Smoking amongst adults experiencing homelessness: A systematic review of prevalence rates, interventions and the barriers and facilitators to quitting and staying quit

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ABSTRACT

Background: To date there has been no review of the research evidence examining smoking cessation among homeless adults. The current review aimed to: i. estimate smoking prevalence in homeless populations; ii. explore the efficacy of smoking cessation and smoking reduction interventions for homeless individuals; and iii. describe barriers and facilitators to smoking cessation and smoking reduction.

Method: Systematic review of peer-reviewed research. Data sources included electronic academic databases. Search terms: '*smoking' AND 'homeless' AND 'tobacco',* including adult (18+ years) smokers accessing homeless support services.

Results*:* 53 studies met the inclusion criteria (n=46 USA). Data could not be meta-analysed due to large methodological inconsistencies and the lack of randomised controlled trials (RCTs). Smoking prevalence ranged from 57-82%. Although there was no clear evidence on which cessation methods work best, layered approaches with additions to usual care seemed to offer modest enhancements in quit rates. Key barriers to cessation exist around the priority of smoking, beliefs around negative impact on mental health and substance use, and environmental influences.

Conclusions*:* Homeless smokers will benefit from layered interventions which support many of their competing needs. To best understand what works, future recommendations include the need for consensus on the reporting of cessation outcomes.

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INTRODUCTION

Smoking rates have seen a general decline across high income countries (Bilano et al., 2015), although this masks significant tobacco related health inequalities, including those experiencing homelessness (e.g. Jha et al., 2006; Jackson, Smith, Cheeseman, West, & Brown, 2019). The definition of homelessness differs by environment but can broadly be understood as living without long-term secure accommodation. This includes those in short term accommodation with friends and relatives, in state or charity temporary accommodation (e.g., hostels, night shelters), and sleeping outside or in premises not intended or fit for tenancy. In the United Kingdom, smoking prevalence is estimated at 78% amongst homeless adults (Homeless link, 2019, September 19), compared to 14.7% in the general population (Office for National Statistics, 2019, July 2). In the US it is estimated that up to three quarters of the 2.3 to 3.5 million homeless adults smoke (Baggett, Tobey & Rigotti, 2013).

Homelessness is associated with high levels of health comorbidity including cardiac and respiratory problems (Hwang, 2001), poorer mental health, high levels of dependence on other (including illicit) substances (Aldridge et al., 2018; Booth, Sullivan, Koegel & Burnam, 2002), and low attendance at support services. The concomitant of poor physical and mental health as well as immediate issues related to housing needs means smoking may be overlooked by both smokers themselves and service providers. Nevertheless, even in the face of complex issues, there is evidence that homeless smokers do wish to quit smoking (Dawkins et al., 2019) and possess, albeit basic, knowledge of the harms caused by tobacco (Garner & Ratschen, 2013). Yet, smoking appears to be a neglected addiction (Baggett et al, 2013) in the context of homelessness. There are challenges for both health professionals in providing smoking cessation support e.g., competing health needs, finite resources and also for researchers when studying this group, e.g. access to services. Taken together, this is an area of health research with many multi-layered complexities and initial barriers which need individual consideration.

In an attempt to reduce tobacco related health inequalities there have been several international and national strategies developed with the intention of reducing smoking prevalence rates. The WHO Framework Convention for Tobacco Control (World Health Organisation, 2003) recognises the need to reduce inequalities caused and exacerbated by smoking through the implementation of a comprehensive tobacco control plan. In England, a key aim of the Tobacco Control Plan (Department of Health (DoH), 2017) is to reduce health inequalities through targeting populations where smoking rates remain high. In order to achieve this the English DoH supports co-working between charities and the research community to develop guidance and training for professionals on the delivery of stop-smoking interventions. Many homeless charities provide a range of health and social inventions including support for drug and alcohol problems which could be extended to smoking cessation support.

The literature on smoking prevalence, the efficacy of smoking cessation interventions, the challenges that exist for this population, and how they may be overcome, have not previously been subjected to a systematic review. Whilst prevalence is known to be high and barriers significant, exploring these over a wide geographic reach and taking a finer grained approach into the issues can help to inform future work to reduce tobacco-related health inequalities. We therefore conducted a systematic review of the literature to assess:

i. The prevalence of tobacco smoking among people who are homeless

ii. The efficacy and effectiveness of smoking cessation and/or smoking reduction interventions for people who are homeless

iii. The barriers and facilitators to smoking cessation and smoking reduction interventions among people who are homeless.

1. METHOD:

1.1. Protocol & registration

A review protocol was registered with PROSPERO on 22/11/2017 (PROSPERO 2017 CRD42017081843) and is reported following the PRISMA guidelines (Moher et al., 2015). We have deviated from our protocol by not including our preregistered secondary aims concerning smoking behaviours and characteristics related to this group (e.g., urge to smoke, smoking discarded cigarettes etc), given that the information would have been too broad for one review and is often inconsistently cited in the literature. Instead, here we focus on our preregistered primary aims only.

Method and risk of bias assessment:

1.1. Eligibility criteria:

1.1.1. Participants

Studies were included if participants included homeless adults (18+ years) and who smoked (combustible tobacco products). Homelessness was defined as sleeping on the streets, housed in temporary (state or charity) accommodation or shelter, and 'sofa surfers'/living 'doubled-up', including both temporary and long-term homelessness and those accessing homeless services. Studies were excluded if participants were users of smokeless tobacco or where the primary aim of the study was not exclusively related to smoking behaviours in homeless groups (e.g., Twyman, Bonevski, Paul, & Bryant, 2014).

1.1.2. Interventions

Intervention studies were considered if they reported smoking rates in homeless populations, data on the nature and success of quit attempts including efficacy of smoking cessation and reduction interventions (e.g., Nicotine Replacement Therapy (NRT), behavioural support and novel

interventions). Studies documenting barriers and facilitators to quit and/or reduction attempts were also included.

1.1.3. Comparators

An initial scoping review found limited evidence from controlled trials; thus, a broad range of study designs were considered for inclusion, taking a similar approach as Husk, Lovell, Cooper, Stahl-Timmins, & Garside (2016). Studies with and without a comparison group are included; the weaknesses of uncontrolled studies for assessing effectiveness was taken into consideration in the assessment of study quality.

1.2. Outcomes

Outcomes of the reviewed articles were to document: i) How common smoking is in adults experiencing homelessness. This was assessed by including studies which aimed to capture or which specifically asked about smoking status. ii) Quit rates and reduction rates as a result of smoking cessation interventions. Studies were included if they had a behavioural and/or medical intervention, cessation intervention, and cessation outcome with any follow up time. iii) The barriers and facilitators to smoking cessation and reduction within this group

1.3. Study design

Peer-reviewed research studies that were written in English and documented one or more of the following issues in the target population were considered. For assessing the prevalence of smoking rates and the effectiveness of smoking cessation treatments for homeless adults, the following were included: cross-sectional studies, RCTs, cluster randomised controlled trials (cRCTs), quasi-RCTs, controlled pre and post studies, interrupted time series studies, cohort studies, case-control studies, mixed methods studies where the quantitative element addressed prevalence rates, and uncontrolled

pre and post studies. Whilst uncontrolled before and after studies are at greater risk of bias and are unable to determine causality, when there is an absence of RCTs or clinical trials, these types of studies may elucidate potential links between processes and behaviours and highlight key entities, allowing reviewers the chance to review available evidence and highlight factors of common importance (Husk et al., 2016). In relation to the second aim, we were interested in studies which measure a smoking cessation intervention and a cessation outcome, however post hoc we noted a small number of studies also measured 'alternative' interventions e.g., staff training, smoking bans, and the impact of this on smoking rates. To provide readers with as much data as possible, we included these narratively.

For assessing the barriers and facilitators to smoking cessation and smoking reduction interventions in homeless individuals, both quantitative (i.e. cross-sectional longitudinal, cohort studies) and qualitative (any recognised method of qualitative data collection including but not limited to: individual interviews, focus groups, participant observations, documentary analysis, and analysis from any discipline or theoretical tradition, including but not limited to phenomenological analysis, grounded theory, thematic analysis), and mixed methods designs were considered.

1.4. Information Sources and Searches:

Electronic databases were searched independently by two researchers (SC and KS), from inception until February 2019 (including those published after this date but available online within the timeframe). Databases included MEDLINE (PubMed), EMBASE, CINAHL (via EBSCO), AMED (via Ovid/EBSCO), BNI, PsycINFO, Cochrane Library, Academic Search Premier, Psychology and Behavioural Sciences Collection, The Cochrane Tobacco Addiction Group (MEDLINE, EMBASE, PsycINFO, and Cochrane Central Register of Controlled Trials (CENTRAL)). Two reviewers (SC and KS) independently conducted the searches using the search terms 's*moking' AND 'homeless' AND 'tobacco'.*

1.5. Study Selection and Data Extraction:

The two reviewers (SC and KS) independently screened titles and abstracts of papers identified in the searches and organised them in a bibliographic database. Reviewers met to discuss eligible abstracts and removed any duplicates. The full-text of all potentially eligible papers were then reviewed before making a final decision concerning inclusion. Any disagreements were resolved by a third reviewer (LD). The following data were extracted (individually by two reviewers) from included studies: participants, studies, comparators, outcomes, and study design.

1.6. Risk of bias (quality) assessment:

Risk of bias was assessed independently by the two reviewers (SC and KS) for each full-text article reviewed following the approach recommended in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011). For assessing risk of bias for the invention studies the ROBINS_I for nonrandomised studies was used (Sterne et al., 2016). All qualitative studies were assessed using the quality appraisal checklist recommended by the National Institute for Health and Care Excellence (2015). All other studies, e.g., cohort, cross sectional surveys, and observational studies were assessed using the Newcastle Ottawa Tool (Wells et al., 2008). As per protocol, disagreements were to be resolved by consulting a third reviewer (either LD or DR); however, this was not necessary.

1.7. Strategy for data synthesis:

Only one RCT met the search criteria and there were large variances in both study design and reporting of outcome; therefore, a meta-analysis could not be conducted. As per protocol, descriptive data are instead presented and, where appropriate, a narrative review conducted. In relation to the qualitative studies, we present distinct categories using descriptive themes that allow the findings to be

presented as 'close' to their original themes in which they were originally published (as recommended by Thomas & Harden, 2008).

1.8. Quality assessment of studies

The Cochrane collaboration tool[18] for assessing bias in RCTs was used to assess the Okuyemi et al., (2013) study as uncertain risk of bias. This is because, as per the author of the tool's recommendation, participants in this study were not blind to the intervention arms, there is also a risk of other health behaviours (e.g., drug use) affecting attrition rates and outcome. The ROBINS-I assessment tool (Sterne et al., 2016) for all intervention and pre-post research studies was used, the majority (n= 15; 79%) having being judged as having a low/medium risk of bias.

Using the Ottawa Newcastle tool (Wells et al., 2008) the remaining studies (non-intervention) were rated as fair quality. The 5 qualitative studies were rated as moderate quality, meaning that most of the NICE criteria (NICE, 2015) had been sufficiently met and the conclusions were unlikely to alter.

Overall, assessment of all included studies indicated considerable variation. Most studies provided clear and appropriate descriptions of their sample, recruitment and study sites (including country), participants (age, gender, ethnicity), design and methods, data collection, and analyses. For studies reporting some form of quantitative data, there was considerable variation in sample sizes; when assessing prevalence rates, sample sizes ranged from 33 to 4750 participants; when assessing an intervention, pre/post study sample sizes ranged from 6 to 430 participants. The one RCT (Okuyemi et al., 2013) included in the review, produced a further three studies reporting findings from different research questions. Thus, multiple reporting of the same data is reported which limits the independence of the collective findings.

Of the studies which identified barriers and facilitators to engaging with smoking cessation services, the majority reported barriers rather than facilitators. Interestingly 6 studies that indicated facilitators

did not report any barriers. Taken together this suggests that there may be biases in the research studies with the assumption that there will only be barriers to engaging in smoking cessation. Less weight is therefore given to possible facilitators which are only identified when explicitly explored.

2. RESULTS:

2.1. Search Results

Figure 1 presents the search results. 1053 initial studies were identified from electronic searches, 948 duplicates were removed. 108 papers were screened with 53 studies meeting the inclusion criteria in line with the review objectives.

There was large heterogeneity between studies, making comparisons difficult. Intervention studies differed greatly by design, follow-up timing, length and type of intervention offered, and types of statistics reported (e.g., ranges, means). Inconsistencies also existed between measures of smoking behaviour (e.g., nicotine dependence) and capturing and reporting comorbidities (e.g., mental health and alcohol and drug use).

2.2. Study characteristics

Forty-six of the papers reported data from the US, four from Australia, two from the UK, and

one from Canada.

Fourteen studies reported smoking prevalence rates **(Table 1).** Fourteen studies reported smoking cessation interventions **(Table 2).** The large majority of the studies (n=42) identified barriers and facilitators to smoking cessation programmes and smoking cessation **(Supplementary Table 1).** Forty-

six studies reported quantitative data, six reported qualitative data, and two mixed methods **(see Figure 1)**, included in this are three secondary data analyses from one RCT (Okuyemi et al., 2013).

Precise detail around age was often lacking (e.g., 50+) thus exact age ranges cannot be provided. Similarly, ethnicity cannot be reported because of major differences in how this was captured and reported (if at all). However, the majority of studies were conducted in urbanised areas. All of the data presented derive from studies, none from national data sets.

2.3. Prevalence studies

Table 1 presents the smoking prevalence data from the fourteen studies noted, from 15'939 participants. Prevalence data is derived mainly from the US. Overall smoking prevalence rates in adults accessing homeless support services ranged from 57 - 82%. This excludes data from Connor, Scharf, Jonkman, & Herbert (2014), who reported smoking prevalence rates of 34% in their sample of homeless smokers, which only represented those smokers who attended the stop smoking clinic (n=14) and is therefore not a true representation of the whole assessed sample. The higher prevalence rates were found amongst those adults accessing services supporting wider health needs e.g. homeless shelters and substance use services.

2.4. Interventions studies

2.4.1. Smoking cessation interventions

Table 2 presents studies (N=14) reporting various types of smoking cessation interventions, providing an overview of different types of interventions which have been explored. Outcome measures and timing varied considerably, with most studies reporting 7-day or 24-hour point prevalence abstinence. Notably, none reported continuous abstinence for 6 months (the Russell standard usually adopted for smoking cessation studies (West, Hajek, Stead, & Stapleton, 2005). Of those reporting outcomes at 6

months, abstinence rates ranged from 4% to 45% (Segan, Maddox, & Borland, 2015; Carpenter et al., 2015).

In relation to the highest quit rate with the longest follow-up, Carpenter et al., (2015) reported a 45% (N = 9/20) 7-day point prevalence abstinence at 26 weeks with a small sample of homeless veterans receiving contingency management (CM) – this was also the most comprehensive intervention with NRT, bupropion, and the inclusion of a smartphone app. The RCT with the largest sample (N=430), Okuyemi et al. (2013), measured the effectiveness of MI with NRT compared to NRT alone. Using intention to treat analysis, verified 7-day abstinence rates at week 26 were 9.3% for MI + NRT and 5.6% for NRT alone, (p = 0.15). Reitzel, Kendzor, Cao, & Businelle (2014a) measured only attendance or abstinence on the quit date. Drop out from intervention studies ranged between 5% and 69% (Santa Ana, LaRowe, Armeson, Lamb, & Hartwell, 2016; Businelle et al., 2014a, respectively), although follow up in one study was higher with small financial incentives (Baggett et al., 2017).

2.4.2. Other interventions

There were other studies which were framed as potential interventions (not included in **Table 2**), which did not directly offer traditional cessation support or did not include cessation as a primary outcome. For example, the impact of policy implementation in the form of a partial homeless centre smoking ban (Businelle et al., 2015) reported no change in average cigarettes smoked per day, although conversely there was a reduction in expired CO. Given that CO is sensitive to the recency of smoking and smoking is banned in the centre, this result may not be too surprising. Another intervention measured the effect of staff training on tobacco cessation (Vijayaraghavan, Guydish, & Pierce, 2016), which resulted in a positive increase in measures of staff knowledge and efficacy in treating tobacco dependence.

2.5. Barriers and facilitators to engagement with smoking cessation

A mix of qualitative and quantitative studies (n=42) are presented in **Table 1** which highlight the barriers and facilitators to smoking cessation and/or engagement with smoking cessation services/programmes. Due to the large and unforeseen differences between study aims, topic guides and types of data presented, the findings are presented as distinct categories which emerged from the evidence, using descriptive themes that allow the findings to be presented as 'close' to their original themes in which they were originally published (Thomas & Harden, 2008). Where possible, quotes from the original qualitative data are presented to add context to themes.

2.5.1.Personal and psychological barriers

Comorbidities were cited as a key barrier by both professionals and the smokers. In particular, mental illness and subjective state (e.g., diminished mood and wellbeing) were identified as barriers to smoking cessation initiation and abstinence maintenance (e.g., Okuyemi et al., 2006; Baggett Campbell, Chang, & Rigotti et al., 2016; Businelle, et al 2014 b; Stewart, Stevenson, Bruce, Greenberg, & Chamberlain, 2015).

Use of other substances was also cited as a barrier to both smoking cessation and uptake of cessation programmes (e.g., Taylor, Kendzor, Reitzel, & Businelle, 2016; Segan, Maddox, & Borland, 2015). Giving up smoking in addition to abstinence from other substances was thought to add to stress levels and considered to be one step too far:

> "*I think for me personally while I'm in this situation there's no reason for me to quit anything. You know I just quit drugs and alcohol two and a half years ago– that was hard enough and I'm still stressin' on that...I wish that I never would've smoked but unfortunately that's not how my situation is ...there's really nothin' I can do about it.*" (Stewart et al., 2015, p. 1143).

However, contrary to these beliefs, through secondary data analysis of the parent RCT (Okuyemi et al., 2013), several studies explored the association between cessation and comorbidities or concerns (e.g., substance use, Reitzel, Nguyen, Eischen, Thomas, & Okuyemi, 2014b; depressive symptoms, Robinson et al., 2014), and no negative associations were reported. However, these findings derive from the same (N=430) adults from one RCT hampering the generalisability of the results.

Reluctance to use, or unsuccessful past experiences with, traditional methods of cessation, or preferring to use no treatment at all, were highlighted across several studies as examples of resistance to treatment or study engagement (e.g., Collins et al., 2018; Porter et al., 2017; Stewart et al., 2015).

2.5.2. Social barriers

The social environment represents a key barrier to cessation, highlighted by both professionals and smokers in respect to quitting and or remaining abstinent (Nguyen, Reitzel, Kendzor, & Businelle, 2015). Social pressure from other smokers and regular proximity with smokers was frequently reported (e.g., Garner & Ratschen, 2013; Businelle, Cuate, Kesh, Poonawalla, & Kendzor, 2013; Chen, Nguyen, Malesker, & Morrow, 2016):

"I am not very confident [that I can quit], because I'm always around people that are smoking' (10; female, 36)". (Garner & Ratschen, 2017, p.4).

For non-smokers, the perceived importance of smoking as a community activity and the opportunity this affords smokers to socialise is reported:

"...I think that people that smoke here—that [smoking] kind of helps them. I mean me, from the outside, I feel like the people that do smoke...make a support group for each other so they get to know each other. They talk to each other, they get to know each other [better] than the

people that are not smoking so I feel like I...don't know the people here", (Stewart et al., 2015, p.1143).

Similarly, there is evidence that some professionals also believe smoking, or at least nicotine use, has a positive impact on both the smoker's mood and a means to socialise:

"*I think that being in a state of homelessness is extremely stressful, and you know nicotine helps you calm your stress. I think it is a routine thing they do with the community members here...it's a very big bonding social experience. (Staff 1)* (Porter et al., 2011, p.92).

2.5.3.Structural and practical barriers

A number of studies highlighted that staff working in close contact with homeless smokers did not prioritise tobacco use, for example, Porter et al. provides examples of how housing may take precedent over many other health issues, including smoking:

"*in my perspective . . . [quitting smoking is] not important at all. I mean housing doesn't have anything to do with smoking. So I don't think it really factors into that. I think a person's health is like the next thing that you get to, but in my opinion, I think housing is health, so I think the first thing as homeless service providers should focus on is how can we get someone housed. And then let's work on the other things.."* (Staff 6) (Porter et al., 2015; page: 89).

There are other examples where staff may have underestimated their clients' interest in cessation programmes or smokers are considered to have too many competing factors in their life to prioritise smoking at the current time of being homeless (e.g., Garner & Ratschen, 2013; Porter et al., 2017; Vijayaraghavan, et al., 2016). For example, from Garner and Ratschen, when speaking to a General Practitioner about quitting one smoker was told:

"you're addressing other things at this time, I don't think you're ready to sort this out yet (...).

She made me not interested' (10; female, 36) (Garner & Ratschen, 2013, p.6).

Practical barriers included the ability to deliver or monitor cessation programmes in these environments, for example, Arangua, McCarthy, Moskowitz, Gelberg, & Kuo (2007) and Vijayaraghavan et al. (2016), present evidence that smoke-free areas may prove challenging in large centres where staff monitoring is difficult and time consuming, with some evidence that staff can view smoking bans as a burden and on occasion, not be taken too seriously:

"I think people have enough issues they're working on while they're here and smoking doesn't even enter their top 4 after homeless, income source, mental health issues, and other substance abuse. And to pile "you can't smoke" on top of that may be just adding...if that's how someone deals with stress. It's [smoking] probably not the end of the world right now. (Staff 8) (Porter et al., 2017, p. 90).

Further practical barriers in relation to specific interventions were highlighted, for example, Buckley et al. (2017) highlighted that participants could not access a quit line, and Businelle et al's. (2013) participants reported travel difficulties which impacted negatively on engaging with cessation programmes.

2.5.4. Facilitators to smoking cessation

The nature of the questions around what factors facilitate engagement and quitting varied between the studies (**as shown in Supplementary Table 1**), with far fewer facilitators reported than barriers (thus these are not broken down thematically as above). Here facilitators refer to methods, behaviours or support structures which actively and positively assist with the act of cessation or enhance engagement in smoking cessation programmes, including a range of options:

"They gave me scenarios that I could try, from cutting down when I needed a cigarette to trying to find me something to do. Instead of going cold turkey, cut down on the intake of

cigarettes that I did each day and stuff like that. Meditation to punching bags." (Collins et al.,2018; p.13).

In the same study, personalised, non-universal goals and harm reduction strategies such as cutting down and the use of e-cigarettes were also cited as beneficial:

"*Actually the best alternative I have found yet because the gums don't work. The patches, once you stop – let's say if you miss a dose of your patch – you are smoking all over again. There is no stopping it because you have to smoke twice as much to bring up that nicotine level. The e-cigarettes . . . takes a little bit but it doesn't take as much as it would with the patch. Patches are more expensive",* (Collins et al.,2018, p.14).

It is interesting that some of Collin's et al participant believed e-cigarettes were cheaper and made the price comparison with NRT, because this contradicts a barrier to e-cigarette use cited by Dawkins et al., (2019) survey, which shows that start-up cost of an e-cigarette starter kit limited ability or desire to purchase amongst their 286 participants. Thus, despite the expense of cigarettes, cost of other, healthier products, remains a disincentive for use for some but not others.

One common facilitator was some form of financial incentive or CM (e.g., Carpenter et al., 2015). However, delineating the contribution of a financial incentive to cessation rates is difficult, because while financial incentives are very common in smoking studies, in some studies presented here, the incentive forms part of the intervention; in others it is only used as an incentive to increase engagement with the research i.e. for follow up.

Other cessation facilitators included staff smoking cessation training, a desire to improve one's health, and a desire to be rid of the cost of smoking. There was evidence that social support facilitated

cessation; in two studies knowing ex-smokers (N=5+) was associated with an increased chance of quitting (Goldade et al., 2012; Goldade et al., 2013).

3. **DISCUSSION:**

The objective was to systematically review the literature on smoking and homelessness, focusing on prevalence, cessation, and barriers and facilitators.

In relation to our first aim, smoking prevalence is disproportionately high amongst adults seeking support for homelessness; the range demonstrated, even at its lowest estimate (57%), is far higher than smokers who are not experiencing homelessness. These prevalence estimates are similar to those presented in other vulnerable populations; a systematic review of smokers within substance use treatment (84%; Guydish et al., 2016) and a meta-analysis of those with schizophrenia (Odds ratio:5.9; de Leon & Diaz, 2005), although smoking appears to be falling and less prevalent in those with a common mental health condition (34.1%; Richardson, McNeill & Brose, 2019) compared to those with multiple and complex needs.

It should be noted that, data for prevalence derives from studies, none from national data sets, and only two studies estimating prevalence were conducted outside of the US. This reduces the ability to track smoking prevalence rates using epidemiological time series methods and to measure and make predictions about the rate at which smoking is declining (if at all), compared to the general national and international smoking populations and compared to other clinical populations. Given efforts to reduce tobacco related health inequalities within certain timeframes (e.g., UK 5% by 2030, New Zealand 5% by 2025) it seems pertinent to now focus efforts on tracking smoking prevalence and tobacco use and characteristics within populations like homeless adults, as well as others with a high smoking prevalence rate (e.g., prisoners, mental illness), so to observe rates of decline and evaluate impacts of national tobacco control strategies amongst these groups. However, while smoking rates

are high, the literature presented highlights this is not solely attributed to homelessness per se, instead homelessness is associated with many risk factors for smoking, e.g., mental illness, poverty, knowing other smokers, and taken together this makes quitting more challenging.

Thus, in relation to the second aim; to ascertain which interventions are most effective for this group, due to the number of different types of interventions, variations in design, follow up timing and definition of abstinence, no conclusions could be drawn regarding the superiority of any particular approach or combination of interventions for smoking cessation. Definitive conclusions are further limited since there is no standard definition of 'usual or standard care' which varied considerably by length, types of medication, and behavioural care offered across territories. There were also no indications within the individual studies as to how well the interventions were delivered.   However, there are promising signs; six-month 7-day point prevalence abstinence rates demonstrate that abstinence is possible and importantly, smokers from this group are willing to engage in smoking cessation interventions. While some variations to 'standard care' did not seem to improve outcomes, for example, text messaging support (Baggett et al., 2019), others, including financial incentives and staff training did have a beneficial effect. Understanding which *additional* interventions can motivate quit attempts is a good step for future studies. As shown here, many adults experiencing homelessness have tried to quit using the most widely available methods but little success, even in cases of high uptake and retention (e.g., Okuyemi et al., 2013).

In moving forward, consensus is required on reporting outcomes within this group in order to statistically determine which methods are most effective. The Russell standard (sustained, biochemically validated abstinence at 6 months; West et al., 2005) is the gold standard for cessation interventions, but this might not be considered achievable or suitable in this group due to the transient nature of homelessness and difficulties with study retention. However, in order to meet the needs of

this group, a shift in thinking is required. Studies should at least consistently report 7-day point prevalence at standard specified periods (e.g. one, three and six months; biochemically validated if possible) in order to draw comparisons across studies. Lessons may be learned from a recent trial of bespoke interventions for smoking cessation for adults with a serious mental illness (Gilbody et al., 2019; SCIMITAR+), the primary outcome was CO validated <10ppm 7-day point prevalence at 12-months; that it was not continuous abstinence is a clear response to the needs of this cohort. The number of smokers reporting 7-day point prevalence at 12 months was greater than at 6 months (32 to 34 in the intervention arm and 14 to 22 in the control arm) – leading some to theorise that this may be in response to shorter periods of smoking abstinence that elicit longer term change, or due to increased exposure to non-smoking environments (Robson & McNeill, 2019). Either way, exploration into the slower rate of change amongst smokers with competing needs is warranted. Support for this comes from one study in this review which showed that (Collins et al., 2018) smokers wished to cut down rather than to abruptly quit. Although cutting down is not associated with any health benefit (Godtfredsen et al., 2002), UK survey data has shown that smokers engaging in efforts to reduce their smoking are more likely to go on and make a quit attempt (Beard & West, 2012). 50% reduction in smoking could therefore be considered another outcome measure for future studies.

The third review aim was to establish the barriers and facilitators to smoking cessation and smoking reduction interventions in homeless adults. Evidence indicates there was no one stand-alone key barrier or facilitator. Instead, this review highlights a confluence of practical, psychological, and social barriers which are finely intertwined. Thus, smoking is perceived as serving multiple functions.

The literature included in this review highlights that from both the professionals' and the smokers' perspective, smoking is somewhat valued especially in relation to the community and social aspect it affords smokers who have so little, e.g., time with peers, sharing cigarettes. Smoking is therefore afforded tacit approval within some of these settings. This social importance can also translate into pressure from peers, either through regular contact with smokers and/or pressure from smokers

(including staff smokers) while making a quit attempt. Such findings are not new; quitting smoking has been described as a transgression of one's social norms and a rejection of other smokers in environments where smoking may be seen as representative of one's class or status (Thirlway, 2016). However, smoking is *often* banned within homeless centres, and increasingly within supported housing, and for this reason, cessation is likely to remain a goal and cessation support should be integrated with wider schemes (e.g., Housing First) which seek to capitalise on providing intense support which addresses health and substance use issues throughout the process of housing. Furthermore, as shown here, with the right training staff are willing and increasingly able to support their smokers through this path (e.g., Vijayaraghavan et al., 2016b).

Strengths and limitations

The review is the first synthesis of the research literature on smoking prevalence rates and cessation amongst adults experiencing homelessness. It provides a useful reference for those wishing to understand the complexities and challenges of cessation specific to this group of adults. Moreover, the limitations and inferences drawn from the individual studies can provide guidance on improvements for future studies and interventions within this area.   However, the review is not without its own limitations and these need to be taken into consideration when drawing inferences and making practice and policy recommendations. The number of studies and the broad scope means that here the nuances of smoking within this group, as highlighted by the qualitative papers, are not fully brought to light, and a future review should perhaps focus on only qualitative papers, particularly the barriers to cessation.

All assessed studies used convenience sampling, the majority conducted within homeless centres or clinics, therefore excluding adults who are not presenting at services. Furthermore, the self-selection of participants may influence any data and intervention outcomes, for example Porter et al (2017) only included smokers interested in quitting. We only included studies published in English and, in

addition, the majority of the studies derive from the US, many produced by the same research team who have recruited from the same services and potentially the same individual participants.

Limitations on drawing any strong conclusions are also a consequence of the variation in the quality of the individual studies (**see Supplementary Table 2**). There is a lack of RCTs, with multi-reporting of the same data set. There was inconsistent, or in some cases, absent reporting, of key data variables which are known to influence cessation, including cessation history (e.g., past quit attempts, methods used), current use, behaviour and motivation (e.g., nicotine dependence, desire to quit), and key post intervention outcome measures. These made it difficult to tabulate and make sense of this data collectively. Lastly, there is a particular bias amongst the research studies to focus on barriers to engagement and cessation, and less data is available on what helps to facilitate participation and quitting.

Conclusion

The current review is the first to explore the factors associated with smoking and cessation amongst homeless adults. Evidence from this review suggests that estimated smoking prevalence rates are high amongst the homeless, but desire to quit is apparent. However, more research is needed to firmly establish the most suitable interventions for this group, taking account of their multi-needs, acknowledging the barriers and facilitators highlighted herein.

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