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Beyond 'planning': A meta-analysis of implementation intentions to support smoking cessation

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Abstract

Objective: Implementation intentions support behaviour change by encouraging people to link critical situations with appropriate responses. Overall effectiveness for smoking cessation is unknown. This systematic review and meta-analysis aimed to evaluate the effectiveness of implementation intentions for smoking cessation. Methods: Using PRISMA guidelines, six electronic databases were searched (updated Feb 2018) using key terms. Data were pooled for smoking cessation (categorical variable; yes/no) and entered in to random effects models. Analyses assessed: a) effectiveness as a single intervention, and b) effectiveness when included as one of multiple intervention components. Results: Twelve studies were identified. Implementation intentions were effective for smoking cessation at follow-up OR 1.70, CI [1.32, 2.20], p <.001, average 10.7% quit rate for intervention participants (4.9% in controls). Implementation intentions as a single intervention were effective for smoking cessation OR 5.69 , 95% CI [1.39, 23.25], p = 0.02 (average quit rate 14.3% in intervention participants versus 3.6% in controls) and as part of multi-component interventions OR 1.67, 95% CI [1.29, 1.66], p < 0.001 (average quit rate 8.2% in intervention participants versus 5.8% in controls). Conclusions: Implementation intentions are effective at helping smokers quit although the review reported substantial heterogeneity across the limited number of included studies. The present review sets the agenda for future research in this area including longer-term objectively-verified abstinence and identification of potential moderators of effectiveness including population characteristics.

Keywords: implementation intentions; smoking cessation; behavior change; systematic review; meta-analysis; if-then planning

Beyond 'planning': A meta-analysis of implementation intentions to support smoking cessation

The World Health Organization (WHO) estimates that there are more than 1 billion smokers worldwide and that tobacco is responsible for 7 million deaths annually (WHO, 2017). Globally, 12% of all deaths among adults aged 30 years and over are attributable to tobacco (WHO, 2012). Smoking is the leading preventable cause of death and promoting smoking cessation has the potential to save world economies more than one trillion US dollars annually from healthcare expenditure and lost productivity (U.S. National Cancer Institute & WHO, 2016; WHO, 2015). Despite a worldwide tobacco free agenda, comprehensive smoking cessation services are available to assist tobacco cessation in only 24 countries, comprising 15% of the world's population (WHO, 2017). In the UK, since 2012-13, the number of smokers who have quit successfully through stop smoking services has decreased year on year, partly due to low uptake and poor service coverage and in spite of a large majority (70%) of smokers expressing the desire to quit (Health & Social Care Information Centre, 2013; NHS Digital, 2016; West & Brown, 2011). Therefore, evidence based alternative methods to help smokers stop smoking tobacco are needed.

It has been proposed that there are two phases involved in the successful performance of behavior: 1) motivational, where the person intends to change their behavior (goal); and 2) volitional, which describes the processes by which intentions are translated into action (Achtziger & Gollwitzer, 2018; Gollwitzer, 1993; Heckhausen & Gollwitzer, 1987). Given that many smokers are already motivated to quit (e.g., 68% of US smokers want to quit completely; Centers for Disease Control and Prevention, 2017), then targeting cessation attempts at the volitional phase is likely to be effective. Gollwitzer (1993) proposes implementation intentions as one means to ensure motivation is translated into action.

In the context of smoking cessation, implementation intention formation involves identifying critical situations in which the unintended behavior of smoking is likely to occur and linking them with appropriate responses that allow the individual to have readily available responses to carry out the intended action (Gollwitzer, 1993). This is particularly helpful for those who have positive intentions to carry out a particular behavior but do not subsequently act upon the intention (Orbell & Sheeran, 1998). For example, the situation 'if I am tempted to smoke when I first get up in the morning' could be linked with 'then I will seek out someone who listens when I need to talk about my smoking' (Armitage, 2008). Thus, on encountering the situation of being tempted to smoke first thing in the morning, the behavior change technique of "helping relationships" (from the transtheoretical model of behaviour change, TTM; Prochaska & DiClemente, 1983) should be triggered automatically (Gollwitzer & Sheeran, 2006). The advantage of a clear and specific plan, or indeed multiple plans for different situations, allows the person to minimise influence from other competing goals (Prestwich, Sheeran, Webb, & Gollwitzer, 2015). Other benefits of setting implementation intentions are that they are both low cost and have low completion burden for participants (Hagger & Luszczynska, 2014).

A meta-analysis including 94 studies assessing the effectiveness of implementation intentions across several different behavioral domains found that implementation intentions had a medium-to-large effect (d = .65) on goal achievement (Gollwitzer & Sheeran, 2006). However, no included study assessed the impact of implementation intentions on smoking cessation and there have been no subsequent reviews reporting the use of implementation intentions or even 'action planning'[1] to promote smoking cessation. Similarly, it is not known what factors (e.g., intervention format, cognitive variables) may moderate the effectiveness of implementation intentions for smoking cessation.

Therefore, the aim of the present study was to identify systematically and critically review studies that investigated the effectiveness of implementation intentions for smoking cessation. Specific objectives were to:

1. Identify studies that have utilised implementation intentions for smoking cessation
2. Assess whether forming implementation intentions leads to successful smoking cessation
3. Examine the impact of potential moderators on intervention effectiveness

Methods

Search Strategy

Following the PRISMA statement for systematic reviews (Moher, Liberati, Tetzlaff, Altman, & The, 2009), an electronic database search was conducted using MEDLINE, Embase, CINAHL, PsycINFO, PubMed, BNI and Amed in April 2017, and updated in February 2018. The review protocol was not pre-registered. No restrictions were applied on publication dates. The following search strategy was applied to all databases:

("if-then") [TIAB] OR ("implementation intention*") [TIAB] OR (action plan*) [TIAB] OR (If ADJ1 then) [TIAB] OR (implementation ADJ1 intention*) [TIAB] OR (ifthen*) [TIAB] OR (coping) [TIAB] OR ("coping plan*") [TIAB] AND ("smoking cessation") [TIAB] OR (stop ADJ2 smoking) [TIAB] OR (quit ADJ2 smoking) [TIAB] OR (smok*) [TIAB]

Reference and 'cited by' lists of included articles were reviewed to identify additional relevant papers that did not appear in the search. Lead and senior author publication lists were searched for the names of authors on included studies. Furthermore, reference lists of relevant reviews identified by the search were reviewed. Companion papers were retrieved where necessary to ascertain further information about intervention content. Study authors were contacted via email to determine whether papers could be included in the meta-analysis. For

example, if it was not clear whether all participants in the intervention group were asked to form implementation intentions, then the corresponding author of the study was emailed.

Eligibility criteria

Empirical research published in any language in peer-reviewed journals was included in the review. Grey literature was not included due to resource and time constraints. The following inclusion criteria were used:

- Participants identified as current smokers, aged 18 years or older recruited from any setting.
- Studies that described an implementation intention intervention in which, consistent with Gollwitzer's conceptualisation (Gollwitzer, 1993) and research on implementation intentions for other behaviors (Chapman, Armitage, & Norman, 2009), participants were asked explicitly to form 'if-then' plans to support smoking cessation.
- Studies had to have at least one non implementation intention comparator arm, with no other restriction placed upon the nature of the comparison with the intervention group.
- The principal outcome used in the review was smoking cessation. Therefore studies were excluded if they did not provide data on smoking cessation rates. For each study we used the most conservative measure of quitting reported. Thus, we used rates of sustained cessation rather than point prevalence abstinence where possible. Studies were included irrespective of whether smoking cessation outcomes were self-reported or biomedically verified.
- All study designs that included a smoking cessation implementation intention intervention were eligible for inclusion in this review. However, case studies and reviews were not eligible.

Study selection

All studies were assessed according to the eligibility criteria for inclusion initially based on title and abstract and where necessary, full papers were retrieved. Screening was completed by two authors who both reviewed all full-text papers. A third author was consulted when it was unclear whether studies met inclusion criteria.

Data extraction

Relevant information was extracted for each included study including sample demographics, smoking behavior characteristics, smoking cessation outcomes, intervention characteristics and delivery, and duration of follow up. Using the Cochrane Collaboration's tool for assessing risk of bias (Higgins et al., 2011), a judgement of risk of bias was made for items related to randomization and blinding procedures, incomplete data assessment, selective reporting and other sources of bias. The additional guidance provided by the Cochrane Collaboration was followed when deciding between low, unclear or high risk judgements. Risk of bias was completed by two authors independently and agreement was met for all studies on each criterion.

Statistical analyses

Meta-analyses of smoking cessation outcomes were performed in RevMan 5.3 (The Cochrane Collaboration, 2014). To account for expected heterogeneity between studies, a random-effects model was applied (DerSimonian & Kacker, 2007). The primary outcome of 'smoking cessation' was calculated as a pooled odds ratio (OR) comparing the total numbers of people who had quit smoking following implementation intention interventions versus control conditions. For studies with multiple follow-up periods, data were extracted from the longest follow up only. Data from intent-to-treat analyses were inputted in all cases. For studies comparing implementation intention interventions to both inactive and active control conditions, data were included and combined from all control conditions. If a study had

multiple intervention arms, data were included and combined from the arms that included an implementation intention component and data from any non-implementation intention intervention arms were added to the control group.

The impact of heterogeneity between studies was quantified as Tau^2 and I^2 values as the latter measure is not dependent on the number of included studies (Higgins & Thompson, 2002). A funnel plot was generated to assess the possibility of publication bias influencing the main analyses. Furthermore, both Egger's test (Egger, Smith, Schneider, & Minder, 1997) and Begg & Mazumdar's test (Begg & Mazumdar, 1994) were applied to quantify the risk of publication bias. A 'Fail-Safe N' (Orwin, 1983) was calculated to determine the number of unpublished null studies which would invalidate the findings (i.e. the number of unpublished null studies required to cause $p > 0.05$). Additionally, a trim-and-fill analysis was applied to recalculate the OR effect of implementation intention interventions after removing all studies which could potentially introduce publication bias (Duval & Tweedie, 2000). Publication bias analyses were conducted using Meta-Essentials (Suurmond, Rhee, & Hak, 2017).

Sensitivity analyses examined the size of main effects when using only medical record data or self-report measures alone.

Subgroup analyses were used to investigate a potential moderator of overall intervention effect. Mode of delivery was conceptualised as whether the participants formed implementation intentions as the single intervention component compared to studies which had multiple components in conjunction with implementation intentions. Additionally, a random-mixed effects meta-regression analysis was performed using Meta-Essentials to explore the relationship between duration of follow up and intervention effect size (Suurmond et al., 2017).

Results

Search results

The search identified 1,307 results; 68 full text versions were retrieved and assessed, of which 12 articles were eligible for inclusion. See Figure 1 for PRISMA flow diagram of study selection including reasons for exclusion.

[Insert Figure 1]

Included studies and participant characteristics

All 12 included studies were RCTs (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008; Bolman et al., 2015; Borland, Balmford, & Swift, 2015; Elfeddali, Bolman, Candel, Wiers, & de Vries, 2012; Smit, Candel, Hoving, & de Vries, 2016; Smit, de Vries, & Hoving, 2012; Stanczyk, de Vries, Candel, Muris, & Bolman, 2016; Te Poel, Bolman, Reubsaet, & de Vries, 2009; van Osch, Lechner, Reubsaet, Wigger, & de Vries, 2008); four conducted in the UK, seven in the Netherlands and one in Australia. No quasi-experimental studies were found.

The total number of participants randomized was 15,290; mean age 40 years and 57% female. All participants except for one study were recruited from the general public. The primary care study used counselling delivered by practice nurses (primary care) as an intervention arm; however the implementation intentions component was delivered on-line only (Smit et al., 2016). Regarding mode of delivery, five studies had a single intervention component whilst seven had multiple components in addition to the use of implementation intentions. In five studies, current smokers were invited to take part regardless of participants' motivation to stop smoking (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008; van Osch et al., 2008). In four of studies, participants were told: 'we want you to stop smoking' in the next one or two months after consenting to participate (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008), and one study did not tell participants explicitly to stop smoking (although eligible participants had to indicate that they intended to quit within the year or sooner; Te Poel et al., 2009). Motivation to quit smoking was a prerequisite for

participant eligibility in another six studies (Bolman et al., 2015; Borland et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Stanczyk et al., 2016), with one study also requiring participants to set a quit date within one month of the baseline assessment (Elfeddali, Bolman, Candel, et al., 2012). The average length of follow-up was six months, ranging from one month to 12 months. For additional study characteristics and information, see Supplementary File 1.

Smoking behavior characteristics

The average number of cigarettes smoked per day at baseline, available for eight studies, was 17 (range: 11-22) (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2012; Te Poel et al., 2009; van Osch et al., 2008). For nine studies, the Fagerström test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was used to measure nicotine dependence at baseline and the average score was 4.1 out of a possible 10 which is regarded as 'high', and indicates greater dependence (range: 2.78-5.40) (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008; Bolman et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Te Poel et al., 2009). All studies, except two, used self-report measures only to assess smoking behavior. Two studies used biochemical verification in a sub-sample at follow-up (Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016).

Intervention characteristics

Implementation intentions were completed using two media: four studies used a paper-pencil format (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008), and eight studies used a web-based format (Bolman et al., 2015; Borland et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Stanczyk et al., 2016; Te Poel et al., 2009; van Osch et al., 2008). Implementation intentions were the sole intervention component for all paper-pencil based interventions. In contrast, the web-based interventions

were multi-faceted with more than one intervention component included with the exception of one trial (van Osch et al., 2008). Additional components included, self-efficacy enhancing and reinforcing guidance (Bolman et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; N. E. Stanczyk et al., 2016; Te Poel et al., 2009), coping skills for stress (Elfeddali, Bolman, Candel, et al., 2012) and assessing the pros and cons of smoking/not smoking (Bolman et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Stanczyk et al., 2016; Te Poel et al., 2009). Supplementary File 1 also provides a summary of implementation intentions formation instructions (for example, pre-specified situations and responses versus self-generated) and format of completion (for example, drop down menu on website or completed as paper-pencil format) for each study.

Risk of bias

Overall, study quality was satisfactory for some aspects and poor for others. See Figure 2 for risk of bias scores for all studies, for all seven types of bias. Only three studies had published protocols (Elfeddali, Bolman, & de Vries, 2012; Smit et al., 2016; Stanczyk, et al., 2011). Therefore risk of bias for selective reporting was coded high for all remaining studies. Areas of methodological strength included clear description of randomization sequence generation and allocation concealment procedures. Reliance on self-reported smoking outcomes was a weakness for all included studies. Although biochemical validation was used in two studies (Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016), only a small subset of the total samples successfully completed the measure. Despite intention to treat analyses, it is important to note that attrition was a substantial problem especially for the web-based studies; 8,790 participants were lost to follow up (47% of total number randomised; see Supplementary File 1 for individual study attrition rates).

[Insert Figure 2]

Effects of implementation intentions on smoking cessation

As an intent-to-treat meta-analysis was conducted, smoking cessation data for the primary outcome was included from a total of 15,290 participants randomized at baseline across 12 studies; 7,558 were assigned to implementation intention interventions, 7,732 to control conditions (Armitage, 2007, 2008, 2016; Christopher J. Armitage & Arden, 2008; Bolman et al., 2015; Borland et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Stanczyk et al., 2016; Te Poel et al., 2009; van Osch et al., 2008). Random-effects meta-analyses found that implementation intention interventions resulted in significantly greater smoking cessation (see Figure 3) than control conditions (OR = 1.70, 95% CI [1.32, 2.20], $p < 0.001$), although there was significant heterogeneity present among study findings ($Tau^2 = 0.09$; $Chi^2 = 28.34$, df = 11 ($p = 0.003$); $I^2 = 61\%$). This finding equated to an average quit rate across studies of 10.7% in the intervention group compared to 4.9% in the control group (see Supplementary File 1 for individual study quit rates).

[Insert Figure 3]

Publication bias and sensitivity analyses. A funnel plot revealed considerable asymmetry indicating strong evidence of publication bias, shown in Figure 4. The risk of publication bias was statistically significant according to both the Egger's ($p < 0.001$) and Begg & Mazumdar's tests (Kendall's $t = 0.48$ and $p = 0.028$). The Fail-safe N calculation showed that nine null studies would need to exist to nullify the main findings. Trim-and-fill analysis showed that, after removing three studies that may introduce publication bias, implementation intention interventions did not significantly increase smoking cessation rates compared to control conditions (OR = 0.53, 95% CI [0.13, 0.93])

Due to only two studies having attempted biological verification, the planned sensitivity analysis comparing self-reported outcomes with those verified biologically was not possible.

Factors associated with intervention efficacy. Further analyses were performed to examine effects of implementation intention interventions on smoking cessation when comparing different modes of delivery.

Significant benefits of implementation intention interventions were observed when delivered as a singular intervention component (k = 5, n = 2,367, OR = 5.69, 95% CI [1.39, 23.25], p = 0.02) (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008; van Osch et al., 2008), with average quit rate across studies of 14.3% in the intervention group compared to 3.6% in the control group. Delivering implementation intentions alongside other behavior change techniques was also found to be effective (k = 7, n = 13,198, OR = 1.67, 95% CI [1.29, 2.15], p < 0.001) (Bolman et al., 2015; Borland et al., 2015; Elfeddali, Bolman, Candel, et al., 2012; Smit et al., 2016; Smit et al., 2012; Stanczyk et al., 2016; Te Poel et al., 2009). For this analysis the average quit rate across studies was 8.2% in the intervention group compared to 5.8% in the control group. There was a trend towards a significant difference in effect sizes between the intervention as a single component group OR = 5.82, 95% CI [1.48-22.90] and multi-component intervention subgroups OR = 1.44, 95% CI [1.25-1.64] when not accounting for length of follow-up ($\chi^2(1) = 3.61$, p = 0.06).

Random-effects meta-regression found that the duration of follow up measured in implementation intention interventions was significantly negatively associated with observed effect size; as the duration of follow up increased, the OR for smoking cessation from implementation intention interventions decreased (B =-0.11, SE = 0.04, Z =-3.11, p <0.005). See Figure 5.

[Insert Figure 5]

Aside from mode of delivery (single or multi-component intervention), we could not conduct additional moderator analyses on these data due to the small number of included studies. Heterogeneity in measures included within the studies hindered meaningful

comparison in order to draw any definitive conclusions. However a summary of moderators and mediators explored by the individual studies is worthwhile to report here and further detail is provided in Supplementary File 1. Habit was found to mediate the effect of implementation intentions on quitting (Armitage, 2016). There was mixed evidence for the role of cognitive constructs such as self-efficacy, perceived control, and stages of change in mediating implementation intention effects (Armitage, 2008, 2016; Armitage & Arden, 2008; Elfeddali, Bolman, Candel, et al., 2012).

Discussion

The results from the systematic review and meta-analysis confirm that the formation of implementation intentions successfully supports smoking cessation albeit there was substantial heterogeneity across studies. Completing individualised strategies to refrain from smoking resulted in successful smoking cessation at follow-up (from 4 weeks up to 7 months). Findings suggest that implementation intentions as part of a multi-component intervention delivered online support long-term smoking cessation up to 12 months following quit dates. These findings are discussed with caution given that the review found substantial publication bias in the limited number of eligible studies.

The findings of the present review build on the evidence demonstrating the effectiveness of implementation intentions, and our findings are comparable with the overall medium-strong effect size found across behaviors in Gollwitzer and Sheeran's (2006) meta-analysis. With respect to more recent meta-analyses of the effectiveness of implementation intention-based interventions in relation to health behaviors such as physical activity (small-medium effectiveness, Bélanger-Gravel, Godin, & Amireault, 2013) and fat intake (moderate effectiveness, Vilà, Carrero, & Redondo, 2017) specifically, our effect size for smoking was marginally greater. Consistent with the present approach, both Bélanger-Gravel et al. (2013)

and Vilà et al. (2017) tried to examine the impact of using an 'if-then' format, but could not retrieve sufficient numbers of studies to conduct moderator analyses.

Additionally, the present findings show similar-sized effects for implementation intention interventions (OR 1.70 95% CI [1.32-2.20]) compared to findings from a systematic review of the effectiveness of relapse prevention self-help materials for smokers who have recently quit unaided (OR 1.52 95% CI [1.15-2.01]; Agboola, McNeill, Coleman, & Leonardi Bee, 2010) Future research should directly compare effectiveness of implementation intentions versus self-help materials for relapse prevention.

Interestingly, quit rates in the control groups of included studies were generally also high compared to typical 2-3% unaided quit rates (Stead, Bergson, & Lancaster, 2008; West & Stapleton, 2008). There may be several reasons for this including one study requiring participants to enter a 'Quit & Win' contest in order to enter the trial indicating that participants received additional smoking cessation intervention components such as a reward prior to the implementation intentions intervention (van Osch et al., 2008). Additionally, six studies required participants to be motivated to stop smoking in order to take part, which is likely to have influenced the findings. Similarly, most of the web-based RCTs included multiple intervention components such as tailored advice given to control participants precluding the ability to assess the effectiveness of implementation intentions compared to passive control conditions.

Length of follow-up was negatively associated with sustained effectiveness. Additionally, there was substantial attrition in the web-based studies. Although it was not possible to conduct moderator analyses, aside from mode of delivery, due to the low overall number of included studies, several individual studies included in the present review suggest that habit is likely to be important for the success of implementation intentions. One study

shows that forming implementation intentions can change people's smoking habits (Armitage, 2016).

Likewise, implementation intentions were most effective in participants who were more motivated to quit prior to forming implementation intentions (Armitage & Arden, 2008). These findings coincide with the theory that motivation precedes volition and that implementation intentions constitute strategies for ensuring motivation is translated into action (Gollwitzer, 1999). Further research is required to elucidate further the moderating and mediating effects of both smoking habits and motivation on the operation of implementation intentions for smoking cessation. Specifically, studies should include appropriate measures of habit given that smoking is one of the most difficult habit-forming behaviors to overcome (Armitage, 2016).

Many of the web-based studies included in this review also focussed on action planning defined as 'preparatory actions' prior to the cessation attempt, for example, planning to remove ashtrays from the home. Although implementation intentions can be defined as a form of planning, our main outcome measure was refraining from smoking and therefore, it was not possible to look at differences of effectiveness between the two types of planning. Furthermore, very few studies collected data to monitor formation of implementation intentions by participants; one study found that only 20% of the intervention group formed implementation intentions as part of a multi-component intervention (Bolman et al., 2015). Perhaps this is due to the format of intervention delivery being web-based for the majority of studies included in the review.

Strengths and limitations

A broad, comprehensive search strategy was conducted for this systematic review although due to the limited number of studies for inclusion in this review, it was not possible to look at potential moderators and mediators of the effect of implementation intentions with

the exception of delivery mode. This resulted in the third review objective, namely, to examine potential moderators not being met. Similarly, all the single-component intervention studies also used paper-pencil format of delivery and almost all (except one) web-based studies were multi-component interventions. Given the limited number of included studies, we were unable to account for this in the analyses. Few studies included in the present review assessed moderators of effectiveness in their analyses limiting the ability to describe this narratively only. Likewise, it was not possible to assess the impact of implementation intentions whether positive or negative effects, compared to other behavior change techniques despite previous research exploring this in other health behavior contexts (Jessop, Sparks, Buckland, Harris, & Churchill, 2014). We found no evidence of implementation intention interventions delivered in clinical settings, for example with patients in a hospital. Although one Dutch study included practice nurse counselling (primary care), implementation intentions were formed using a web-based intervention (Smit et al., 2016). Therefore it is unclear whether implementation intentions would demonstrate effectiveness for smoking cessation in a healthcare context. As the focus of this review was on smoking cessation rather than prevention of smoking uptake, the present review is limited to the adult (aged over 18 years) population only. Given that sustained cessation rates were used in the analyses, effectiveness of implementation intentions on smoking lapses or additional quit attempts were not assessed in the present review. The authors did not carry out a reliability assessment during screening of titles and abstracts although two researchers double screened all full-text articles retrieved with agreement on inclusion and exclusion.

Additionally, substantial heterogeneity was found across the analyses where duration of follow-up accounted for 43% of the variance in true effect size. This between-study heterogeneity is unsurprising, given the clear differences between implementation intention interventions in terms of smoking cessation definitions, dissimilarity of instructions for the

formation of implementation intentions, and presence of other behavior change techniques in addition to implementation intentions. Although this heterogeneity was accounted for statistically by the random-effects model applied, it is acknowledged that the strength of conclusions from the present review is limited as a result. Likewise, the confidence intervals were wide when assessing the effectiveness of implementation intentions as the single intervention component on smoking cessation and although likely due to the small sample size of these five studies, should be interpreted with caution. Further research with larger sample sizes is likely to overcome this issue. Furthermore, publication bias was indicated and as a result it is likely that studies have been missed by this review especially as grey literature was not searched. This is acknowledged as a limitation of the review. Nevertheless, this is the first review providing evidence of the effectiveness of implementation intentions specifically for smoking cessation and would encourage further research using this approach.

There was little evidence of long-term follow-up of participants beyond two months assessing effectiveness of forming implementation intentions when these were the only intervention component used in the aid of smoking cessation. Therefore, it was expected that heterogeneity would be high given data was pooled from only five studies in this instance; longer follow-up periods are required. Additionally, drop-out was high for the studies included, possibly due to the online delivery of the majority of included interventions (Geraghty, Torres, Leykin, Perez-Stable, & Munoz, 2013). Overall, studies relied on self-reported smoking cessation primarily due to the online delivery of the majority of included intervention studies; objective measures of smoking cessation should be incorporated into future trials, where feasible.

Conclusions

In conclusion, the present review has shown that implementation intentions are effective for smoking cessation for individuals recruited from community settings. Given the

absence of long-term follow up periods in the included studies, it is not yet clear what the longer-term effectiveness is when implementation intentions are the sole intervention component. It is unknown whether the intervention is appropriate for use in clinical settings. Future research is required to fill this gap and to identify the strength of implementation intentions on smoking cessation compared to other smoking cessation behavior change techniques.

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Declaration of interest

The authors have no interests to declare.

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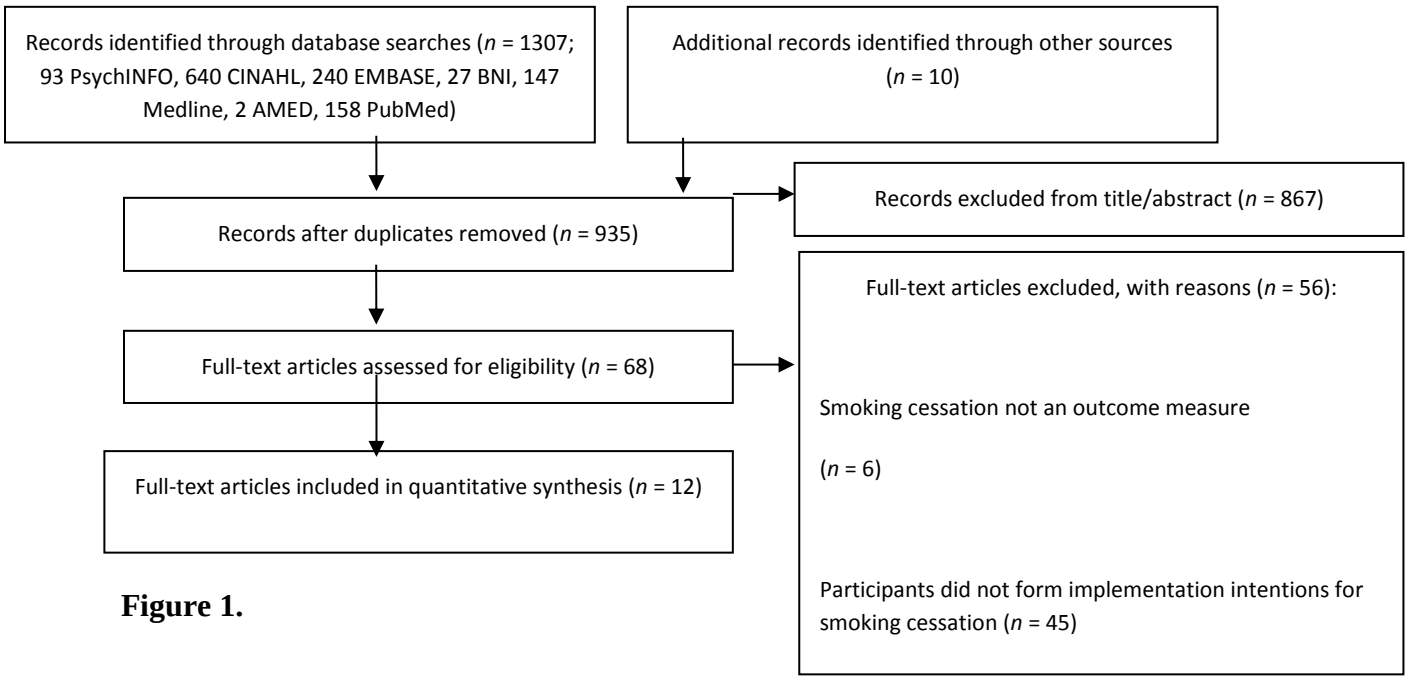

Records identified through database searches (n = 1307; 93 PsychINFO, 640 CINAHL, 240 EMBASE, 27 BNI, 147 Medline, 2 AMED, 158 PubMed)
Additional records identified through other sources (n = 10)
Records after duplicates removed (n = 935)
Records excluded from title/abstract (n = 867)
Full-text articles assessed for eligibility (n = 68)
Full-text articles excluded, with reasons (n = 56):
Smoking cessation not an outcome measure
(n = 6)
Participants did not form implementation intentions for smoking cessation (n = 45)
Full-text articles included in quantitative synthesis (n = 12)

Figure 1.

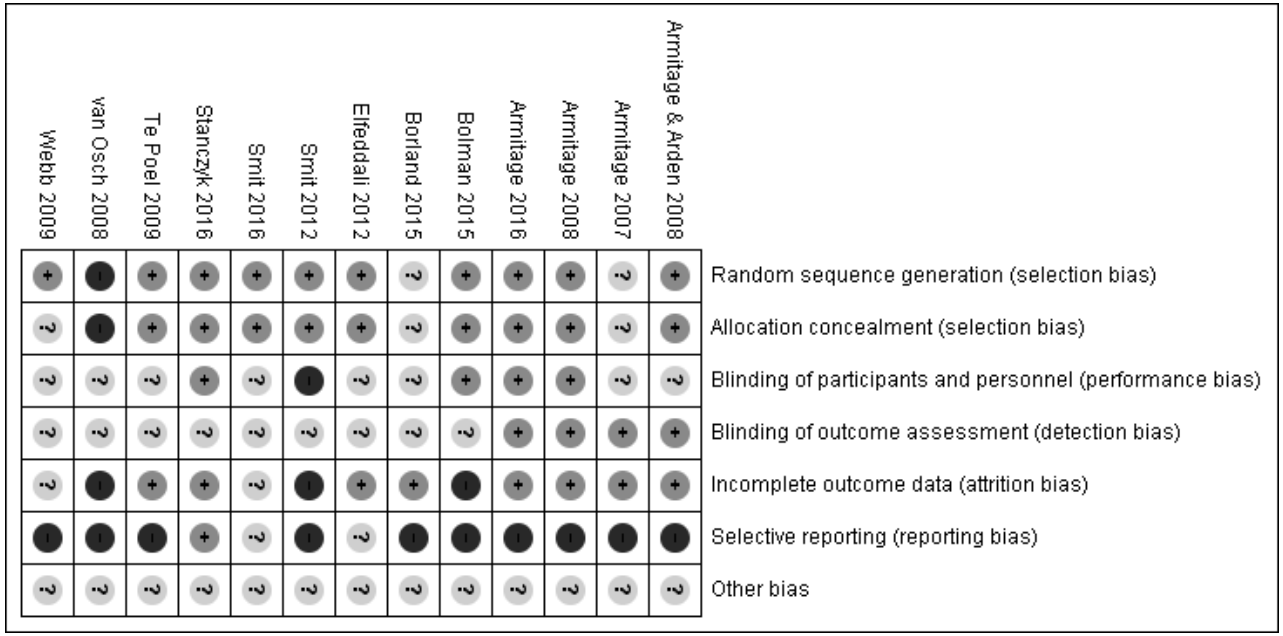


Figure 2.

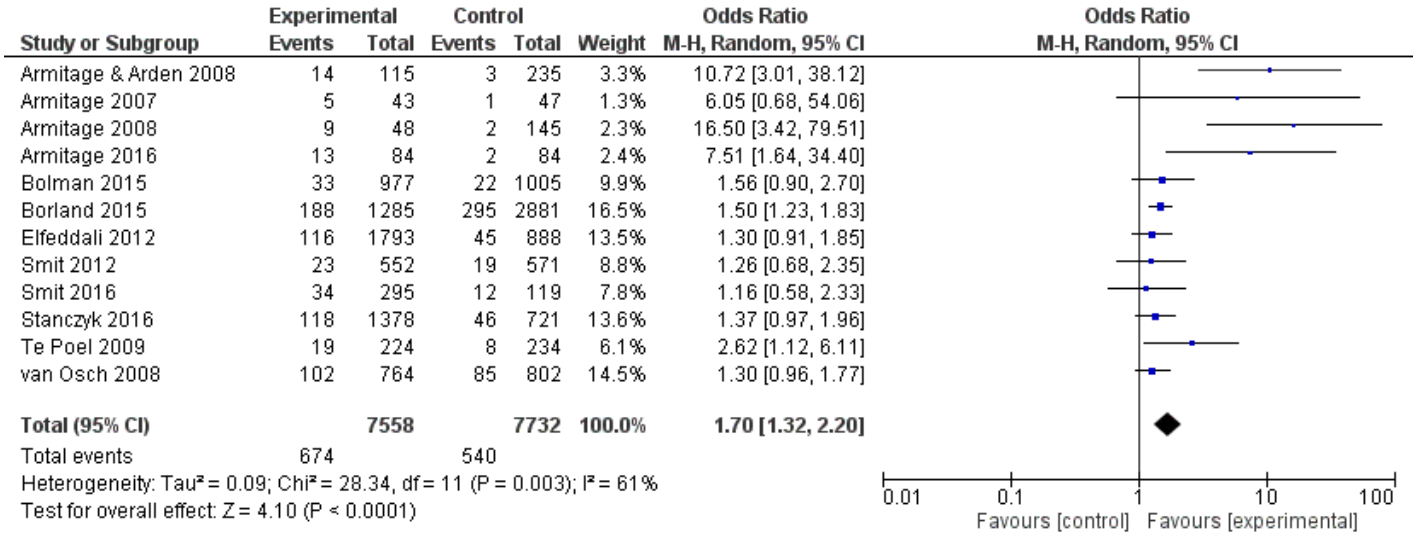


Figure 3..

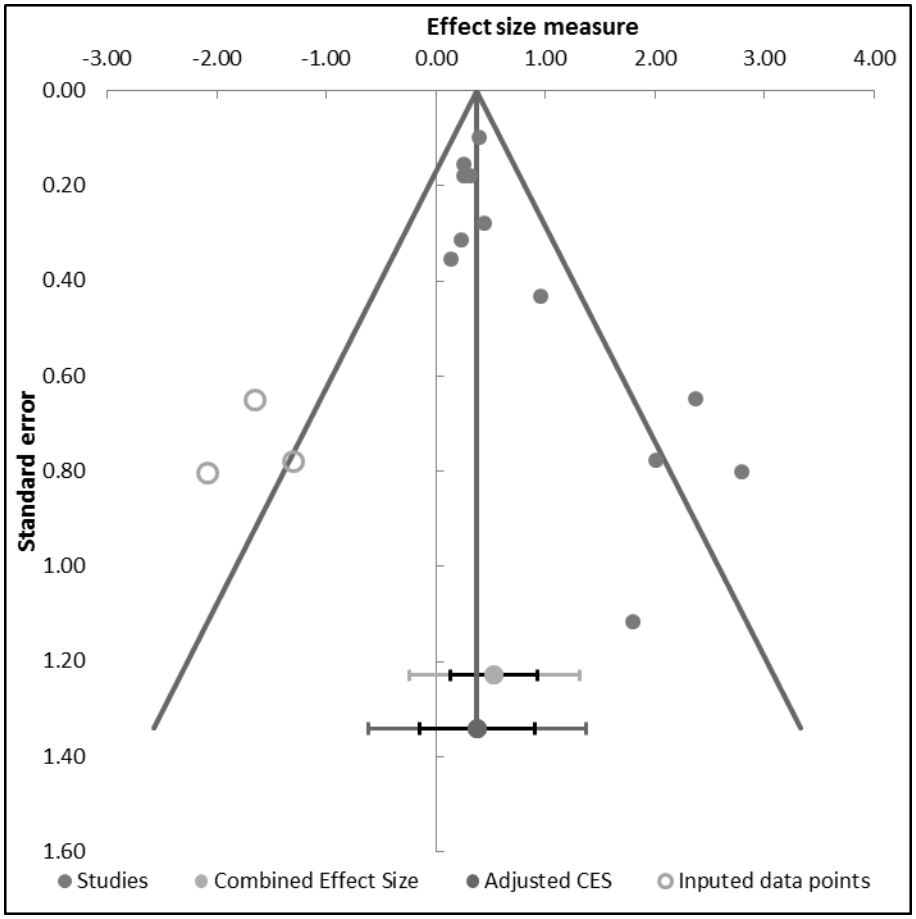
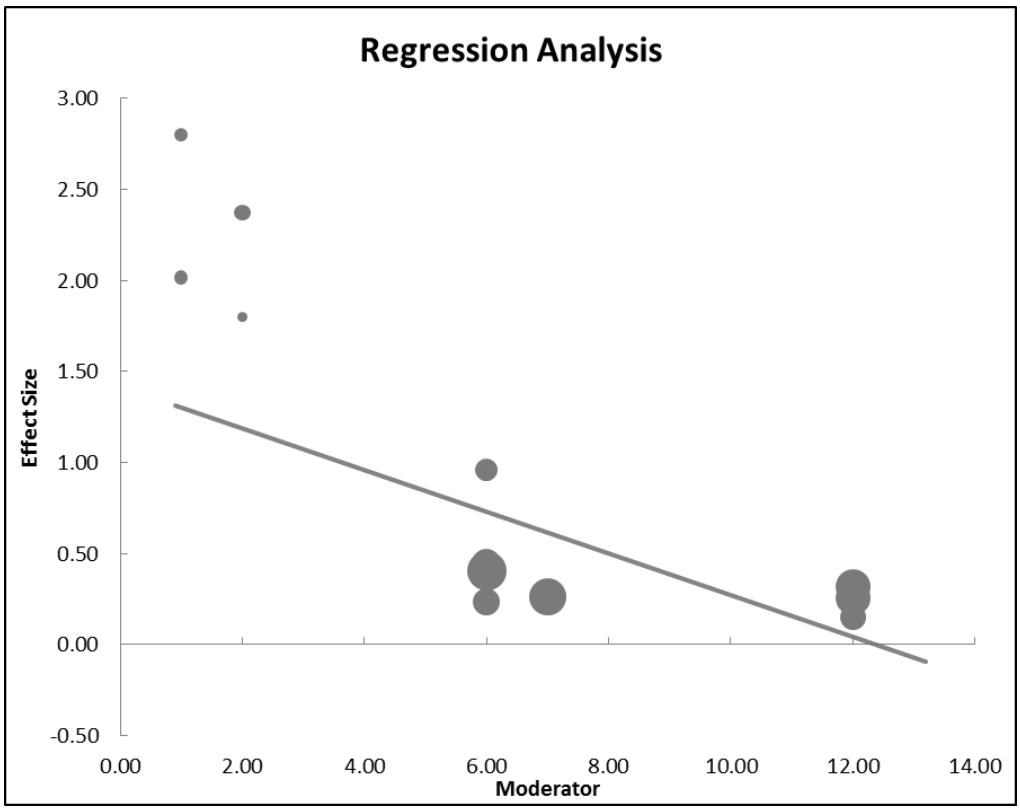


Figure 4.

Figure 5.



Footnotes[1] Strictly speaking, implementation intentions are not considered a behaviour change technique in their own right according to Michie et al.'s (2013) taxonomy, but are listed as one kind of "action plan" (BCTTv1 1.4; Michie, Hyder, Walia, & West, 2011) . In our view, implementation intentions are best considered "delivery devices" in so far as they can be used to ensure that behaviour change techniques are deployed at appropriate times and places, as described above and including "coping plans" (listed under "problem solving" BCTTv1 1.2 in the taxonomy). Thus, in addition to action plans (BCTTv1 1.4) and coping plans (BCTTv1 1.2), self-incentives (BCTTv1 10.7) have been deployed using implementation intentions (Armitage, 2014; Brown, Smith, & Armitage, in press), as have valued self-identities (BCTTv1 13.4; Armitage, Harris, & Arden, 2011; Armitage, Rowe, Arden, & Harris, 2014), among numerous other behaviour change techniques (Armitage, 2008). Indeed, in one of the studies included in the present review, van Osch et al. (2008) refer to their intervention as a 'coping planning intervention' (page 528) but is actually framed in terms of an "if-then" plan or implementation intention. Similarly, coping plans have similarly been described as "implementation intentions" in other published reviews of implementation intention-based interventions (e.g., Belanger-Gravel et al., 2013).