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Behavioural interventions for smoking cessation: a meta-analysis of randomized controlled trials

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Aims Widely varying estimates of treatment effects have been reported in randomized controlled trials (RCTs) investigating the efficacy of behavioural interventions for smoking cessation. Previous meta-analyses investigating behavioural interventions have important limitations and do not include recently published RCTs. We undertook a meta-analysis of RCTs to synthesize the treatment effects of four behavioural interventions, including minimal clinical intervention (brief advice from a healthcare worker), and intensive interventions, including individual, group, and telephone counselling.

Methods and results We searched the CDC Tobacco Information and Prevention, Cochrane Library, EMBASE, Medline, and PsycINFO databases. We included only RCTs that reported biochemically validated smoking cessation outcomes at 6 and/or 12 months after the target quit date. Outcomes were aggregated using hierarchical Bayesian random-effects models. We identified 50 RCTs, which randomized $n = 26\,927$ patients (minimal clinical intervention: 9 RCTs, $n = 6456$; individual counselling: 23 RCTs, $n = 8646$; group counselling: 12 RCTs, $n = 3600$; telephone counselling: 10 RCTs, $n = 8225$). The estimated mean treatment effects were minimal clinical intervention [odds ratio (OR) 1.50, 95% credible interval (CrI) 0.84–2.78], individual counselling (OR 1.49, 95% CrI 1.08–2.07), group counselling (OR 1.76, 95% CrI 1.11–2.93), and telephone counselling (OR 1.58, 95% CrI 1.15–2.29).

Conclusion Intensive behavioural interventions result in substantial increases in smoking abstinence compared with control. Although minimal clinical intervention may increase smoking abstinence, there is insufficient evidence to draw strong conclusions regarding its efficacy.

Keywords Smoking cessation • Smoking abstinence • Minimal clinical intervention • Meta-analysis • Bayesian • Behavioural intervention • Counselling • Individual counselling • Group counselling • Telephone counselling

Introduction

More than 50 million North-American adults are cigarette smokers.[1] Of these smokers, an estimated 19.2 million (43%) make at least one quit attempt of 24 h each year.[1] Behavioural interventions, defined as verbal instructions to modify health-related behaviours, are commonly used for smoking cessation. Four commonly used behavioural interventions include minimal clinical intervention (brief advice from a healthcare worker)[2] and more intensive interventions, including individual counselling, group counselling, and telephone counselling. These four interventions have been extensively investigated in randomized controlled trials (RCTs), and these RCTs have produced widely varying quit rates.

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Previous meta-analyses carried out by the Cochrane Collaboration[2–6] and the Agency for Healthcare Research and Quality (AHRQ)[7] have concluded that all four behavioural interventions are efficacious at helping smokers quit. However, these meta-analyses included RCTs in which reports of smoking abstinence were not biochemically validated. They also included RCTs in which smoking abstinence was reported at varying follow-up times. Furthermore, 10 RCTs have recently been published that were not included in these previous meta-analyses. Consequently, there is a need to conduct a meta-analysis that includes only the most rigorous RCTs, in which reports of smoking abstinence were biochemically validated at specific follow-up times. In this meta-analysis, we combined the results from individual RCTs that reported biochemically validated abstinence using a hierarchical Bayesian random-effects[8] analysis to obtain estimates of the efficacy of smoking cessation behavioural interventions. Our objective was to determine how our meta-analysis, which only includes studies of the highest quality, compares with the previous Cochrane and AHRQ meta-analyses.

Methods

Search strategy

Randomized controlled trials of minimal clinical intervention, individual, group, and telephone counselling published in English were identified through a systematic search of the CDC Tobacco Information and Prevention, Cochrane Library, EMBASE, Medline, and PsycINFO databases. Several searches were carried out, each combining the term 'smoking' with the following key words: cognitive therapy, counselling, behavioural therapy, dentist, general practitioner, group counselling, group therapy, individual counselling, nurse, physician, and telephone counselling. The search was limited to RCTs published prior to August 2007. References from published RCTs, relevant reviews, and previous meta-analyses were examined for additional RCTs not identified in the database search.

We classified RCTs according to the definitions for smoking cessation behavioural interventions provided by the Cochrane Collaboration.[2] Minimal clinical intervention was defined as brief advice to 'stop smoking' delivered in $<$20 min by a healthcare worker during a single consultation. This advice included routine counselling, discussions, or recommendations that physicians or nurses (not trained in smoking cessation) provide their patients on a daily basis. Individual counselling was defined as one or more face-to-face encounters of 15 min or more between a smoker and a trained smoking cessation counsellor not involved in routine clinical care. Minimal clinical intervention is the treatment a patient may expect to receive upon a regular clinical visit. In contrast, individual counselling is the treatment a patient may expect to receive upon requesting aid from a trained smoking cessation therapist. Group counselling was defined as two or more behavioural therapy meetings in which at least two smokers were present. In group counselling sessions, smokers received advice from counsellors and were encouraged to discuss their problems with the group. Telephone counselling was defined as the provision of telephone calls to aid in smoking cessation. Calls were made to outpatients or to smokers recruited through a telephone helpline. We included RCTs investigating both pro-active telephone counselling (counsellor initiates calls) and reactive telephone counselling (counsellor responds to calls from smokers).

Included RCTs evaluated one of the four behavioural interventions combined with usual care, where usual care was administered to both the treatment and control arms. In RCTs investigating minimal clinical intervention, usual care consisted of only self-help materials or no treatment. In RCTs investigating individual, group, or telephone counselling, usual care was defined as brief advice from a healthcare worker to stop smoking with or without self-help materials. We included two types of RCTs which investigated more than one intervention strategy: (a) factorial-designed RCTs and (b) RCTs with multiple arms per intervention. For factorial-designed RCTs, we treated these as two separate RCTs and compared treatment arms such that the only difference between arms was the behavioural intervention itself. For RCTs with multiple arms per intervention, we reused the control group in each comparison. We accounted for this reuse in our analysis, avoiding double counting of groups from trials with multiple arms, while using all available data. We also restricted our meta-analysis to RCTs that reported biochemically validated point-prevalence and continuous smoking abstinence at 6 or 12 months. Randomized controlled trials in which the follow-up was conducted within a 2 week window prior to or after 6 or 12 months following the quit date were considered to have satisfied this criterion. We excluded RCTs reporting outcomes that were not biochemically validated or that were recorded at any time period other than 6 or 12 months. Also, we included only RCTs that randomized individual patients, and we excluded cluster RCTs that randomized physicians, therapists, or centres rather than patients. Typically, the efficacies of an intervention in individuals within a cluster tend to be more similar than the efficacies in individuals from different clusters.[9] Consequently, cluster RCTs may introduce biases in study design that are difficult to adjust for and were thus excluded. Finally, RCTs were also excluded if they had a statement specifying that recruited patients 'were not motivated' to quit smoking. All other RCTs that did not have such a statement were considered for inclusion in our meta-analysis.

Two reviewers independently extracted information for each RCT. This information included demographic and clinical characteristics of the study populations, length of intervention, and smoking abstinence outcomes. Disagreements were resolved by consensus or by a third reviewer.

Classification of outcomes

For our analysis, we included the 'most rigorous criterion' of abstinence reported for each RCT.[10] The most rigorous criterion uses the most conservative outcome reported in any given RCT. Starting from the most conservative outcome, the criteria of abstinence reported were (a) continuous abstinence at 12 months, (b) continuous abstinence at 6 months, (c) point prevalence at 12 months, and (d) point prevalence at 6 months. Continuous abstinence was defined as strictly no smoking from the initial target quit date until follow-up at 6 or 12 months. Point prevalence was defined as no smoking over a time period, usually 7 days, directly preceding follow-up. Outcomes reported in terms of repeated point prevalence (subjects who were abstinent for a period of time immediately before two or more follow-ups) were classified as continuous abstinence.

In order to determine the true efficacy of behavioural interventions, we included only RCTs that verified smoking abstinence outcomes by means of biochemical validation. Finally, we calculated abstinence outcomes according to an intention-to-treat analysis, where patients who were randomized but lost to follow-up were considered smokers. Only patients who had moved or died prior to follow-up were excluded from the analysis.

Quality assessment

We measured the quality, or internal validity, of each RCT using a modified Jadad quality assessment scale.[11] We scored trials out of a maximum of 3 points. A maximum of 2 points were awarded on the basis of the method of randomization, and a maximum of 1 point was awarded for a description of patient withdrawals and dropouts. We did not assess for blinding since RCTs involving behavioural interventions are open-label owing to the nature of the intervention. On the basis of our modified scale, a score of 1 out of 3 signifies that the report has a high probability of bias, whereas scores of 2 or 3 have a medium and low probability of bias, respectively.

Statistical analysis

For each of the four behavioural interventions, a separate meta-analysis was performed to estimate the mean effect across individual RCTs. The results from RCTs investigating more than one intervention were analysed alongside RCTs investigating a single intervention provided that the treatment and control groups only differed by the intervention of interest. Our model used data from each arm from each trial exactly once, avoiding double counting of groups from RCTs with multiple arms, while using all available data. A Bayesian hierarchical meta-analysis based on a random-effects model was employed to account for RCT-to-RCT variability, which could arise from differences in patients' characteristics, trial methodology, setting, and intensity of adjunct support. In a Bayesian hierarchical model, the probability of an event within each RCT is allowed to vary between intervention and control groups, and effects across RCTs are assumed to vary according to a common distribution. To model the between-RCT variability, the logarithms of the odds ratio (OR) of each outcome variable were assumed to follow a normal distribution. The mean of the normal distribution therefore represents the mean intervention effect in RCTs on a log(OR) scale, and variance represents the variability between RCTs.

A meta-analysis based upon the above model was conducted for each of the four behavioural interventions. To specify our Bayesian hierarchical model, we first assumed that each arm of each study independently estimated the probability p_{ij} of smoking cessation, where i indexed each study and j indexed the group ($j = 0$ for the control group and $j = 1$ for the intervention group). The log (OR) for trial i was defined as $\log(OR_i) = \log(p_{(i1)}/(1 - p_{(i1)})/p_{(i0)}/(1 - p_{(i0)}))$. The collection of log(OR)s across the different RCTs was assumed to follow a normal distribution with mean m and variance σ^2. As discussed earlier, μ represents the overall mean effect across RCTs, and σ^2 represents the RCT-to-RCT variation. We used diffuse prior distributions for μ and σ^2, so that all parameter estimates were almost entirely determined by the observed data. In our modelling, we did not use any tests for heterogeneity, since these tests typically have very low power and since the null hypothesis that all ORs are identical from trial to trial is not a priori plausible. Furthermore, Bayesian models do not rely on an assumption of homogeneity. Our Bayesian hierarchical model estimates a between-study variance parameter, σ^2, which controls the degree of pooling between studies. The final ORs and credible intervals (CrIs) automatically reflect the degree of heterogeneity of the ORs between studies. Forest plots were produced to display the ORs and 95% CrI for all smoking cessation outcomes examined in our meta-analysis. Analyses were conducted using Winbugs 1.4.1. In Winbugs, we ran 1000 burn-in iterations, followed by 20 000 iterations for inference. Convergence was checked by verifying the sample paths to ensure that no nodes became stuck. In addition, we constructed funnel plots to assess for the possible presence of publication bias. The plots were created using MIX software.[12,13]

Results

We identified a total of 50 RCTs (*Figure 1*) including 64 comparisons that met our inclusion criteria (*Tables 1–4*). The most common reason for exclusion was non-biochemically validated reports of smoking cessation (Supplementary material online, Appendix S1). The total number of patients randomized was 26 927. Among the included comparisons, 9 evaluated minimal clinical intervention (6456 patients), 25 evaluated individual

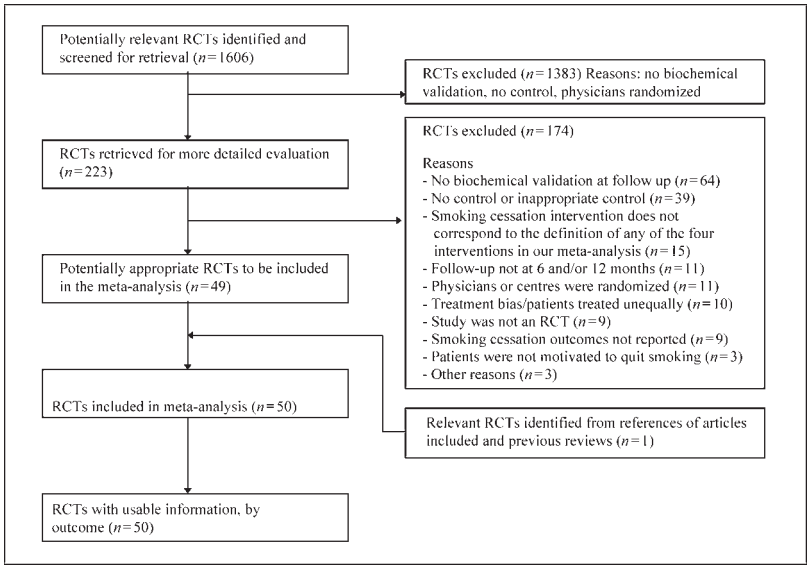

Figure 1 Flow diagram of randomized clinical trials (RCTs) included in the meta-analysis.

Table 1 Randomized controlled trials investigating minimal clinical intervention

Study	Sample size	Population	Design	Country	Mean CPD	Treatment characteristics		Most rigorous outcome reported		Smoking abstinence (%)	
						Delivered by	Mean duration of session (min)	Months	Abstinence classification	Active	Control
Sanders *et al.* (21)	1393	Patients receiving surgery	MC	England	NR	Nurse	NR	12	CA	5	1
Hennrikus *et al.* (22)[a]	1362	In-patients	MC	USA	NR	Physician/nurse	1	12	PP	10	9
Allen *et al.* (23)	1086	African-Americans	SC	USA	14	Physician	4	12	PP	2	2
Li *et al.* (24)	576	Male asbestos-exposed workers	SC	USA	NR	Physician	4	12	CA	8	4
Tonnesen *et al.* (25)	507	Patients with lung disorders	SC	Denmark	13	Nurse	5	12	CA	3	1
Hajek *et al.* (26)	505	Subjects who had MI/CABG	MC	England	22	Nurse	20	12	CA	37	41
Vetter and Ford (27)	433	Subjects 60 years or older	SC	England	NR	Physician	NR	12	PP	16	9
Jackson *et al.* (28)	372	Malaysian males	SC	Malaysia	11	Research assistant	1	6	PP	5	6
Slama *et al.* (29)	207	Healthy	MC	Australia	NR	Physician	1.4	12	CA	1	1

CPD, cigarettes per day; SC, single-centre; MC, multi-centre; NR, not reported; CA, continuous abstinence; PP, point prevalence; CABG, coronary artery bypass graft surgery; MI, myocardial infarction.
[a]In addition to a minimal clinical intervention arm, patients were randomized to a telephone counselling arm.

counselling (8646 patients), 18 evaluated group counselling (3600 patients), and 12 evaluated telephone counselling (8225 patients). A total of 11 RCTs included two or more comparisons investigating different intervention strategies that were included in the meta-analysis. The average quality assessment score of all 50 RCTs was 2.14 on a scale of 3, suggesting that most of the RCTs had medium-to-low probability of bias.

Characteristics of recruited patients varied widely among RCTs (*Tables 1–4*). A total of 22 RCTs evaluated behavioural interventions in healthy populations. The remaining 28 RCTs were evaluated in 'at-risk' populations, such as pregnant women or diabetic patients, and miscellaneous populations corresponding to various age, sex, socioeconomic, or ethnic groups. The mean number of cigarettes smoked per day (CPD) of the study population varied between 20 and 30, with few exceptions, for individual, group, and telephone counselling (*Tables 2–4*). However, the highest mean CPD for RCTs investigating minimal clinical intervention was only 22 (*Table 1*).

The method of delivery and duration of each behavioural intervention also varied among RCTs. Among the nine comparisons evaluating minimal clinical intervention, the mean duration of sessions varied from 1 to 20 min (*Table 1*). The mean total duration of sessions for RCTs investigating individual counselling varied from 13.5 min to 10 h (*Table 2*). For group counselling, the mean total duration of sessions varied from 7.5 to 16 h (*Table 3*). For telephone counselling, the mean total duration of sessions varied from 3 to 60 min (*Table 4*). Furthermore, the number of sessions delivered and the treatment span (time frame) in which the sessions were delivered varied for each intervention.

Efficacy of smoking cessation behavioural interventions

A separate meta-analysis was performed for each of the four behavioural interventions, where smoking abstinence was defined using the most rigorous criterion reported (*Figures 2–5*). The point estimate for minimal clinical intervention (OR 1.50, 95% CrI 0.84–2.78) suggests that it is efficacious at promoting smoking abstinence. However, we cannot draw any strong conclusions about the efficacy of minimal clinical intervention since its CrI was wide and included 1.0. Intensive interventions, including individual counselling (OR 1.49, 95% CrI 1.08–2.07), group counselling (OR 1.76, 95% CrI 1.11–2.93), and telephone counselling (OR 1.58, 95% CrI 1.15–2.29), all substantially increased smoking abstinence compared with control. The wide CrIs for all four interventions prevented the ranking of interventions through indirect comparisons (data not shown). The point estimates of all four interventions are similar, suggesting that the efficacies of the different interventions were similar.

Discussion

Our meta-analysis was designed to assess the efficacy of four behavioural interventions at increasing smoking abstinence. We included only the most rigorous RCTs, in which reports of smoking abstinence were biochemically validated at two specific follow-up times (6 and/or 12 months). Individual, group, and

Table 2 Randomized controlled trials investigating individual counselling

Study	Sample size	Population	Design	Country	Mean CPD	Treatment characteristics			Most rigorous outcome reported		Smoking abstinence (%)	
						Number of sessions	Mean total duration of sessions (min)	Treatment span (weeks)	Months	Abstinence classification	Active	Control
RCBTS (30)	1462	Patients with smoking diseases	MC	England	17	8	NR	6	12	CA	9	7
Miller *et al.* (31)	1402	Hospitalized patients	MC	USA	20	1	30	1	12	CA	14	13
Glasgow *et al.* (32)	1154	15–35-year old women	MC	USA	32	1	13.5	1	6	PP	6	4
Aveyard *et al.* (33)[a]	1045	Healthy	MC	England	NR	3	NR	24	6	CA	2	2
Tappin *et al.* (34)	743	Pregnant women	MC	England	28	6	180	NR	6	PP	5	5
Fiore *et al.* (15)[b]	631	Healthy	MC	USA	22	4	80	3	12	CA	9	7
Secker-Walker *et al.* (35)	513	Pregnant women	SC	USA	25	3	NR	NR	6	PP	11	10
Lancaster *et al.* (36)	497	Healthy	MC	England	17	5	55	6	12	CA	3	4
Maguire *et al.* (37)	484	Healthy	MC	England, Ireland	NR	8	NR	16	12	CA	14	3
Secker-Walker *et al.* (38)	399	Pregnant women	SC	USA	25	5	NR	36	6	CA	6	2
Segnan *et al.* (39)	337	Healthy	SC	Italy	NR	5	NR	36	12	PP	5	5
Weissfield and Holloway (40)	316	Male smokers	SC	USA	26	1	20	1	6	PP	6	1
Windsor *et al.* (41)	265	Pregnant women	SC	USA	10	1	NR	1	6	PP	17	9
Lowe *et al.* (42)	217	Pregnant women of low SE status	SC	Australia	NR	1	15	1	6	PP	3	3
Richmond *et al.* (43)	200	Healthy	SC	Australia	24	6	NR	26	6	PP	33	3
Molyneux *et al.* (44)	183	Healthy	SC	England	NR	1	20	1	12	CA	4	8
Jorenby *et al.* (14)[c]	172	Healthy	MC	USA	28	3	45	4	6	PP	30	26
Jorenby *et al.* (14)[d]	165	Healthy	MC	USA	26	3	45	4	6	PP	34	26
Alterman *et al.* (16)[e]	160	Healthy	SC	USA	27	3	52.5	9	12	PP	11	25
Alterman *et al.* (16)[f]	160	Healthy	SC	USA	27	12	570	12	12	PP	33	11
Malchodi *et al.* (45)[g]	142	Pregnant Hispanic women	SC	USA	12	8	360	NR	6	PP	24	21
Chouinard and Robichaud-Ekstrand (46)[h]	108	Patients with CVD	SC	Canada	NR	1	40	1	6	CA	25	13
Tappin *et al.* (47)	100	Pregnant women	SC	England	19	9	600	NR	6	PP	4	8

Rigotti *et al.* (48)[i]	87	Patients scheduled for CABG	SC	USA	30	3	60		NR	12	CA	51	51
Ardron *et al.* (49)	60	Diabetic patients	SC	England	18	1	NR		1	6	PP	0	3

CPD, cigarettes per day; SC, single centre; MC, multi-centre; NR, not reported; CA, continuous abstinence; PP, point prevalence; RCBTS, Research Committee of the British Thoracic Society; CRD, cardiorespiratory disease; SE, socioeconomic; CVD, cardiovascular disease; CV, cardiovascular; CABG, coronary artery bypass graft surgery; COPD, chronic obstructive pulmonary disease.
[a]In addition to an individual counselling arm, patients were randomized to a telephone counselling arm.
[b]All subjects were provided one individual counselling session, one telephone counselling session, and 21 mg nicotine patches.
[c]All subjects were provided 44 mg nicotine patches.
[d]All subjects were provided 22 mg nicotine patches.
[e]Active intervention consisted of three counselling sessions. All subjects were provided one individual counselling session and 21 mg nicotine patches.
[f]Active intervention consisted of 12 counselling sessions. All subjects were provided one group counselling session, three individual counselling sessions, and 21 mg nicotine patches.
[g]All subjects were provided one individual counselling session.
[h]In addition to individual counselling, patients were randomized to telephone counselling.
[i]All subjects were provided one group counselling session.

telephone counselling were all found to increase smoking abstinence by a factor of 1.49 to 1.76 in smokers motivated to quit. Despite a point estimate of 1.50, we could not say with certainty that minimal clinical intervention was an efficacious therapy for smoking cessation since the CrI was wide and included 1.0. Counsellors may expect an impact from their intensive interventions (individual, group, and telephone counselling); however, there is insufficient evidence to draw strong conclusions regarding the efficacy of minimal clinical intervention.

We identified only nine RCTs investigating minimal clinical intervention in which reports of smoking abstinence were biochemically validated. Furthermore, only three of these RCTs enrolled over 1000 patients. Had more RCTs with larger patient populations been included in our meta-analysis, the wide CrI for minimal clinical intervention would have been narrower and likely would have not included unity. A narrower CrI would have allowed us to conclude with certainty that minimal clinical intervention is efficacious. Therefore, we recommend that healthcare workers advise smokers to quit, especially since minimal clinical intervention requires fewer resources than more intensive interventions. In addition, we recommend that physicians refer their patients for individual, group, or telephone counselling. Although these more intensive interventions entail higher costs, our meta-analysis has shown that they are efficacious at helping smokers quit.

Behavioural interventions might be more efficacious when used in combination with pharmacological interventions as part of a smoking cessation strategy. We identified five RCTs in the literature that met our inclusion criteria and that investigated the use of behavioural interventions as an adjunct to a particular pharmacotherapy.[14–18] However, the number of RCTs investigating more than one intervention was insufficient to conclude whether a smoking cessation strategy combining pharmacotherapy and behavioural intervention was more efficacious than a strategy with behavioural intervention alone. Furthermore, a smoking cessation strategy consisting of only behavioural interventions may be particularly useful to smokers who are reluctant to using smoking cessation pharmacotherapy. The efficacy of smoking cessation pharmacological interventions has been previously investigated.[19] However, the efficacy of a cessation strategy combining pharmacotherapy and behavioural interventions remains poorly understood.

Previous studies

Previous meta-analyses on smoking cessation behavioural interventions have been carried out by the Cochrane Collaboration and the AHRQ. We classified the behavioural interventions using the definitions provided by the Cochrane Collaboration. The definition for minimal clinical intervention included counselling that lasted a maximum of 20 min, which allowed us to include more RCTs than the definition provided by the AHRQ. The AHRQ defined minimal counselling as lasting <3 min, and thus, was very limiting.[7] The use of the AHRQ definition would have reduced the number of RCTs included in our meta-analysis from nine to five RCTs.

Unlike our meta-analysis, the Cochrane[2,4] and AHRQ[7] meta-analyses obtained narrow confidence intervals (CIs). These previous meta-analyses concluded with certainty that minimal clinical intervention was efficacious at increasing smoking abstinence

Table 3 Randomized controlled trials investigating group counselling

Study	Sample size	Population	Design	Country	Mean CPD	Treatment characteristics			Most rigorous outcome reported		Smoking abstinence (%)	
						Number of sessions	Mean total duration of sessions (min)	Treatment span (weeks)	Months	Abstinence classification	Active	Control
Hollis *et al.* (50)	1350	Healthy	MC	USA	18	9	NR	8	12	PP	5	3
Mogielnicki *et al.* (51)	377	Male veterans	MC	USA	NR	5	450	5	6	PP	10	11
Slovinec D'Angelo *et al.* (52)	332	Women	MC	Canada	20	8	960	8	12	PP	18	15
Romand *et al.* (53)[a]	228	Healthy	SC	France	NR	6	NR	26	12	CA	13	3
Jorenby *et al.* (14)[b]	172	Healthy	SC	USA	27	8	480	8	6	PP	26	26
Jorenby *et al.* (14)[c]	164	Healthy	SC	USA	29	8	480	8	6	PP	25	26
Bakkevig *et al.* (54)	139	Healthy	SC	Norway	19	8	NR	7	12	CA	30	7
Omenn *et al.* (55)[d]	108	Worksite employees	SC	USA	26	8	960	8	12	PP	18	8
Omenn *et al.* (55)[e]	102	Worksite employees	SC	USA	26	6	NR	3	12	PP	16	8
Sawicki *et al.* (56)	89	Diabetic subjects	SC	Germany	21	10	900	10	6	PP	5	16
Garcia *et al.* (57)[f]	79	Healthy	SC	Spain	26	5	300	5	12	PP	39	2
Curry *et al.* (58)[d]	74	Healthy	SC	USA	28	8	960	8	12	CA	25	26
Garcia *et al.* (57)[g]	73	Healthy	SC	Spain	27	10	600	5	12	PP	16	2
Hall *et al.* (17)[h]	73	Healthy	SC	USA	23	5	450	8	12	PP	17	11
Hall *et al.* (17)[i]	73	Healthy	SC	USA	22	5	450	8	12	PP	24	25
Hall *et al.* (17)[j]	73	Healthy	SC	USA	21	5	450	8	12	PP	17	18
Curry *et al.* (58)[k]	65	Healthy	SC	USA	28	8	960	8	12	CA	38	17
Glasgow *et al.* (59)	29	Healthy	SC	USA	32	8	NR	8	6	PP	7	7

CPD, cigarettes per day; SC, single centre; MC, multi-centre; NR, not reported; CV, cardiovascular; CA, continuous abstinence; PP, point prevalence.
[a]All subjects were provided one group counselling session.
[b]All subjects were provided with 22 mg nicotine patches.
[c]All subjects were provided with 44 mg nicotine patches.
[d]Active intervention consisted of relapse-prevention component counselling sessions.
[e]Active intervention consisted of multi-component counselling sessions.
[f]Active intervention consisted of five counselling sessions.
[g]Active intervention consisted of 10 counselling sessions.
[h]All subjects were provided four individual counselling sessions and placebo pills.
[i]All subjects were provided four individual counselling sessions and 300 mg bupropion hydrochloride.
[j]All subjects were provided four individual counselling sessions and 50 mg nortriptyline hydrochloride.
[k]Active intervention consisted of absolute abstinence component counselling sessions.

Table 4 Randomized controlled trials investigating telephone counselling

Study	Sample size	Population	Design	Country	Mean CPD	Treatment characteristics			Most rigorous outcome reported		Smoking abstinence (%)	
						Number of sessions	Mean total duration of sessions (min)	Treatment span (weeks)	Months	Abstinence classification	Active	Control
Rabius *et al.* (60)	3102	Subjects over 25 years old	SC	USA	24	5	NR	3	6	CA	8	4
Hennrikus *et al.* (22)[a]	1352	In-patients	MC	USA	NR	6	60	24	12	PP	10	10
Aveyard *et al.* (33)[b]	1306	Healthy	MC	England	NR	3	NR	24	6	CA	2	2
Curry *et al.* (61)	479	Healthy	SC	USA	18	3	NR	9	12	CA	5	3
Rabius *et al.* (60)	420	Subjects 18–25 years old	SC	USA	18	5	NR	3	6	CA	9	2
Kim *et al.* (62)	401	Healthy	SC	South Korea	NR	2	14	4	6	CA	14	9
Lando *et al.* (18)[c]	347	Healthy	SC	USA	28	NR	NR	NR	6	CA	15	15
Lando *et al.* (18)[d]	335	Healthy	SC	USA	28	4	12.5	12	6	CA	17	15
Miguez *et al.* (63)	200	Healthy	SC	Spain	28	6	60	6	12	CA	27	14
Taylor *et al.* (64)	130	Patient with MI	SC	USA	NR	7	3	20	12	PP	71	45
Chouinard and Robichaud-Ekstrand (46)[e]	106	Patients with CVD	SC	Canada	NR	6	NR	7	6	CA	25	25
Brown *et al.* (65)	45	Healthy	SC	Australia	23	6	NR	10	12	PP	30	9

CPD, cigarettes per day; SC, single-centre; MC, multi-centre; NR, not reported; CA, continuous abstinence; PP, point prevalence; CABG, coronary artery bypass graft surgery; MI, myocardial infarction; CVD, cardiovascular disease.
[a]In addition to a telephone counselling arm, patients were randomized to an individual counselling arm.
[b]In addition to a telephone counselling arm, patients were randomized to an individual counselling arm.
[c]Active intervention consisted of reactive counselling. All subjects were provided one group counselling session and 22 mg nicotine patches.
[d]Active intervention consisted of reactive and pro-active counselling. All subjects were provided one group counselling session and 22 mg nicotine patches.
[e]All subjects were provided one individual counselling session.

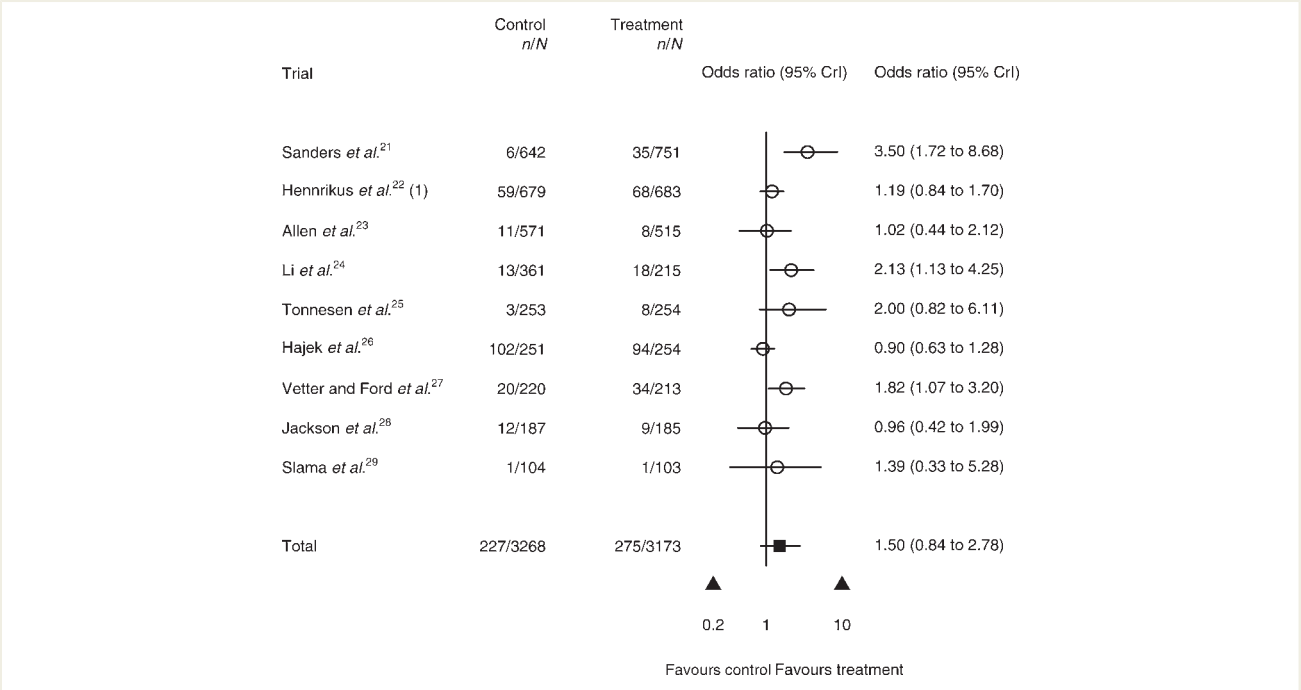

Figure 2 Forest plot of the effect of minimal clinical intervention on the incidence of smoking abstinence. Smoking abstinence is defined by the most rigorous criterion. (1) In addition to a minimal clinical intervention arm, patients were randomized to a telephone counselling arm.

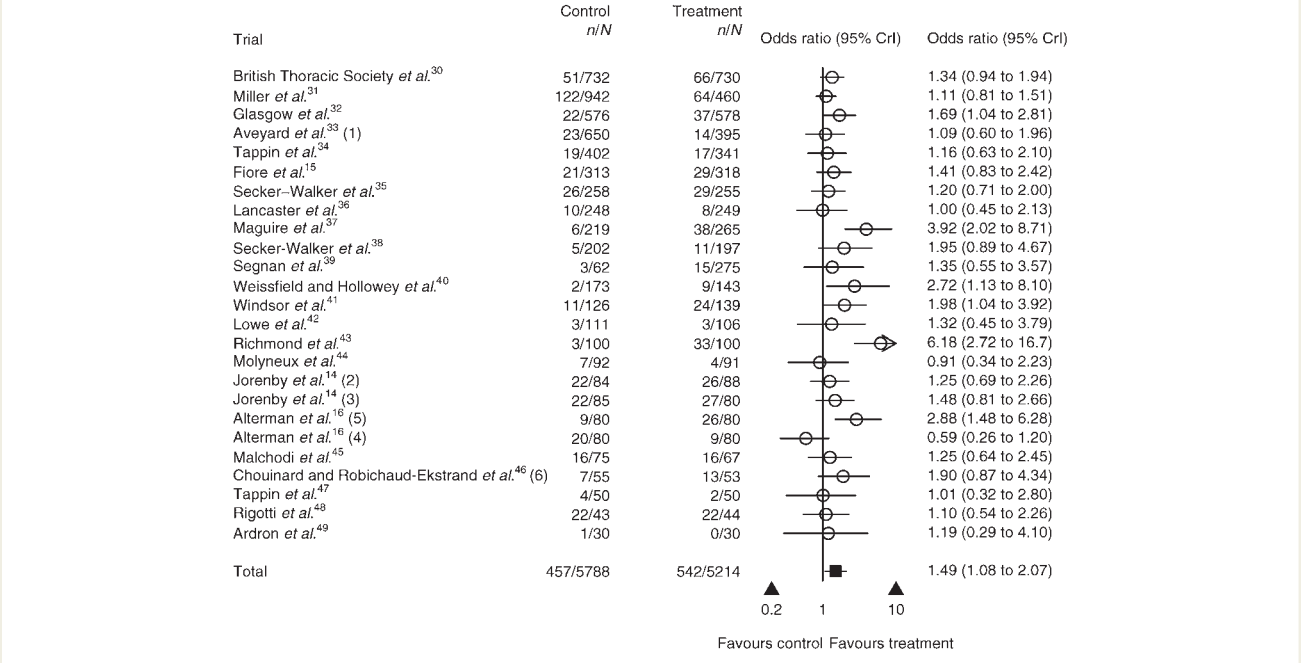

Figure 3 Forest plot of the effect of individual counselling on the incidence of smoking abstinence. Smoking abstinence is defined by the most rigorous criterion. (1) In addition to an individual counselling arm, patients were randomized to a telephone counselling arm. (2) All subjects were provided 44 mg nicotine patches. (3) All subjects were provided 22 mg nicotine patches. (4) Active intervention consisted of three counselling sessions. All subjects were provided one individual counselling session and 21 mg nicotine patches. (5) Active intervention consisted of 12 counselling sessions. All subjects were provided one group counselling session, three individual counselling sessions, and 21 mg nicotine patches. (6) In addition to an individual counselling arm, patients were randomized to a telephone counselling arm.

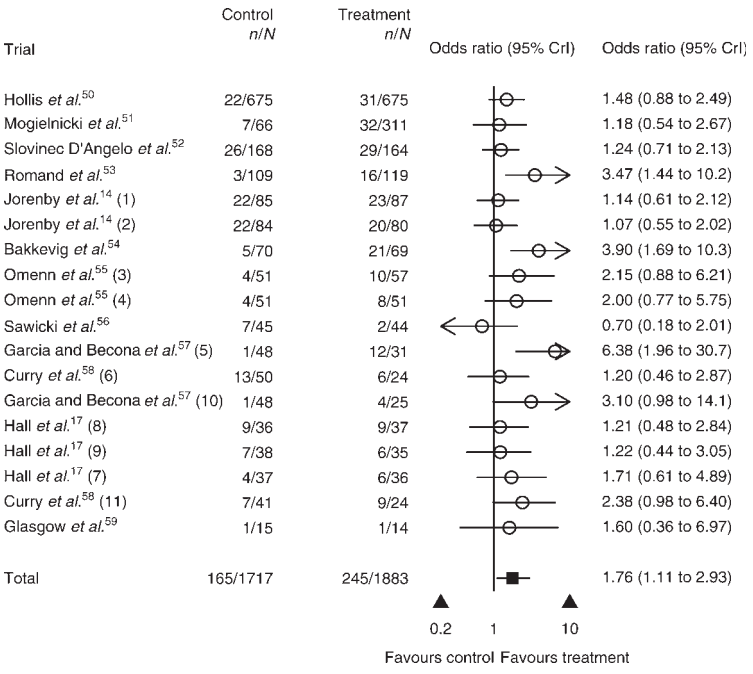

Figure 4 Forest plot of the effect of group counselling on the incidence of smoking abstinence. Smoking abstinence is defined by the most rigorous criterion. (1) All subjects were provided with 22 mg nicotine patches. (2) All subjects were provided with 44 mg nicotine patches. (3) Active intervention consisted of relapse-prevention component counselling sessions. (4) Active intervention consisted of multi-component counselling sessions. (5) Active intervention consisted of five counselling sessions. (6) Active intervention consisted of relapse-prevention component counselling sessions. (7) All subjects were provided four individual counselling sessions and placebo pills. (8) All subjects were provided four individual counselling sessions and 300 mg bupropion hydrochloride. (9) All subjects were provided four individual counselling sessions and 50 mg nortriptyline hydrochloride. (10) Active intervention consisted of 10 counselling sessions. (11) Active intervention consisted of absolute abstinence component counselling sessions.

compared with control. In contrast, we obtained wider CrIs for each intervention by including only RCTs in which reports of smoking abstinence were biochemically validated. The efficacies for minimal clinical intervention, individual, group, and telephone counselling obtained in previous Cochrane meta-analyses were similar to the efficacy that we obtained.[3,5,6] However, our CrI for minimal clinical intervention was wide and included unity; therefore, we cannot draw strong conclusion about its efficacy.

The AHRQ concluded that an exposure response relationship of behavioural interventions exists.[7] More intensive interventions, such as individual counselling, were more efficacious than minimal clinical interventions. In contrast, our results suggest that there is minimal difference in efficacy between the four interventions since their point estimates are similar and their CrIs overlap. However, head-to-head RCTs comparing the different interventions would be needed to confirm that the four interventions are equally efficacious. Nevertheless, minimal clinical intervention is likely a low-cost alternative to more intensive behavioural interventions which require a great deal of resources. A cost-effectiveness analysis would be needed to confirm the cost benefits of minimal clinical interventions.

Our strict inclusion criteria limited our meta-analysis to RCTs of the highest quality, thereby maximizing the internal validity of our results but yielding wide CrI. We included only RCTs with follow-up of smoking abstinence at 6 and/or 12 months. Previous meta-analyses, however, included RCTs reporting smoking abstinence at various follow-up times. Most importantly, we restricted our meta-analysis to RCTs that biochemically validated reports of smoking abstinence. Self-reports of smoking abstinence are not always reliable and may overestimate the efficacy of smoking cessation interventions, such as minimal clinical intervention.[20] Patients in at-risk populations, such as pregnant smokers or smokers with cardiovascular disease, are typically more likely to give false reports of smoking abstinence owing to societal pressures. Furthermore, patients who are in frequent contact with their counsellors, such as those receiving individual or group counselling, may be more likely to give false reports of smoking abstinence owing to their desire to not disappoint their counsellors. Finally, we also maximized the internal validity of our results by using Bayesian models, which account for greater uncertainty and thus produce wider intervals.[8]

Limitations

Our meta-analysis has a number of potential limitations. First, the motivation of patients, the number of CPD, ethnicity, and age all contributed to the heterogeneity of RCTs. Randomized controlled trials also varied in the total duration of counselling sessions, the number of sessions, and the type of treatment provider (i.e. physician, nurse). We partially accounted for these variations by employing a random effects model for our meta-analysis.

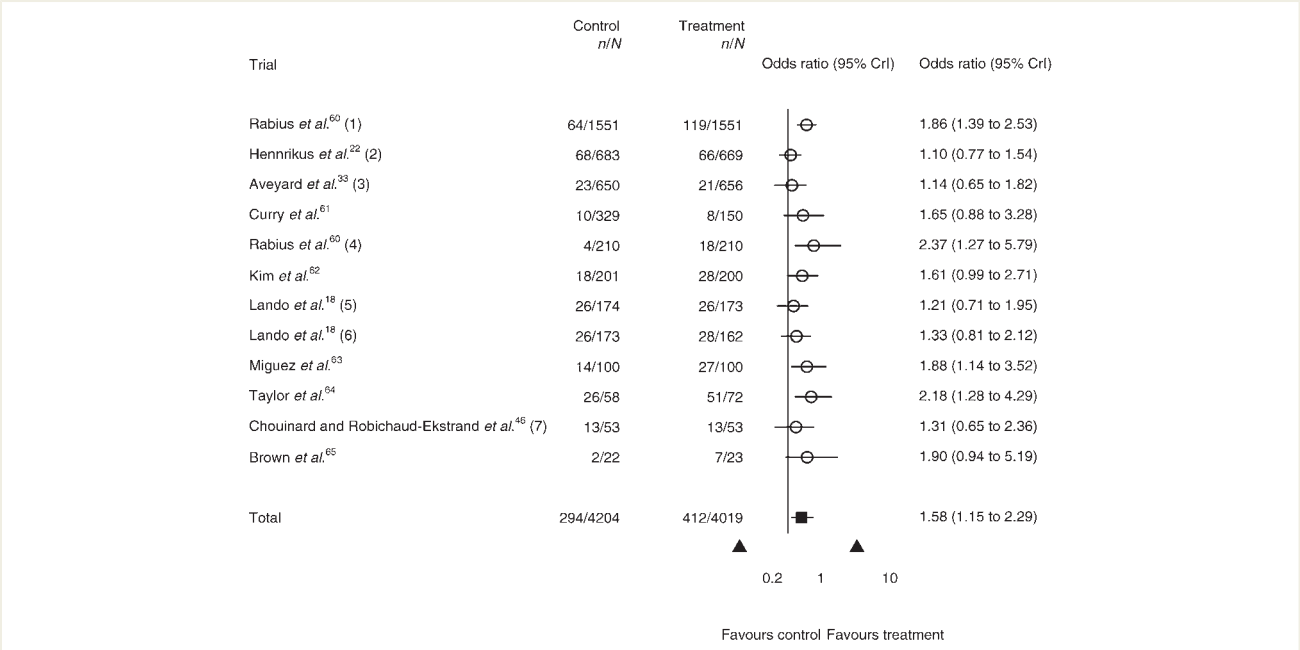

Figure 5 Forest plot of the effect of telephone counselling on the incidence of smoking abstinence. Smoking abstinence is defined by the most rigorous criterion. (1) Subjects over 25 years old. (2) In addition to a telephone counselling arm, patients were randomized to a minimal clinical intervention arm. (3) In addition to a telephone counselling arm, patients were randomized to an individual counselling arm. (4) Subjects 18–25 years old. (5) Active intervention consisted of reactive counselling. All subjects were provided one group counselling session and 22 mg nicotine patches. (6) Active intervention consisted of reactive and pro-active counselling. All subjects were provided one group counselling session and 22 mg nicotine patches. (7) In addition to a telephone counselling arm, patients were randomized to an individual counselling arm.

Furthermore, hierarchical Bayesian models do not rely on a homogeneity assumption. Second, the smoking abstinence outcomes also varied between RCTs; some reported the point prevalence of abstinence at 6 and/or 12 months, whereas others reported continuous abstinence at 6 and/or 12 months. We analysed the outcomes using the most rigorous criterion of smoking abstinence, as used previously.[10] Third, the smokers selected to participate in RCTs are typically more motivated than smokers in actual practice. Fourth, publication bias is a potential limitation for our meta-analysis as is true for virtually any meta-analysis. Fifth, we limited our search to RCTs published in English. However, <5% of RCTs identified in our literature search were published in a language other than English. Finally, we may have underestimated the efficacy of intensive behavioural interventions. In RCTs examining intensive interventions, the control consisted of brief advice from a healthcare worker. Brief advice alone may improve smoking abstinence in the control, which would consequently lower the point estimate of the OR for intensive interventions.

Conclusion

The use of intensive behavioural interventions, including individual, group, and telephone counselling, results in substantial increases in smoking abstinence compared with control in smokers motivated to quit. Although minimal clinical intervention may increase smoking abstinence, there is insufficient evidence to draw strong conclusions regarding its efficacy. However, in addition to advising patients to quit smoking, we recommend that healthcare workers also advise smokers to seek more intensive individual, group, or telephone counselling for smoking cessation. The point estimates of efficacy for the four behavioural interventions are similar; however, in the absence of head-to-head RCTs, we are unable to confirm if all four interventions are equally efficacious.

Supplementary material

Supplementary material is available at *European Heart Journal* online.

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