primary outcome: smoking abstinence Secondary outcome: Moderating variables (e.g. nicotine dependence, quit motivation, self-efficacy, social support and influences)	((nicotine or tobacco or smok* or cigarette) adj (quit* or stop* or cess* or cease* or cut down or "giv* up" or reduc*)).tw.

Study eligibility criteria

All searches were restricted to high-income countries (24). Inclusion criteria for the included publications were; *'Socioeconomically deprived groups'* that defined their sample through individual level indicators (e.g. educational level, income) or area level indicators (e.g. postcode). *'Older adults',* defined as aged 50 years + (or when the majority of the sample was aged 40+) were included to represent a sample at or approaching lung cancer screening age (25). The review included studies that examined behavioural aspects of SCIs and outcomes including smoking abstinence and psychosocial variables such as quit motivation, nicotine dependence, perceived social influence and quit determination.

Data extraction and synthesis

Study outcomes, including moderating variables and selected study features were extracted. Where relevant, statistical associations between variables are described in order to examine relationships within and between the included studies. Data from qualitative elements of included studies were extracted and a narrative synthesis was conducted. Due to the heterogeneity of included studies, a narrative synthesis was performed using guidance outlined by Popay (26) and organised under relevant behavioural intervention elements.

Critical Appraisal

The methodological quality of included studies and risk of bias was assessed using an adapted Critical Appraisal Skills Programme (CASP) tool (27). Quality was assessed according to each domain on the checklist including rationale, study design, recruitment, sample size, data collection and analysis, ethical issues, reporting of findings and contribution to research. The CASP tool was adapted to address quality of methods for verifying smoking abstinence, intervention type, and socioeconomic and age variation within the sample. Overall quality was categorised as high, medium or low.

Patient and Public Involvement

Patient and public involvement was not adopted for the review.

RESULTS

Eleven studies met the inclusion criteria (Figure 1). Nine of the 11 studies were quantitative (28-36) and two were mixed-methods design (37, 38). Three studies were randomised control trials, with the remaining using a range of non-randomised designs. Two studies (28, 34) were conducted in a lung screening context. Quality of included studies was high (n=2), medium (n=5) and low (n=4). Limitations of lower quality studies included measuring but not reporting a subgroup analysis of age and/or deprivation, study design, limited description of the intervention and statistically underpowered results. Where available, relevant statistical values are presented in Table 2.

Nine studies used a combination of nicotine replacement therapy and behavioural counselling (28-30, 32-37). One study used only nicotine replacement therapy (31) and one used behavioural counselling without nicotine replacement therapy (38). Results are presented in relation to intervention elements including the behavioural content, setting, intervention provider and mode and duration of delivery. A sub-heading under each intervention element presents data on smoking outcomes. Further study characteristics and findings are also presented in Table 2.

Table 2: Study Characteristic

Study (Country)	Study design	Sample	Intervention	Measure of smoking abstinence	Summary of findings	Quality appraisal
Bade et al (2016) (Germany)	Randomised controlled trial	4052 participants from the German lung cancer screening intervention trial. 1535 (62%) male, 950 (38%) female. 1737 (70%) aged 50-59 years, 748 (30%) 60-69 years old. 1823 (73%) 'low' in education and 1594 (65%) 'low' in vocational training.	Low-dose multislice CT screening and smoking cessation counselling (SCC) delivered by a psychologist in a radiology department. 20 minute counselling followed by at least one telephone call.	Self-report at 12 and 24 months	Proportion of current smokers decreased among screenees (3.4%, p<0.0001), controls (4.5%, p<0.0001), and entire cohort (4.0%, p<0.0001). The magnitude of decrease in smoking rate was larger in SSC participants (screenees 9.6%, p<0.0001; controls 10.4%, p<0.0001) compared to non-SSC participants (screenees 0.8%, p=0.30; controls 1.6%, p=0.03).	High
Bauld et al (2009) (United Kingdom)	Observational study	1785 pharmacy service users. 762 (56%) in the Starting Fresh (SF) group and 311 (76%) in the Smoking Concerns (SC) group were aged 41 years or older. 796 (58%) from SF were in the lowest deprivation quintile, 187 (46%) from SC were in the lowest quintile.	Behavioural support delivered by a trained adviser in a group-based community setting (SC) up to 12 weeks or individually in a pharmacy setting (SF) up to 12 weeks, with access to nicotine replacement therapy.	Biochemical validation at 1 month	146 (36%) quit rate in SC versus 255 (19%) in SF (OR[1]=1.98; 95% CI[2] 1.90 to 3.08). SC and SF deprived smokers had lower cessation rates (OR=0.677; p=0.015). Cessation rate for pharmacy clients increased sharply with age from 13.4% for age 16–40 to 30.7% for age 61 and over (p<0.001). The increase for group-based clients (SC) was statistically insignificant (p<0.25). Determination to quit was not statistically significant: *P* = 0.072 (SF) and *P* = 0.092 (SC).	Medium
Celestin Jr et al (2016) (United States)	Retrospective cohort study	8, 549 tobacco users in Louisiana's public hospital facility. 1531 (68%) in the intervention group were aged 45 years and over. 1,196 (57%) were from the lowest 'financial class'.	Standard care plus group behavioural counselling in a hospital classroom. 4 one-hour sessions, once a week within a 1-month period.	Self-report at 12 months	Intervention participants had greater odds of sustained abstinence than non-attendees (aOR[3]=1.52; 95% CI 1.21 to 1.90). Higher 12-month quit rate in patients over age 60 (22%) compared to 18-30 year olds (11%) (aOR 2.36; 95% CI 1.58 to 3.52). There was a statistically significant effect of COPD status on quit rate (from UOR 1.01 CI 0.86 to 1.19, to AOR 0.75 CI 0.63 to 0.90).	Low
Copeland et al (2005) (United Kingdom)	Observational cohort study	101 patients from a disadvantaged area of Edinburgh. Mean age for males was 47 years and for females was 44 years.	GP consultation and subsequent prescription of nicotine replacement therapy	Self-report at 3 months	Post intervention 35 (35%) smoked the same, 46 (45%) were smoking less and 20 (20%) had stopped smoking. Older participants were more likely to have	Low

[1] *Odds ratio*
[2] *Confidence interval*
[3] *Adjusted odds ratio*

					stopped or to be smoking less (p<0.00).	
Lasser et al (2017) (United States)	Prospective, randomised trial	352 participants randomised (177 intervention, 175 control). 197 (56%) aged 51-74. 193 (55%) with a household yearly income <$20,000.	Patient navigation and financial incentive (intervention) versus enhanced traditional care (control). Intervention received 4 hours of support over 6 months. Delivered by patient navigators over the phone or in-person.	Biochemical validation at 12 months	21 (12%) intervention participants quit smoking compared to 4 (2%) control participants (OR=5.8, 95% CI 1.9 to 17.1, p<0.00). In the intervention arm (n=177), participants aged 51-74 had higher quit rates compared to those aged 21-50 (19 [19.8%] vs 2 [2.0%]; p< 0.00). Household yearly income of <$20,000 had higher quit rates compared to >$20,000 (15 [15.5%] vs 4 [8%]; p= 0.00).	Medium
Neumann et al (2013) (Denmark)	Observational prospective cohort study	20,588 disadvantaged patients (low level of education and receiving unemployment benefits). 15,244 (74%) aged 40 years or over.	6-week manualised Gold Standard Programme in hospitals and primary care facilities (e.g. pharmacies). Delivered in 5 meetings over 6 weeks by a certified staff member. Both group and individual counselling was offered.	Self-reported continuous abstinence at 6 months	34% of responders reported 6 months of continuous abstinence. Continuous abstinence was significantly lower in those with less education (30%) versus more education (35%) (p<0.00). For participants with a lower educational level, individual counselling was a predictor of success in smoking cessation (OR=1.31, 95% CI 1.05 to 1.63).	Medium
Ormston et al (2015) (United Kingdom)	Mixed-methods, quasi-experimental study	2042 smokers living in deprived areas of Dundee. 70 (54%) aged 45 years and over. 119 (92%) from the two most deprived areas.	Financial incentive and behavioural support based on Scottish national guidelines, with pharmacotherapy (Quit4u Scheme) delivered in group (practice nurses) and one-to-one settings (community pharmacists) for up to 12 weeks.	Biochemical validation at 1, 3 and 12 months	Intervention was responsible for 36% of all quit attempts in the three most deprived areas. 12 month quit rate (9.3%) was significantly higher than other Scottish stop smoking services (6.5%) (relative difference 1.443, 95% CI 1.132 to 1.839, p=0.00).	Medium
Park et al (2015) (United States)	Matched case control study	3336 National Lung Screening Trial participants.	SCI delivered by a primary care clinician using the 5As.	Self-report at 12	Assist was associated with a 40% increase in quitting (OR=1.40, 95% CI 1.21 to 1.63).	Medium

		Aged 55 to 74 years old. No report of deprivation at baseline. Subgroup analysis performed for education.		months	Arrange was associated with a 46% increase in quitting (OR=1.46, 95% CI 1.19 to 1.79). Higher educational level was significantly associated with quitting after delivery of each of the 5As (ORs=1.14 to 1.26 for college degree or higher versus high school education). Lower nicotine dependence (OR= 0.94, 95% CI 0.91-0.98), and higher quit motivation (OR=1.28, 95% CI 1.21-1.35) were significantly associated with quitting after delivery of each of the 5As	
Sheffer et al (2013) (United States)	Observational study	7267 participants in telephone treatment: 30% aged >50 years, 35% aged 36-49 years. In-person participants: 38% aged >50 years, 38% aged 36-49 years. No report of deprivation at baseline. Subgroup analysis performed for deprivation.	Behavioural counselling-manual driven sessions delivered weekly in-person (healthcare settings) or over the telephone, with free nicotine patches for 6 weeks. Delivered by a health care provider trained in brief evidence-based tobacco dependence interventions.	Self-report at 3 and 6 months	Abstinence rates were higher for in-person counselling (37.7%) versus telephone counselling (30.8%) (p<0.00). No significant difference at 3 months (p=0.73) and 6 months (p=0.27) between in-person (28.2%; 27.2%) and telephone (28.7%; 28.7%). The highest socioeconomic (SES) group was more likely to be abstinent with telephone treatment (SES3: P =0.03; OR = 1.45; 95% CI = 1.04, 2.01). No significant differences between the in-person and telephone for the two lower SES groups (SES1: OR=1.02, 95% CI 0.88 to 1.18, p=0.82; SES2: OR=0.91, 95% CI 0.72 to 1.15, p=0.41).	Low
Sheikhattari et al (2016) (United States)	Randomised controlled trial	409 (52%) were aged 48 years and over. Recruited in targeted communities where more than 40% of the households earn less than $25,000. 531 (72%) were unemployed.	Peer-led community-based intervention over three phases. Phase 1 (n=404) – the American Cancer Society's 4-week Fresh Start smoking cessation curriculum expanded to 12 weeks at health centres and delivered by a doctor, nurse or social worker. Phase 2 (n=398) and Phase 3 (n=163) – tailored group counselling in community venues, delivered by trained peer motivators.	Self-report and biochemical validation at 3 and 6 months	Delivery of services in community settings was a predictor of quitting (OR=2.6, 95% CI 1.7 to 4.2). Smoking cessation increased from 38 (9.4%) in Phase 1 to 84 (21.1%) in Phase 2, and 49 (30.1%) in Phase 3. Phases 2 and 3 were associated with higher odds compared to Phase 1, with adjusted ORs of 2.1 (95% CI 1.3 to 3.5) and 3.7 (95%CI 2.1 to 6.3) respectively. Older age (>48 years versus <48 years) was associated with higher quit rate (13.3% vs 19.1%, p=0.028).	High

Stewart et al (2010) (Canada)	Pilot evaluation of a before and after study	44 women, aged 25-69, living on low income in urban areas of Western Canada. 23 (52%) aged 40 years or older. 18 (39%) participants unemployed, 26 (62%) on welfare/income support.	Facilitated group support supplemented with one-to-one support from a mentor. Once a week, duration of 12 weeks minimum. Groups facilitated by professionals and former smokers with the option of one-to-one from peers in community centres.	Self-report at 3 months	The mean number of cigarettes smoked daily decreased from pre to post-test (p=0.00). Among women completing all data collection (n=22), the mean number of cigarettes consumed daily decreased from 0.95 pre-intervention to 0.32 immediately after the intervention, then increased to 0.64 at 3 months post-intervention. Four women reported sustained cessation.	Low

Behavioural intervention content

Ten studies focused on meeting the individual participant's needs using education and motivational techniques including support and encouragement (28-30, 32-38). In all ten studies, the interventions involved used motivational techniques with varying levels of intensity (Table 2).

Nine studies used interventions that were of higher intensity (28-30, 32, 33, 35-38). These studies involved incorporating specific action planning, tailored by the participant's level of quit motivation (28), using a combination of manual-based teaching and patient education sessions including relapse prevention modules (36), motivational interviewing techniques (32), discussions on the benefits and costs of smoking versus cessation (33), empowering strategies to enhance self-efficacy (38) and cognitive behavioural content (35).

Three studies used financial incentives as part of their intervention (32, 36, 37). A randomised control trial conducted by Lasser et al (32) offered participants $750 for abstinence at 12-month follow-up. This element of the intervention was combined with patient navigation in which trained navigators identified and discussed salient social contextual factors using motivational interviewing. Ormston et al (37) combined behavioural support with financial incentives to participants upon biochemically verified cessation.

Outcomes

A study by Park et al (34) found that the 'assist' and 'arrange follow-up' elements of a brief SCI based on the 5As (ask, advise, assess, assist and arrange follow-up) alongside lung cancer screening significantly increased the odds of quitting. Results showed that the decrease in smoking rate was larger for participants who received behavioural support compared to those who did not. Smoking abstinence was higher in participants with a higher educational level. (Table 2).

Studies of interventions that involved using financial incentives found that older participants and those with the lowest income had higher quit rates (Table 2). Ormston et al (37) found that quit rates for the intervention group were significantly higher compared to other stop smoking services (Table 2). Seventy-one percent of participants reported that the incentive component was '*very*' or '*quite useful'* in helping them quit, with participants describing it as a '*bonus*' or '*reward*' to motivate them.

Stewart et al (38) reported qualitative data on self-efficacy for quitting and found that participants thought the education they gained from the intervention increased their awareness of their smoking habits, reasons why they smoked and the importance of quitting. Participants also reported an increase in the number of available support sources (e.g. parents, spouse and friends) along with a significant increase in perceived social support (38).

Setting

Two studies took place in a lung screening setting (28, 34) and used contrasting forms of interventions. Park et al (34) offered a brief SCI delivered by a primary care clinician, whereas Bade et al (28) used a more intensive intervention delivered by a psychologist who was trained in tobacco treatment. The latter study used a randomised control trial design with a large sample size and took place in the radiology department before or after the participant's screening.

Five studies were delivered in a variety of easily accessible community settings including community pharmacies (29, 33, 37) and community venues such as centres and churches (29, 36-38) (Table 2). Three studies took place at medical facilities such as local medical/health centres (31, 32, 35) and two studies took place in hospitals (30, 33). One study delivered the intervention in both community and primary care settings (33).

Outcomes

Stewart et al (38) used a community-based intervention that took place in a local community centre, familiar to participants. Findings from this small-scale pilot study of female smokers suggested that the number of cigarettes smoked decreased post-intervention (Table 2). Ormston et al (37) compared intervention delivery in community pharmacies and behavioural support (both group and one-to one sessions) to other stop smoking services and demonstrated significantly higher quit rates in deprived communities (Table 2).

Bauld et al (29) showed that specialist-led group-based services have higher quit rates compared to one-to-one services that are provided by pharmacies. Cessation rates for pharmacy clients increased with age, and more deprived smokers had lower smoking cessation rates in both the pharmacy-led and one-to-one services (Table 2). Sheikhattari et al (36) found higher quit rates for community-based participants compared to those receiving support in clinics during phase 1 of the intervention (Table 2). Results from this study also showed that older age (defined as over 48 years) was associated with higher quit rates for participants.

Provider

Interventions were delivered by a range of providers (Table 2). Seven studies employed healthcare professionals such as general practitioners, primary care practice nurses, psychologists and pharmacists (28, 30, 31, 33-35, 38). Two studies employed trained peer motivators to deliver their intervention. Sheikhattari et al (36) used peer motivators who were former smokers to deliver the behavioural sessions. Peer motivators lived or worked in the community and were trained in delivering the intervention. Lasser et al (32) used patient navigators who had completed 10 hours of training in motivational interviewing techniques and had experience of working in community settings.

Outcomes

Smoking abstinence outcomes varied according to SCI provider (Table 2). A small-scale observational study by Copeland et al (31) examined the use of nicotine replacement theory and a brief GP consultation. Results showed that older smokers were more likely to have stopped smoking (Table 2).

Sheikhattari et al (36) demonstrated that subsequent phases of the intervention delivered by trained peer facilitators were associated with higher odds of quitting compared to the first phase where intervention delivery was conducted by a doctor, nurse or social worker (Table 2). Findings from Lasser et al (32) demonstrated that older participants and those with a lower household yearly income had higher quit rates (Table 2).

Qualitative data from Stewart et al (38) demonstrated that participants felt peer facilitators helped to support their cessation efforts as they were able to share personal experiences and strategies. Participants reported that they were able to learn coping strategies and techniques from other participants in the group which then helped them with their quit attempt.

Mode and duration

Studies varied in the mode and duration of delivery of SCIs (Table 2). Seven studies examined both individual and group behavioural counselling sessions (29, 30, 32, 33, 35, 37, 38) (Table 2) and four studies used only one-to-one behavioural support (28, 31, 32, 34). Duration of interventions varied greatly between and within studies (Table 2). The shortest duration was an intervention embedded in a GP consultation (31) and the longest was 16 weeks of smoking cessation support (38).

Outcomes

Bauld et al (29) showed that participants accessing group-based services were almost twice as likely as those who used individual pharmacy-based support to have quit smoking at four weeks (Table 2). Similarly, Celestin et al (30) showed that attendees of group behavioural

counselling had significantly higher long-term quit rates compared to non-attendees. Sheikhattari et al (36) used a six-week group-counselling module followed by a six-week relapse prevention module. Higher odds of quitting were associated with later phases of the intervention in which community-based group counselling was delivered (Table 2).

Lasser et al (32) delivered their one-to-one behavioural support over six months either in-person or over the telephone, with a goal of four hours per participant. Results demonstrated that more participants from the intervention group had quit smoking in comparison to the control group (Table 2). Bade et al (28) also employed behavioural counselling in-person, with at least one subsequent telephone call for those who had specified a quit date. Participants were offered four telephone calls that lasted around 20 minutes in duration and findings demonstrated a larger decrease in smoking for screening attendees compared to non-attendees (Table 2).

Sheffer et al (35) delivered both telephone and in-person behavioural counselling. Smoking abstinence rates were higher for in-person counselling, with smokers from higher socioeconomic groups more likely to quit after telephone counselling than smokers from lower socioeconomic groups. Neumann et al (33) offered either group or individual counselling and demonstrated that for those with a lower educational level, individual counselling was a predictor of smoking cessation (Table 2).

Moderating variables

Seven studies reported limited data on moderating variables (28-30, 32, 34-36). Bauld et al (29) found that smokers who reported being '*extremely determined'* to quit were more likely to be successful in their quit attempt. Celestin et al (30) demonstrated that COPD status had a statistically significant effect on quit rates (Table 2) and Park and colleagues (34) showed that lower nicotine dependence and higher quit motivation were significantly associated with

quitting after the delivery of each of the 5As. Three RCTs demonstrated that participants who had a lower Fagerstrom score (36), who were contemplating quitting (32) and reported high readiness to quit (28) at baseline were more likely to have abstained from smoking post-intervention.

DISCUSSION

To our knowledge, this systematic review is the first to examine the influence of behavioural SCIs for an older, deprived population. The majority of included studies used a combination of pharmacotherapy and a form of behavioural counselling, supporting previous evidence that a combined approach is the most effective for older, deprived smokers (21). Additionally, findings relating to the intensity, provider, mode, duration and setting of behavioural counselling are encouraging. Behavioural counselling delivered in a community setting and tailored to individual needs appeared to demonstrate a positive impact on smoking cessation outcomes.

Behavioural interventions identified in the current review used a range of approaches and although none of the included studies explicitly described their intervention as "tailored", many used a form of behavioural counselling that was implicitly flexible according to the needs of the individuals. Interventions were implemented in locations that addressed barriers to access, such as local community centres, and intervention content was driven by the individual's psychological needs (29, 36-38). Previous research suggests that in order for people to access stop smoking services, the appointments should be flexible and accessible (39).

The optimal mode and duration of intervention was unclear from our review, with findings suggesting varying success for both group and one-to-one behavioural support. The current results reflect similar findings from a review conducted in the UK. Bauld et al (21) concluded

that due to a dearth of studies examining subpopulations of smokers, further research is needed to determine the most effective models of treatment for smoking cessation and their efficacy with these subgroups (21). The current review did, however, demonstrate that certain aspects of behavioural interventions, such as incentives, the use of peer facilitators and more intensive counselling are promising for encouraging cessation in older, deprived smokers. Additionally, limited data regarding the influence of moderating variables suggests that factors such as nicotine dependence, quit motivation and pre-existing health conditions such as COPD can impact the effectiveness of smoking cessation interventions. Future research should aim to understand the needs and preferences of older, deprived smokers and focus on psychosocial mechanisms that can be targeted in more holistic level interventions.

The eleven studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence. Some of the included studies did not report confidence intervals, thus making it difficult to interpret findings. Only three of the studies included were randomised control trials, of which one was underpowered (32), thus the effectiveness results across the studies were modest. Chen and Wu (40) also identified the need for controlled trials of SCIs for older smoker, in order to better understand the most suitable form of intervention for this population. Similarly to findings from Pineiro et al's systematic review (41), the studies in the current review did not consistently use biochemical verification of smoking cessation, with most relying on self-reported smoking cessation (Table 2).

Various design aspects of the included studies, including the use of non-randomised methods, limited the extent to which firm conclusions can be drawn about the effectiveness of behavioural SCIs for older, deprived smokers. Only two studies included qualitative process evaluation data, limiting the ability to understand why specific intervention characteristics were more or less likely to influence smoking cessation outcomes. Evidence suggests that

smokers from disadvantaged backgrounds face particular obstacles to successful quitting such as lack of support, higher nicotine dependence and life stress (20). Further mixed-methods research is therefore warranted to understand why some forms of SCI support may be more suited to mitigating these barriers in the target population.

The findings indicate a clear lack of evidence from large-scale trials of effectiveness in a lung screening context as well as a lack of data reporting psychosocial moderators of cessation for older, deprived smokers. We acknowledge methodological limitations of the present systematic review. By restricting the inclusion criteria for age and socioeconomic group, several potentially relevant studies were excluded. For example, telephone-based counselling for smokers undergoing lung cancer screening, involving messages about risks of smoking in the context of lung scan results, can improve self-efficacy for quitting and the likelihood of a successful quit attempt (42). However, our review highlights the current absence of robust evidence regarding behavioural SCIs that are effective for the lung screening eligible population of older deprived smokers.

CONCLUSION

Our systematic review demonstrates the potential for tailored, multimodal SCIs for older, deprived smokers that can be embedded within disadvantaged communities. With the prospect of lung cancer screening being implemented in the UK and Europe in the near future, this research adds to the evidence base regarding promising SCIs for older, deprived populations who will benefit most from lung screening and integrated smoking cessation support. Further studies to understand the psychosocial barriers to quitting in the target population should be conducted to inform the design and conduct of high-quality trials of intervention effectiveness in older, deprived smokers.

DECLARATION

Competing Interests

The authors declare that they have no competing interests.

Data availability statement

All data derived from the review search (i.e. included papers and their relevant references) have been included in the paper along with the search terms that were used.

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Authors' contribution

Pamela Smith, Prof Kate Brain, Mala Mann, Prof Annmarie Nelson and Dr Graham Moore were responsible for the concept, overall design and conduct of the review. MM gave additional support and advice on methodology including the search strategy. PS was responsible for collection of data and manuscript preparation. Dr Ria Poole double-checked 20% of included abstracts and full-texts. RP, MM, AN, GM and KB reviewed the edited manuscript preparation. All authors were involved in the interpretation of the results and approved the final version of the manuscript.

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FIGURE LEGEND

Figure 1: PRISMA Flow Diagram

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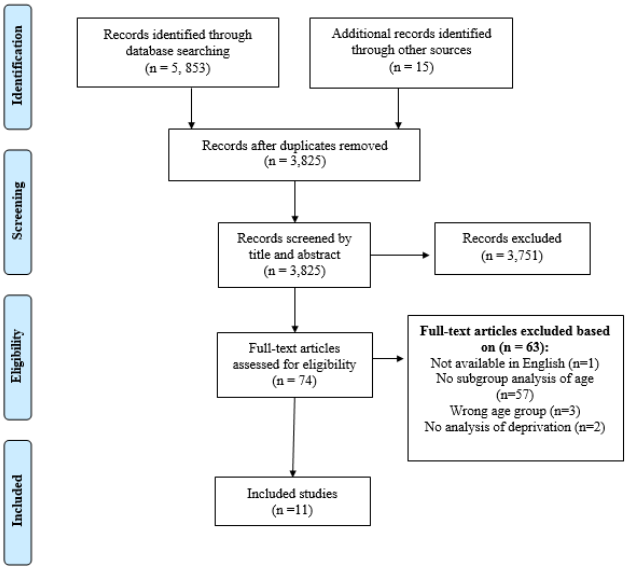

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3,4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3,4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6,7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Supp. File, 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	13-18
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13-18
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	n/a
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	18-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18-20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds

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Systematic review of behavioural smoking cessation interventions for older smokers from deprived backgrounds

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ABSTRACT

Introduction

The associations between smoking prevalence, socioeconomic group and lung cancer outcomes are well established. There is currently limited evidence for how inequalities could be addressed through specific smoking cessation interventions (SCIs) for a lung cancer screening eligible population. This systematic review aims to identify the behavioural elements of SCIs used in older adults from low socioeconomic groups, and to examine their impact on smoking abstinence and psychosocial variables.

Method

Systematic searches of Medline, EMBASE, PsychInfo and CINAHL up to November 2018 were conducted. Included studies examined the characteristics of SCIs and their impact on relevant outcomes including smoking abstinence, quit motivation, nicotine dependence, perceived social influence and quit determination. Included studies were restricted to socioeconomically deprived older adults who are at (or approaching) eligibility for lung cancer screening. Narrative data synthesis was conducted.

Results

Eleven studies met the inclusion criteria. Methodological quality was variable, with most studies using self-reported smoking cessation and varying length of follow-up. There were limited data to identify the optimal form of behavioural SCI for the target population. Intense multimodal behavioural counselling that uses incentives and peer facilitators, delivered in a community setting and tailored to individual needs indicated a positive impact on smoking outcomes.

Conclusion

Tailored, multimodal behavioural interventions embedded in local communities could potentially support cessation among older, deprived smokers. Further high-quality research is needed to understand the effectiveness of SCIs in the context of lung screening for the target population.

Keywords: Smoking, smoking cessation, older, deprived, lung cancer, lung cancer screening

Article summary

- There is a current gap in knowledge about the most suitable form of behavioural smoking cessation intervention (SCI) for older, deprived smokers who are most likely to be eligible for lung screening
- This systematic review suggests that tailored, multimodal behavioural SCIs could support smoking cessation for those most likely to be eligible for lung screening; however, the studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence
- There is a lack of rigorous, high quality research for the target population

INTRODUCTION

Smoking is the leading global cause of death and disease (1) and data show that there are approximately 7.4 million adult cigarette smokers in the United Kingdom (2, 3). Twenty-six percent of smokers in the UK are aged 50 years or older (3); these individuals tend to have long standing smoking histories, are often from deprived communities and are a population that are likely to be eligible for future lung screening implementation. The associations between smoking prevalence, socioeconomic group and a range of chronic disease outcomes, including lung cancer outcomes are well established, with higher smoking rates and greater lung cancer incidence and mortality (4-6) among people living in deprived areas.

The US Preventive Services Task Force recommends annual low-dose computed tomography screening for those who are high-risk heavy smokers, including adults aged 55-80 years old, with a 30 pack-year history (7). LDCT lung cancer screening has the potential to prompt a smoking cessation attempt and evidence for integrated smoking cessation support is growing (8-11), with research demonstrating promising results for quit rates when using a combined approach of smoking cessation support in a lung screening setting (9).

Prior to implementing appropriate smoking cessation intervention (SCIs) in a lung screening context in the UK, it is important to understand the factors that influence cessation attempts in older, deprived smokers who may be eligible for lung cancer screening. Known barriers to smoking cessation in this population include higher nicotine dependence, less motivation to quit, more life stress, lack of social support and differences in perceptions of smoking (12-14). Smokers from a low socioeconomic background may find quitting more difficult due to lack of support from their family members or community with quit attempts (15), partly due to higher smoking prevalence and normalisation of smoking in their social networks (16).

Studies suggest that cessation attempts in older smokers are more likely to fail due to heavy nicotine dependence and insufficient motivating factors such as self-efficacy to quit (17, 18).

Using pharmacotherapy with structured behavioural support to assist smoking cessation has shown promise with disadvantaged smokers (19, 20). Intensive SCIs involving tailored pharmacotherapy and behavioural counselling to increase self-efficacy are most effective for deprived smokers (21). However further research is needed to understand specific characteristics of behavioural SCIs, such as mode of delivery, setting, intensity and duration, that could be used for older, deprived smokers.

A recent review by Iaccarino (22) attempted to identify the best approach for delivering SCIs in a lung cancer screening setting and concluded that the optimal strategy remains unclear. There is a need to identify gaps in the evidence surrounding the optimal models for integrated smoking cessation in a lung screening setting, focusing specifically on a disadvantaged lung screening eligible population, as well as gain a better understanding of what form of SCI may work best for this population in the UK.

The aims of this systematic review were to identify the behavioural aspects of SCIs for older, deprived adults who are eligible (or approaching eligibility) for lung cancer screening, and to explore which elements of the interventions were most effective in reducing smoking abstinence and modifying psychosocial variables. The findings from the systematic review will contribute to further understanding of optimal SCIs for individuals who are a target population for lung cancer screening.

METHODS

The systematic review was registered on PROSPERO (CRD42018088956) and followed the PRISMA guidelines (23). Throughout all stages of the search, data extraction and quality appraisal, 20% of studies were double-checked for consistency by another member of the

team (RP). All discrepancies were resolved through discussion. Data duplication was managed by removing duplications using a reference management software package (EndNote X9), which were then manually checked.

Search strategy

The literature was searched from 1900 to November 2018 on electronic databases: Medline, EMBASE, PsychInfo and CINAHL. Search terms related to smoking cessation, SCIs and socioeconomic status were used (Table 1). To limit restricting the search in relation to age, papers were manually screened to identify studies that used a relevant sample.

Table 1: PICO tool

PICO	Description	Search terms and connectors
Population	Individuals from socioeconomically deprived groups, defined through either individual or area level indicators	(Depriv* or disadvantage* or inequit* or socioeconomic or socio-economic or sociodemographic or socio-demographic or social class or deprivation group or poverty or low income or social welfare).tw.
Intervention	A range of interventions including individual and group counselling, self-help materials, pharmacological interventions (e.g. nicotine replacement therapy), social and environmental support, comprehensive programmes and incentives	Smoking Cessation/ and (intervention* or initiative* or strategy* or program* or scheme* or outcome* or approach*).tw.
Comparison	All study types with a pre/post intervention and/or a control group	-
Outcome	Primary outcome: smoking abstinence Secondary outcome: Moderating variables (e.g. nicotine dependence, quit motivation, self-efficacy, social support and influences)	((nicotine or tobacco or smok* or cigarette) adj (quit* or stop* or cess* or cease* or cut down or "giv* up" or reduc*)).tw.

Study eligibility criteria

All searches were restricted to high-income countries (24). Inclusion criteria for the included publications were; *'Socioeconomically deprived groups'* that defined their sample through individual level indicators (e.g. educational level, income) or area level indicators (e.g. postcode). *'Older adults',* defined as aged 50 years + (or when the majority of the sample was aged 40+) were included to represent a sample at or approaching lung cancer screening age (25). The review included studies that examined behavioural aspects of SCIs and outcomes including smoking abstinence and psychosocial variables such as quit motivation, nicotine dependence, perceived social influence and quit determination.

Data extraction and synthesis

Study outcomes, including moderating variables and selected study features were extracted. Where relevant, statistical associations between variables are described in order to examine relationships within and between the included studies. Data from qualitative elements of included studies were extracted and a narrative synthesis was conducted. Due to the heterogeneity of included studies, a narrative synthesis was performed using guidance outlined by Popay (26) and organised under relevant behavioural intervention elements.

Critical Appraisal

The methodological quality of included studies and risk of bias was assessed using an adapted Critical Appraisal Skills Programme (CASP) tool (27). Quality was assessed according to each domain on the checklist including rationale, study design, recruitment, sample size, data collection and analysis, ethical issues, reporting of findings and contribution to research. The CASP tool was adapted to address quality of methods for verifying smoking abstinence, intervention type, and socioeconomic and age variation within the sample. Overall quality was categorised as high, medium or low.

Patient and Public Involvement

Patient and public involvement was not adopted for the review.

RESULTS

Eleven studies met the inclusion criteria (Figure 1). Nine of the 11 studies were quantitative (28-36) and two were mixed-methods design (37, 38). Three studies were randomised control trials, with the remaining using a range of non-randomised designs. Two studies (28, 34) were conducted in a lung screening context. Quality of included studies was high (n=2), medium (n=5) and low (n=4). Limitations of lower quality studies included measuring but not reporting a subgroup analysis of age and/or deprivation, study design, limited description of the intervention and statistically underpowered results. Where available, relevant statistical values are presented in Table 2.

Nine studies used a combination of nicotine replacement therapy and behavioural counselling (28-30, 32-37). One study used only nicotine replacement therapy (31) and one used behavioural counselling without nicotine replacement therapy (38). Results are presented in relation to intervention elements including the behavioural content, setting, intervention provider and mode and duration of delivery. A sub-heading under each intervention element presents data on smoking outcomes. Further study characteristics and findings are also presented in Table 2.

Table 2: Study Characteristic

Study (Country)	Study design	Sample	Intervention	Measure of smoking abstinence	Summary of findings	Quality appraisal
Bade et al (2016) (Germany)	Randomised controlled trial	4052 participants from the German lung cancer screening intervention trial. 1535 (62%) male, 950 (38%) female. 1737 (70%) aged 50-59 years, 748 (30%) 60-69 years old. 1823 (73%) 'low' in education and 1594 (65%) 'low' in vocational training.	Low-dose multislice CT screening and smoking cessation counselling (SCC) delivered by a psychologist in a radiology department. 20 minute counselling followed by at least one telephone call.	Self-report at 12 and 24 months	Proportion of current smokers decreased among screenees (3.4%, p<0.0001), controls (4.5%, p<0.0001), and entire cohort (4.0%, p<0.0001). The magnitude of decrease in smoking rate was larger in SSC participants (screenees 9.6%, p<0.0001; controls 10.4%, p<0.0001) compared to non-SSC participants (screenees 0.8%, p=0.30; controls 1.6%, p=0.03).	High
Bauld et al (2009) (United Kingdom)	Observational study	1785 pharmacy service users. 762 (56%) in the Starting Fresh (SF) group and 311 (76%) in the Smoking Concerns (SC) group were aged 41 years or older. 796 (58%) from SF were in the lowest deprivation quintile, 187 (46%) from SC were in the lowest quintile.	Behavioural support delivered by a trained adviser in a group-based community setting (SC) up to 12 weeks or individually in a pharmacy setting (SF) up to 12 weeks, with access to nicotine replacement therapy.	Biochemical validation at 1 month	146 (36%) quit rate in SC versus 255 (19%) in SF (OR[1]=1.98; 95% CI[2] 1.90 to 3.08). SC and SF deprived smokers had lower cessation rates (OR=0.677; p=0.015). Cessation rate for pharmacy clients increased sharply with age from 13.4% for age 16–40 to 30.7% for age 61 and over (p<0.001). The increase for group-based clients (SC) was statistically insignificant (p<0.25). Determination to quit was not statistically significant: *P* = 0.072 (SF) and *P* = 0.092 (SC).	Medium
Celestin Jr et al (2016) (United States)	Retrospective cohort study	8, 549 tobacco users in Louisiana's public hospital facility. 1531 (68%) in the intervention group were aged 45 years and over. 1,196 (57%) were from the lowest 'financial class'.	Standard care plus group behavioural counselling in a hospital classroom. 4 one-hour sessions, once a week within a 1-month period.	Self-report at 12 months	Intervention participants had greater odds of sustained abstinence than non-attendees (aOR[3]=1.52; 95% CI 1.21 to 1.90). Higher 12-month quit rate in patients over age 60 (22%) compared to 18-30 year olds (11%) (aOR 2.36; 95% CI 1.58 to 3.52). There was a statistically significant effect of COPD status on quit rate (from UOR 1.01 CI 0.86 to 1.19, to AOR 0.75 CI 0.63 to 0.90).	Low
Copeland et al (2005) (United Kingdom)	Observational cohort study	101 patients from a disadvantaged area of Edinburgh. Mean age for males was 47 years and for females was 44 years.	GP consultation and subsequent prescription of nicotine replacement therapy	Self-report at 3 months	Post intervention 35 (35%) smoked the same, 46 (45%) were smoking less and 20 (20%) had stopped smoking. Older participants were more likely to have	Low

[1] *Odds ratio*
[2] *Confidence interval*
[3] *Adjusted odds ratio*

					stopped or to be smoking less (p<0.00).	
Lasser et al (2017) (United States)	Prospective, randomised trial	352 participants randomised (177 intervention, 175 control). 197 (56%) aged 51-74. 193 (55%) with a household yearly income <$20,000.	Patient navigation and financial incentive (intervention) versus enhanced traditional care (control). Intervention received 4 hours of support over 6 months. Delivered by patient navigators over the phone or in-person.	Biochemical validation at 12 months	21 (12%) intervention participants quit smoking compared to 4 (2%) control participants (OR=5.8, 95% CI 1.9 to 17.1, p<0.00). In the intervention arm (n=177), participants aged 51-74 had higher quit rates compared to those aged 21-50 (19 [19.8%] vs 2 [2.0%]; p< 0.00). Household yearly income of <$20,000 had higher quit rates compared to >$20,000 (15 [15.5%] vs 4 [8%]; p= 0.00).	Medium
Neumann et al (2013) (Denmark)	Observational prospective cohort study	20,588 disadvantaged patients (low level of education and receiving unemployment benefits). 15,244 (74%) aged 40 years or over.	6-week manualised Gold Standard Programme in hospitals and primary care facilities (e.g. pharmacies). Delivered in 5 meetings over 6 weeks by a certified staff member. Both group and individual counselling was offered.	Self-reported continuous abstinence at 6 months	34% of responders reported 6 months of continuous abstinence. Continuous abstinence was significantly lower in those with less education (30%) versus more education (35%) (p<0.00). For participants with a lower educational level, individual counselling was a predictor of success in smoking cessation (OR=1.31, 95% CI 1.05 to 1.63).	Medium
Ormston et al (2015) (United Kingdom)	Mixed-methods, quasi-experimental study	2042 smokers living in deprived areas of Dundee. 70 (54%) aged 45 years and over. 119 (92%) from the two most deprived areas.	Financial incentive and behavioural support based on Scottish national guidelines, with pharmacotherapy (Quit4u Scheme) delivered in group (practice nurses) and one-to-one settings (community pharmacists) for up to 12 weeks.	Biochemical validation at 1, 3 and 12 months	Intervention was responsible for 36% of all quit attempts in the three most deprived areas. 12 month quit rate (9.3%) was significantly higher than other Scottish stop smoking services (6.5%) (relative difference 1.443, 95% CI 1.132 to 1.839, p=0.00).	Medium
Park et al (2015) (United States)	Matched case control study	3336 National Lung Screening Trial participants.	SCI delivered by a primary care clinician using the 5As.	Self-report at 12	Assist was associated with a 40% increase in quitting (OR=1.40, 95% CI 1.21 to 1.63).	Medium

		Aged 55 to 74 years old. No report of deprivation at baseline. Subgroup analysis performed for education.		months	Arrange was associated with a 46% increase in quitting (OR=1.46, 95% CI 1.19 to 1.79). Higher educational level was significantly associated with quitting after delivery of each of the 5As (ORs=1.14 to 1.26 for college degree or higher versus high school education). Lower nicotine dependence (OR= 0.94, 95% CI 0.91-0.98), and higher quit motivation (OR=1.28, 95% CI 1.21-1.35) were significantly associated with quitting after delivery of each of the 5As	
Sheffer et al (2013) (United States)	Observational study	7267 participants in telephone treatment: 30% aged >50 years, 35% aged 36-49 years. In-person participants: 38% aged >50 years, 38% aged 36-49 years. No report of deprivation at baseline. Subgroup analysis performed for deprivation.	Behavioural counselling-manual driven sessions delivered weekly in-person (healthcare settings) or over the telephone, with free nicotine patches for 6 weeks. Delivered by a health care provider trained in brief evidence-based tobacco dependence interventions.	Self-report at 3 and 6 months	Abstinence rates were higher for in-person counselling (37.7%) versus telephone counselling (30.8%) (p<0.00). No significant difference at 3 months (p=0.73) and 6 months (p=0.27) between in-person (28.2%; 27.2%) and telephone (28.7%; 28.7%). The highest socioeconomic (SES) group was more likely to be abstinent with telephone treatment (SES3: P =0.03; OR = 1.45; 95% CI = 1.04, 2.01). No significant differences between the in-person and telephone for the two lower SES groups (SES1: OR=1.02, 95% CI 0.88 to 1.18, p=0.82; SES2: OR=0.91, 95% CI 0.72 to 1.15, p=0.41).	Low
Sheikhattari et al (2016) (United States)	Randomised controlled trial	409 (52%) were aged 48 years and over. Recruited in targeted communities where more than 40% of the households earn less than $25,000. 531 (72%) were unemployed.	Peer-led community-based intervention over three phases. Phase 1 (n=404) – the American Cancer Society's 4-week Fresh Start smoking cessation curriculum expanded to 12 weeks at health centres and delivered by a doctor, nurse or social worker. Phase 2 (n=398) and Phase 3 (n=163) – tailored group counselling in community venues, delivered by trained peer motivators.	Self-report and biochemical validation at 3 and 6 months	Delivery of services in community settings was a predictor of quitting (OR=2.6, 95% CI 1.7 to 4.2). Smoking cessation increased from 38 (9.4%) in Phase 1 to 84 (21.1%) in Phase 2, and 49 (30.1%) in Phase 3. Phases 2 and 3 were associated with higher odds compared to Phase 1, with adjusted ORs of 2.1 (95% CI 1.3 to 3.5) and 3.7 (95%CI 2.1 to 6.3) respectively. Older age (>48 years versus <48 years) was associated with higher quit rate (13.3% vs 19.1%, p=0.028).	High

Stewart et al (2010) (Canada)	Pilot evaluation of a before and after study	44 women, aged 25-69, living on low income in urban areas of Western Canada. 23 (52%) aged 40 years or older. 18 (39%) participants unemployed, 26 (62%) on welfare/income support.	Facilitated group support supplemented with one-to-one support from a mentor. Once a week, duration of 12 weeks minimum. Groups facilitated by professionals and former smokers with the option of one-to-one from peers in community centres.	Self-report at 3 months	The mean number of cigarettes smoked daily decreased from pre to post-test (p=0.00). Among women completing all data collection (n=22), the mean number of cigarettes consumed daily decreased from 0.95 pre-intervention to 0.32 immediately after the intervention, then increased to 0.64 at 3 months post-intervention. Four women reported sustained cessation.	Low

Behavioural intervention content

Ten studies focused on meeting the individual participant's needs using education and motivational techniques including support and encouragement (28-30, 32-38). In all ten studies, the interventions involved used motivational techniques with varying levels of intensity (Table 2).

Nine studies used interventions that were of higher intensity (28-30, 32, 33, 35-38). These studies involved incorporating specific action planning, tailored by the participant's level of quit motivation (28), using a combination of manual-based teaching and patient education sessions including relapse prevention modules (36), motivational interviewing techniques (32), discussions on the benefits and costs of smoking versus cessation (33), empowering strategies to enhance self-efficacy (38) and cognitive behavioural content (35).

Three studies used financial incentives as part of their intervention (32, 36, 37). A randomised control trial conducted by Lasser et al (32) offered participants $750 for abstinence at 12-month follow-up. This element of the intervention was combined with patient navigation in which trained navigators identified and discussed salient social contextual factors using motivational interviewing. Ormston et al (37) combined behavioural support with financial incentives to participants upon biochemically verified cessation.

Outcomes

A study by Park et al (34) found that the 'assist' and 'arrange follow-up' elements of a brief SCI based on the 5As (ask, advise, assess, assist and arrange follow-up) alongside lung cancer screening significantly increased the odds of quitting. Results showed that the decrease in smoking rate was larger for participants who received behavioural support compared to those who did not. Smoking abstinence was higher in participants with a higher educational level. (Table 2).

Studies of interventions that involved using financial incentives found that older participants and those with the lowest income had higher quit rates (Table 2). Ormston et al (37) found that quit rates for the intervention group were significantly higher compared to other stop smoking services (Table 2). Seventy-one percent of participants reported that the incentive component was '*very*' or '*quite useful'* in helping them quit, with participants describing it as a '*bonus*' or '*reward*' to motivate them.

Stewart et al (38) reported qualitative data on self-efficacy for quitting and found that participants thought the education they gained from the intervention increased their awareness of their smoking habits, reasons why they smoked and the importance of quitting. Participants also reported an increase in the number of available support sources (e.g. parents, spouse and friends) along with a significant increase in perceived social support (38).

Setting

Two studies took place in a lung screening setting (28, 34) and used contrasting forms of interventions. Park et al (34) offered a brief SCI delivered by a primary care clinician, whereas Bade et al (28) used a more intensive intervention delivered by a psychologist who was trained in tobacco treatment. The latter study used a randomised control trial design with a large sample size and took place in the radiology department before or after the participant's screening.

Five studies were delivered in a variety of easily accessible community settings including community pharmacies (29, 33, 37) and community venues such as centres and churches (29, 36-38) (Table 2). Three studies took place at medical facilities such as local medical/health centres (31, 32, 35) and two studies took place in hospitals (30, 33). One study delivered the intervention in both community and primary care settings (33).

Outcomes

Stewart et al (38) used a community-based intervention that took place in a local community centre, familiar to participants. Findings from this small-scale pilot study of female smokers suggested that the number of cigarettes smoked decreased post-intervention (Table 2). Ormston et al (37) compared intervention delivery in community pharmacies and behavioural support (both group and one-to one sessions) to other stop smoking services and demonstrated significantly higher quit rates in deprived communities (Table 2).

Bauld et al (29) showed that specialist-led group-based services have higher quit rates compared to one-to-one services that are provided by pharmacies. Cessation rates for pharmacy clients increased with age, and more deprived smokers had lower smoking cessation rates in both the pharmacy-led and one-to-one services (Table 2). Sheikhattari et al (36) found higher quit rates for community-based participants compared to those receiving support in clinics during phase 1 of the intervention (Table 2). Results from this study also showed that older age (defined as over 48 years) was associated with higher quit rates for participants.

Provider

Interventions were delivered by a range of providers (Table 2). Seven studies employed healthcare professionals such as general practitioners, primary care practice nurses, psychologists and pharmacists (28, 30, 31, 33-35, 38). Two studies employed trained peer motivators to deliver their intervention. Sheikhattari et al (36) used peer motivators who were former smokers to deliver the behavioural sessions. Peer motivators lived or worked in the community and were trained in delivering the intervention. Lasser et al (32) used patient navigators who had completed 10 hours of training in motivational interviewing techniques and had experience of working in community settings.

Outcomes

Smoking abstinence outcomes varied according to SCI provider (Table 2). A small-scale observational study by Copeland et al (31) examined the use of nicotine replacement theory and a brief GP consultation. Results showed that older smokers were more likely to have stopped smoking (Table 2).

Sheikhattari et al (36) demonstrated that subsequent phases of the intervention delivered by trained peer facilitators were associated with higher odds of quitting compared to the first phase where intervention delivery was conducted by a doctor, nurse or social worker (Table 2). Findings from Lasser et al (32) demonstrated that older participants and those with a lower household yearly income had higher quit rates (Table 2).

Qualitative data from Stewart et al (38) demonstrated that participants felt peer facilitators helped to support their cessation efforts as they were able to share personal experiences and strategies. Participants reported that they were able to learn coping strategies and techniques from other participants in the group which then helped them with their quit attempt.

Mode and duration

Studies varied in the mode and duration of delivery of SCIs (Table 2). Seven studies examined both individual and group behavioural counselling sessions (29, 30, 32, 33, 35, 37, 38) (Table 2) and four studies used only one-to-one behavioural support (28, 31, 32, 34). Duration of interventions varied greatly between and within studies (Table 2). The shortest duration was an intervention embedded in a GP consultation (31) and the longest was 16 weeks of smoking cessation support (38).

Outcomes

Bauld et al (29) showed that participants accessing group-based services were almost twice as likely as those who used individual pharmacy-based support to have quit smoking at four weeks (Table 2). Similarly, Celestin et al (30) showed that attendees of group behavioural

counselling had significantly higher long-term quit rates compared to non-attendees. Sheikhattari et al (36) used a six-week group-counselling module followed by a six-week relapse prevention module. Higher odds of quitting were associated with later phases of the intervention in which community-based group counselling was delivered (Table 2).

Lasser et al (32) delivered their one-to-one behavioural support over six months either in-person or over the telephone, with a goal of four hours per participant. Results demonstrated that more participants from the intervention group had quit smoking in comparison to the control group (Table 2). Bade et al (28) also employed behavioural counselling in-person, with at least one subsequent telephone call for those who had specified a quit date. Participants were offered four telephone calls that lasted around 20 minutes in duration and findings demonstrated a larger decrease in smoking for screening attendees compared to non-attendees (Table 2).

Sheffer et al (35) delivered both telephone and in-person behavioural counselling. Smoking abstinence rates were higher for in-person counselling, with smokers from higher socioeconomic groups more likely to quit after telephone counselling than smokers from lower socioeconomic groups. Neumann et al (33) offered either group or individual counselling and demonstrated that for those with a lower educational level, individual counselling was a predictor of smoking cessation (Table 2).

Moderating variables

Seven studies reported limited data on moderating variables (28-30, 32, 34-36). Bauld et al (29) found that smokers who reported being '*extremely determined'* to quit were more likely to be successful in their quit attempt. Celestin et al (30) demonstrated that COPD status had a statistically significant effect on quit rates (Table 2) and Park and colleagues (34) showed that lower nicotine dependence and higher quit motivation were significantly associated with

quitting after the delivery of each of the 5As. Three RCTs demonstrated that participants who had a lower Fagerstrom score (36), who were contemplating quitting (32) and reported high readiness to quit (28) at baseline were more likely to have abstained from smoking post-intervention.

DISCUSSION

To our knowledge, this systematic review is the first to examine the influence of behavioural SCIs for an older, deprived population. The majority of included studies used a combination of pharmacotherapy and a form of behavioural counselling, supporting previous evidence that a combined approach is the most effective for older, deprived smokers (21). Additionally, findings relating to the intensity, provider, mode, duration and setting of behavioural counselling are encouraging. Behavioural counselling delivered in a community setting and tailored to individual needs appeared to demonstrate a positive impact on smoking cessation outcomes.

Behavioural interventions identified in the current review used a range of approaches and although none of the included studies explicitly described their intervention as "tailored", many used a form of behavioural counselling that was implicitly flexible according to the needs of the individuals. Interventions were implemented in locations that addressed barriers to access, such as local community centres, and intervention content was driven by the individual's psychological needs (29, 36-38). Previous research suggests that in order for people to access stop smoking services, the appointments should be flexible and accessible (39).

The optimal mode and duration of intervention was unclear from our review, with findings suggesting varying success for both group and one-to-one behavioural support. The current results reflect similar findings from a review conducted in the UK. Bauld et al (21) concluded

that due to a dearth of studies examining subpopulations of smokers, further research is needed to determine the most effective models of treatment for smoking cessation and their efficacy with these subgroups (21). The current review did, however, demonstrate that certain aspects of behavioural interventions, such as incentives, the use of peer facilitators and more intensive counselling are promising for encouraging cessation in older, deprived smokers. Additionally, limited data regarding the influence of moderating variables suggests that factors such as nicotine dependence, quit motivation and pre-existing health conditions such as COPD can impact the effectiveness of smoking cessation interventions. Future research should aim to understand the needs and preferences of older, deprived smokers and focus on psychosocial mechanisms that can be targeted in more holistic level interventions.

The eleven studies included in the review were heterogeneous in design, SCI modality, sample size, intervention timing and measurement of smoking abstinence. Some of the included studies did not report confidence intervals, thus making it difficult to interpret findings. Only three of the studies included were randomised control trials, of which one was underpowered (32), thus the effectiveness results across the studies were modest. Chen and Wu (40) also identified the need for controlled trials of SCIs for older smoker, in order to better understand the most suitable form of intervention for this population. Similarly to findings from Pineiro et al's systematic review (41), the studies in the current review did not consistently use biochemical verification of smoking cessation, with most relying on self-reported smoking cessation (Table 2).

Various design aspects of the included studies, including the use of non-randomised methods, limited the extent to which firm conclusions can be drawn about the effectiveness of behavioural SCIs for older, deprived smokers. Only two studies included qualitative process evaluation data, limiting the ability to understand why specific intervention characteristics were more or less likely to influence smoking cessation outcomes. Evidence suggests that

smokers from disadvantaged backgrounds face particular obstacles to successful quitting such as lack of support, higher nicotine dependence and life stress (20). Further mixed-methods research is therefore warranted to understand why some forms of SCI support may be more suited to mitigating these barriers in the target population.

The findings indicate a clear lack of evidence from large-scale trials of effectiveness in a lung screening context as well as a lack of data reporting psychosocial moderators of cessation for older, deprived smokers. We acknowledge methodological limitations of the present systematic review. By restricting the inclusion criteria for age and socioeconomic group, several potentially relevant studies were excluded. For example, telephone-based counselling for smokers undergoing lung cancer screening, involving messages about risks of smoking in the context of lung scan results, can improve self-efficacy for quitting and the likelihood of a successful quit attempt (42). However, our review highlights the current absence of robust evidence regarding behavioural SCIs that are effective for the lung screening eligible population of older deprived smokers.

CONCLUSION

Our systematic review demonstrates the potential for tailored, multimodal SCIs for older, deprived smokers that can be embedded within disadvantaged communities. With the prospect of lung cancer screening being implemented in the UK and Europe in the near future, this research adds to the evidence base regarding promising SCIs for older, deprived populations who will benefit most from lung screening and integrated smoking cessation support. Further studies to understand the psychosocial barriers to quitting in the target population should be conducted to inform the design and conduct of high-quality trials of intervention effectiveness in older, deprived smokers.

DECLARATION

Competing Interests

The authors declare that they have no competing interests.

Data availability statement

All data derived from the review search (i.e. included papers and their relevant references) have been included in the paper along with the search terms that were used.

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Authors' contribution

Pamela Smith, Prof Kate Brain, Mala Mann, Prof Annmarie Nelson and Dr Graham Moore were responsible for the concept, overall design and conduct of the review. MM gave additional support and advice on methodology including the search strategy. PS was responsible for collection of data and manuscript preparation. Dr Ria Poole double-checked 20% of included abstracts and full-texts. RP, MM, AN, GM and KB reviewed the edited manuscript preparation. All authors were involved in the interpretation of the results and approved the final version of the manuscript.

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FIGURE LEGEND

Figure 1: PRISMA Flow Diagram

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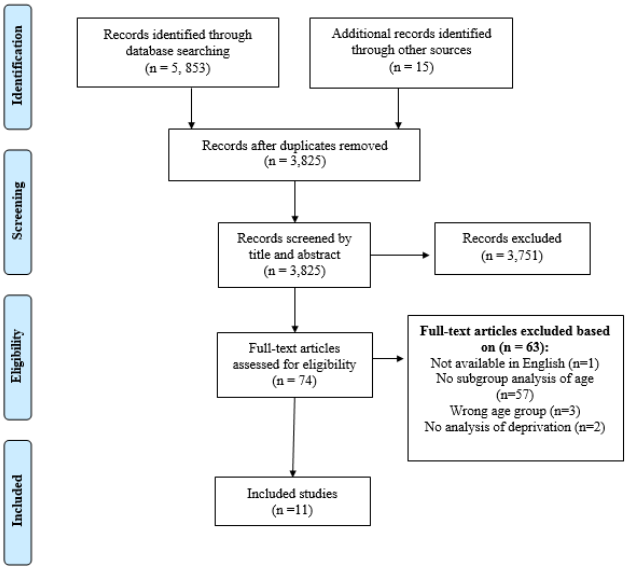

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3,4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3,4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	6
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	6
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6,7
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	7
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	n/a
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	n/a

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	n/a
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	Supp. File, 8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	13-18
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	13-18
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9-12
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	n/a
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	n/a
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	n/a
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	18-20
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	18-20
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	20
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	21

From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

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