

A Meta-Analysis of Smoking Cessation Interventions With Individuals in Substance Abuse Treatment or Recovery

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This meta-analysis examined outcomes of smoking cessation interventions evaluated in 19 randomized controlled trials with individuals in current addictions treatment or recovery. Smoking and substance use outcomes at posttreatment and long-term follow-up (≥ 6 months) were summarized with random effects models. Intervention effects for smoking cessation were significant at posttreatment and comparable for participants in addictions treatment and recovery; however, intervention effects for smoking cessation were nonsignificant at long-term follow-up. Smoking cessation interventions provided during addictions treatment were associated with a 25% increased likelihood of long-term abstinence from alcohol and illicit drugs. Short-term smoking cessation effects look promising, but innovative strategies are needed for long-term cessation. Contrary to previous concerns, smoking cessation interventions during addictions treatment appeared to enhance rather than compromise long-term sobriety.

Cigarette smoking is endemic among individuals with substance abuse problems, with rates as high as 74% to 88% (Kalman, 1998), compared with 23% in the general population (Centers for Disease Control and Prevention, 2002). Substance abusers tend to start smoking at a younger age and are more likely to be heavy smokers, nicotine dependent, and experience greater difficulty with quitting (e.g., Breslau, Peterson, Schultz, Andreski, & Chilcoat, 1996; Hayford et al., 1999; Hays et al., 1999; Novy, Hughes, & Callas, 2001; Richter, Ahluwalia, Mosier, Nazir, & Ahluwalia, 2002). Individuals with current or past substance abuse problems also are more likely to have psychiatric, cognitive, or medical comorbidities and, thus, may require more intensive or specialized cessation interventions (Burling, Ramsey, Seidner, & Kondo, 1997; Covey, Glassman, Stetner, & Becker, 1993; Saxon et al., 2003).

Treatment of tobacco dependence, however, has not been included in many addictions treatment settings. In a recent survey of 223 addiction treatment programs in Canada, only 10% reported offering formal smoking cessation programs, 54% reported placing very little emphasis on smoking, and 47% still allowed smoking indoors (Currie, Nesbitt, Wood, & Lawson, 2003). Traditionally, the drug treatment culture has explicitly excluded smoking cessation treatments and dissuaded individuals from attempting cessation out of concern that concurrent treatment of multiple drugs of abuse is too difficult and may compromise sobriety. Tobacco use

has few immediate consequences, and thus has not been a priority for treatment. Yet, the use of tobacco accounts for greater morbidity than alcohol and all other drugs combined (U.S. Department of Health and Human Services, 2000). Among individuals treated for alcohol dependence, tobacco-related diseases were responsible for half of all deaths, greater than alcohol-related causes (Hurt et al., 1996). In a 24-year study of long-term drug abusers, Hser, McCarthy, and Anglin (1994) documented the death rate among cigarette smokers to be four times that of nonsmokers. The health consequences of tobacco and other drug use are synergistic and estimated to be 50% greater than the sum of each individually (Bien & Burge, 1990).

The assumption that individuals with substance abuse problems do not want to quit smoking has not been supported. Surveys of individuals in addictions treatment have documented that 44% to 80% are interested in quitting their tobacco use (Clarke, Stein, McGarry, & Gogineni, 2001; Ellingstad, Sobell, Sobell, Cleland, & Agrawal, 1999; Irving, Seidner, Burling, Thomas, & Brenner, 1994; Richter, Gibson, Ahluwalia, & Schmelzle, 2001; Rohsenow et al., 2003; Sees & Clark, 1993; Zullino, Besson, & Schnyder, 2000). The optimal timing for promoting smoking cessation with this population, however, has not been identified, and 17% to 41% of clients report concern that quitting smoking during addictions treatment may make it harder to stay sober (Asher et al., 2003; Irving et al., 1994; Stein & Anderson, 2003).

In the past 10 years there has been growing interest in treating nicotine dependence among individuals with substance abuse problems (Bowman & Walsh, 2003; Hurt & Patten, 2003; Richter & Ahluwalia, 2000). Although the magnitude of the problem of tobacco use in this patient population is clear, questions of when and how best to intervene remain. Furthermore, limited research is available on the impact of smoking cessation efforts on future recovery, and an estimate of the incidence of relapse to drugs and alcohol is needed (Hughes, 2002). Studies have been conducted in inpatient and outpatient settings with participants in current addictions treatment and in recovery. Most studies have had small sample sizes and findings have been equivocal, making it an area

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in need of a systematic review that provides an overall estimate of treatment effects.

We conducted a systematic review of randomized controlled trials to assess the effectiveness of smoking cessation interventions evaluated with individuals in addictions treatment or recovery. The comparison of abstinence rates and treatment effects may provide some guidance on the **optimal timing of smoking cessation interventions in relation to addictions treatment**. Studies were categorized based on whether participants were enrolled in addiction treatment programs (in treatment) or identified as in recovery. Studies with participants in methadone maintenance treatment programs were categorized as in treatment. We combined studies conducted with individuals with alcohol and/or drug problems because of the substantial comorbidity across substances of abuse and the focus of many treatment centers to target a variety of addictions. This meta-analysis complements prior qualitative reviews of the efficacy of smoking cessation interventions conducted with substance abusing populations (el-Guebaly, Cathcart, Currie, Brown, & Gloster, 2002; Hughes, 1996; Hurt & Patten, 2003; Sussman, 2002).

Method

Literature Search

Computer-based searches of *MEDLINE*, *PsycINFO*, *Biosis*, the Cochrane Library, *EMBASE*, *Electronic Collections Online (ECO)*, conference abstracts (e.g., Society for Research on Nicotine and Tobacco), and *Digital Dissertations* identified randomized controlled trials testing smoking cessation interventions in substance abusing populations, either in current treatment or recovery. The search covered January 1966 through September 2003. Key search criteria combined study design (e.g., randomized controlled trial, double-blind method), smoking cessation (e.g., tobacco, nicotine), and substance abuse (e.g., alcohol abuse, drug dependence) terms. Bibliographies of relevant research and review articles were manually searched. Studies in progress were identified through a search of the National Institutes of Health Computer Retrieval of Information on Scientific Projects database of funded research; principal investigators were contacted regarding the status of their studies.

Studies included in the meta-analysis met the following criteria: (a) randomized controlled design, (b) evaluation of a smoking cessation intervention, (c) study participants in addictions treatment or recovery, (d) adult aged sample (>18 years old), and (e) quantitative assessment of smoking cessation (e.g., point prevalence abstinence). Use of biochemical verification was recorded but not required. Excluded studies included use of a quasi-experimental or single group design, multiple publications relating to the same study, and studies targeting an outcome other than smoking cessation (e.g., smoking reduction).

MEDLINE yielded 53 citations. Of these, 18 met the inclusion criteria. Five articles were secondary publications from the original trial, leaving a group of 13 original articles. *PsycINFO* and *Biosis* did not contribute any additional articles. One study each was identified in the *ECO* database, *Digital Dissertations*, and search of conference abstracts, and 3 studies were identified through manual search of bibliographies, for a total of 19 trials meeting all inclusion criteria for the meta-analysis. Of these, 12 trials were conducted with 1,410 participants in addictions treatment and 7 studies with 638 participants in recovery (see Table 1).

Data Extraction

Two reviewers independently conducted article data extraction for each study meeting the inclusion criteria. One of the reviewers was blinded to authorship, institution, article title, journal, year of publica-

tion, and references. Data extraction included sample recruitment and descriptive characteristics; intervention setting, strategies, and duration; study design; outcome measures; sample attrition; and abstinence rates for smoking and substance use. Abstinence rates at posttreatment and longest follow up (i.e., 6 to 12 months) were abstracted and the most conservative estimates were used (i.e., biochemically verified, intention-to-treat). Point prevalence abstinence, reported in nearly all studies ($n = 15$), was used as the smoking outcome in the meta-analysis. In studies with participants in addictions treatment, many individuals were not planning to quit smoking (i.e., precontemplation stage) and intention to quit was not required for participation, making continuous abstinence less appropriate (Hughes, Keely, et al., 2003). For drug and alcohol outcomes, any use was counted as a relapse to be conservative and provide consistency across studies. Lead authors were contacted to provide additional relevant information when necessary.

The quality of the studies was assessed using a three-item method developed by Jadad et al. (1996), with demonstrated interrater reliability and validity, that evaluates adequacy of randomization (2 points), concealment of randomization (2 points), and completeness of follow up (1 point). Two additional items were added, relevant to the area of interest: use of biochemical verification of smoking and substance use abstinence (1 point each) and use of a balanced contact comparison condition (1 point), for a maximum of 8 points. To date, no quality scoring system has proven to correlate consistently with treatment outcome, and it is recognized that general quality scales often need to be supplemented with more problem-specific items for each particular meta-analysis (Lau, Ioannidis, & Schmid, 1997). Discrepant findings between reviewers were settled through discussion, further review of the article, and, when necessary, consultation with a third reviewer.

Statistical Analysis

Abstinence rate ratios from each study were used as measures of effect for smoking and substance use outcomes. The total numbers of events (i.e., abstinence) in both the treatment and control groups were recorded in 2×2 tables using Comprehensive Meta-Analysis (Borenstein & Rothstein, 1999). To reduce bias and improve precision properties, 0.5 was added to every cell in any table containing a zero (Walter & Cook, 1991). Abstinence rates were expressed as relative risks (RRs) with 95% confidence intervals (CIs) for each study (Fleiss, 1993). An RR greater than 1.00 indicated favoring of the intervention for increased abstinence relative to the comparison condition. Treatment effects were calculated for smoking and substance use abstinence at posttreatment and at the farthest follow-up assessment reported (6 to 12 months). For studies with multiple intervention conditions, intervention groups were collapsed and compared with the control group. A random effects model that incorporated the variance between study findings in a weighted average of rate ratios was used to calculate the estimated overall RR and 95% CI (DerSimonian & Laird, 1986). In calculation of the summary effect, we worked with the natural logarithm of the RR. We tested for heterogeneity of pooled results and took $p < .10$ to be significant (Oxman, Cook, & Guyatt, 1994). For studies with participants in addictions treatment, subgroup analyses examined intervention effects by study quality (three or greater), year of publication (2000 or later), and provision of nicotine replacement therapy (NRT). The limited number of trials with participants in recovery prevented subgroup analysis of study effects.

Results

Posttreatment Smoking Outcomes

Figure 1 summarizes posttreatment abstinence rates by treatment condition and summary estimates for studies conducted with participants in addictions treatment ($n = 11$) and recovery ($n = 7$).

Table 1
Included Studies ($N = 19$)

Source(s)	Recruitment	Participants	Conditions	Outcomes	Quality
Studies with participants in addictions treatment ($n = 12$)					
Bobo et al. (1995); Bobo et al. (1996)	Recruited from 4 residential 28-day treatment centers in Nebraska after 3 weeks of treatment; RR = 93%	$N = 90$ (74% men); Age $M = 35$ years; 90% Caucasian; CPD ≥ 1 ($M = 22$); 57% no intention to quit; 76% depression	I: One 15-min stage- tailored individual counseling session delivered by clinical staff prior to discharge; 100% completed; C: Usual care	Smoking: 7-day PPA, Continine (not used); Substance use: collaterals (not contacted); Attrition at 6 months: 10%	0
Bobo et al. (1998)	Recruited from 12 treatment centers in Iowa, Kansas, and Nebraska after 3 weeks of treatment; RR = 74%	$N = 575$ (67% men); Age $M = 33$ years; 67% Caucasian; CPD ≥ 1 ($M = 20$); 63% no intention to quit	I: Four 10–15 min stage- tailored sessions over 4-months delivered onsite by clinical staff and over the phone by research staff; 31% completed all sessions; C: Usual care	Smoking: 7 day PPA, continine; Substance use: collaterals; Attrition at 12 mo: 21%	1
Burling et al. (1991)	Recruited from 4-month VA residential treatment program in California after 30 days in treatment; RR: NR	$N = 39$ (100% men); Age $M = 32$; 64% Caucasian; CPD ≥ 1 ($M = 19$)	I: Daily 15-min individual skill-based counseling over 3–4 weeks, generalized to alcohol and drugs; 74% completed treatment; C: Waitlist control; 0% sought the treatment after the study ended	Smoking: 30-day PPA, CO; Substance use: 30-day PPA: UTOX, & breathalyzer (not used); Attrition at 6 months: 0%	1
Burling et al. (2001)	Recruited from 6-month VA residential treatment program in California after 30 days in treatment; RR = 95%	$N = 150$ (95% men); Age $M = 40$; 44% Caucasian; 45% African American; CPD ≥ 7 ($M = 18$)	I: Thirty-six 30–45 min individual CBT sessions over 9 weeks with NRT with or without generalization to quitting drugs and alcohol; 45% completed all sessions; C: Usual care	Smoking: 7-day PPA, continuous abstinence, CO continine; Substance use: 30-day PPA, continued abstinence, UTOX, breathalyzer; Attrition at 12 months 8%	3
Campbell et al. (1995)	Recruited from private nonprofit residential and outpatient clinics in Oregon; RR = 26%	$N = 112$ (38% men); Age $M = 35$; 86% Caucasian; CPD ≥ 1 ($M = 23$)	I: Nineteen 90-min CBT groups (17% completed all), individual contacts, and booster calls over 16 weeks, NRT, generalized to drugs and alcohol; C: Delayed treatment; 48% never received treatment	Smoking: PPA, CO; Substance use: self-report; Attrition at 16 weeks: 26%	2
Cornelius et al. (1997); Cornelius et al. (1999)	Recruited from dual diagnosis inpatient psychiatric unit in Pennsylvania after 1-week washout; RR = NR	$N = 42$ (48% men); Age $M = 35$; 50% Caucasian; 50% African American; CPD ≥ 1 ($M = 20$)	I: Fluoxetine (20–40 mg); C: Placebo; % completion: NR	Smoking: 7-day PPA; Substance: UTOX, blood alcohol content; Attrition at 3 months: 0%	5
Gariti et al. (2002)	Recruited from VA inpatient treatment program in Pennsylvania within 48 hr of admission; RR = 49%	$N = 64$ (100% men); Age $M = 44$; 60% African American; CPD ≥ 10 ($M = 24$)	I: One MET session, video class encouraged, cessation clinic referral averaged five sessions (range = 2–8); C: Usual care; Both access to NRT	Smoking: 7-day PPA, CO, cotinine; Substance use: 30-day PPA, UTOX, breathalyzer; Attrition at 6 months: 14%	3
Grant et al. (2003)	Recruited from VA outpatient treatment program in Nebroska; RR = 32%	$N = 42$ (92% men); Age $M = 45$; 65% Caucasian; 33% African American; CPD ≥ 10	I: Five educational groups (30 min); followed by 1-hr process groups; 29% completed all sessions; C: Usual care; Both access to NRT	Smoking: 7-day PPA, collaterals (6 months only); Substance use: self-report, collaterals (6 months only); Attrition at 12 months: 38%	1

Table 1 (continued)

Source(s)	Recruitment	Participants	Conditions	Outcomes	Quality
Studies with participants in addictions treatment (<i>n</i> = 12) (continued)					
Haug et al. (2002)	Recruited from 7-day residential perinatal treatment program in Maryland within 48 hr of admission, ≤ 26 week gestational age; RR = 82%	<i>N</i> = 63 (100% women); Age <i>M</i> = 30; 84% African American; CPD ≥ 5 (<i>M</i> = 20); 56% no intention to quit; 32% MDD in past month; Methadone maintained	I: Four 60-min MET sessions over 6 weeks, 77% completed all sessions; C: Usual care	Smoking: 24-hr PPA, CO, cotinine; Substance use: UTOX; Attrition at 10 weeks: 14%	4
Kalman et al. (2001)	Recruited from 21-day inpatient VA treatment program in Rhode Island the 1st week of admission; RR = 21%	<i>N</i> = 36 (100% men); Age and ethnicity: NR CPD ≥ 10 (<i>M</i> = 33); All ready to quit smoking	I: Three 45-min individual behavioral sessions, NRT, generalized to drugs and alcohol, 67% completed all sessions C: Delayed treatment; 23% never received treatment	Smoking: 7-day PPA, CO Substance use: self-report; Attrition at 1 month: 20%	4
Shoptaw et al. (2002)	Recruited from three methadone clinics in California, reported desire to quit smoking; RR = 68%	<i>N</i> = 175 (61% men); Age <i>M</i> = 44; 39% Caucasian; 38% Hispanic; 22% African American; CPD ≥ 10 (<i>M</i> = 22)	12-week-long treatments: I: Relapse prevention and contingency management alone or in combination, NRT; C: NRT only; 12% completed all sessions	Smoking: 7-day PPA, CO, cotinine; Substance use: UTOX; Attrition at 12 months 19%	5
Story & Stark (1991)	Recruited from a methadone clinic in Oregon after 8 weeks in treatment; RR = 67%	<i>N</i> = 22 (29% men); Age <i>M</i> = 36; 100% Caucasian; CPD ≥ 20 (<i>M</i> = 35)	I: 8-hr CBT group over 3 weeks with 20% increase in methadone dose; C: CBT group only; 77% completed interventions	Smoking: PPA, collaterals; Substance use: NR; Attrition at 10 months: 18%	5
Studies with participants in recovery (<i>n</i> = 7)					
Hayford et al. (1999); Hurt et al. (1997)	Secondary analysis of a larger trial, recruited from ads and press releases in California, Minnesota and West Virginia; RR = NR	<i>N</i> = 60 (55% men); Age <i>M</i> = 43; 96% Caucasian; CPD ≥ 15 (<i>M</i> = 29); Alcohol recovery > 1 year (<i>M</i> = 8 yrs); 32% MDD+ history; All ready to quit smoking	I: Bupropion: 300mg, 150mg, 100mg; C: Placebo; Both: physician advice followed by 11 brief (10–15 min) counseling visits with research staff over 52 weeks; 64% completion rate (for parent trial)	Smoking: 7-day PPA, CO; Substance use: NR; Attrition at 12 months: NR	5
Hughes (1993); Hughes et al. (1989)	Secondary analysis of a larger trial, recruited by physician referral and word of mouth from 2 family medicine clinics in Minnesota; RR = NR	<i>N</i> = 38 (55% men); Age <i>M</i> = 34; CPD ≥ 1 (<i>M</i> = 32); Single item report of past problems with alcohol; All ready to quit smoking	I: NRT gum; C: Placebo; Both: 10-min individual physician and nurse counseling visits; % completion: NR	Smoking: continuous abstinence, CO, cotinine, thiocyanate, collaterals; Substance use: NR; Attrition at 12 months: NR	6
Hughes & Callas (2003); Hughes et al. (1999)	Secondary analysis of a larger trial, recruited from ads and outpatient medical facilities at 12 U.S. sites and one in Australia; RR = NR	<i>N</i> = 160 (66% men); Age <i>M</i> = 42; 94% Caucasian; CPD ≥ 30 (<i>M</i> = 38); Alcohol recovery > 1 year; All ready to quit smoking	I: NRT patch; C: Placebo; Both: stop smoking booklet and precessation visit, six weekly 30–60 min behavioral groups followed by five biweekly <10-min individual behavioral sessions; % completion: NR	Smoking: prolonged abstinence, CO; Substance use: NR; Attrition at 6 months: 32%	4

(table continues)

Table 1 (continued)

Source(s)	Recruitment	Participants	Conditions	Outcomes	Quality
Studies with participants in recovery ($n = 7$) (continued)					
Hughes, Novy, et al. (2003); Novy et al. (1999)	Recruited with ads and flyers at treatment centers and Alcoholics Anonymous meetings in Vermont and Minnesota; RR = NR	$N = 115$ (68% men); Age $M = 43$; 93% Caucasian; CPD ≥ 20 ($M = 30$); Alcohol recovery ≥ 1 month ($Mdn = 5$ years); All ready to quit smoking	I: NRT patch; C: Placebo; Both six weekly 1-hr behavioral groups followed by three biweekly ≤ 15 -min individual behavioral sessions; 77% use of NRT	Smoking: prolonged abstinence, CO; Substance use: self-report, breathalyzer; Attrition at 6 mo: 73%	5
Hurt et al. (1994); Hurt et al. (1995)	Secondary analysis of three trials in primary care clinics in Arizona, Florida, and Minnesota; RR: NR	$N = 43$ (63% men); Age $M = 46$; 99% Caucasian; CPD ≥ 20 ($M = 34$); Alcohol recovery ≥ 1 year; All ready to quit smoking	I: NRT patch; C: Placebo; Both: physician advice (2 visits) and nurse follow-up (8 visits) over 8 weeks; Findings reported for 31 (72%) who received consistent treatment	Smoking: 7-day PPA, CO; Substance use: NR; Attrition at 12 months: NR	6
Martin et al. (1997)	Recruited from Alcoholics Anonymous meetings to attend an outpatient smoking cessation clinic in California; RR = 93% of eligible participants	$N = 205$ (55% men); Age $M = 42$; 93% Caucasian; CPD ≥ 10 ($M = 27$); Alcohol recovery ≥ 3 months ($M = 4$ years); 33% MDD+ history; All ready to quit smoking	Eight 60–75 min groups over 12 weeks: I: Behavioral counseling plus exercise or NRT, generalized to recovery issues; C: Standard treatment plus Nicotine Anonymous; 37% attended all sessions	Smoking: 24-hr PPA, 7-day PPA at posttreatment, CO, collaterals; Substance use: collaterals; Attrition at 12 months: 24%	3
Patten et al. (1998)	Recruited from Alcoholics Anonymous meetings to attend an outpatient smoking cessation clinic in California; RR = 62%	$N = 29$ (48% men); Age $M = 42$; 97% Caucasian; CPD ≥ 10 ($M = 30$); Alcohol recovery ≥ 3 months ($M = 7$ years); 100% MDD+ history; All ready to quit smoking	12 weekly 2-hr groups: I: Behavioral counseling plus CBT mood management, generalized to recovery issues; C: Behavioral counseling alone; 38% attended all 12 groups	Smoking: 24-hr PPA, CO, collaterals; Substance use: 90-day PPA, collaterals; Attrition at 12 months: 14%	3

Note. RR = recruitment rate; CPD = cigarettes per day; I = intervention; C = comparison condition; PPA = point prevalence abstinence; NR = not reported; CO = carbon monoxide; UTOX = urine toxicology drug test; CBT = cognitive-behavioral therapy; NRT = nicotine replacement therapy; VA = veteran's administration; MET = motivational enhancement therapy; MDD+ = major depressive disorder.

The findings for 14 of the 18 trials demonstrated a trend toward greater abstinence at posttreatment among intervention participants. Collapsing across studies, the posttreatment abstinence rates for participants in addictions treatment were 12% (89/758) in the intervention group and 3% (17/588) in the comparison condition. The summary RR was 2.03 (95% CI, 1.21–3.39; for test of heterogeneity, $p = .519$), indicating a significant two-fold increase in the likelihood of smoking abstinence among intervention versus control participants. Subgroup analyses indicated significant intervention effects among studies that were more recently published and provided NRT (see Table 2). For participants in recovery, summary abstinence rates were 38% (147/392) in the intervention group and 22% (55/246) in the comparison condition. The summary RR was 1.77 (95% CI, 1.37–2.30; for test of heterogeneity, $p = .878$), indicating a significant 77% increase in the likelihood of smoking abstinence among intervention versus control participants. An analysis of variance comparing intervention ef-

fects for studies with participants in treatment versus recovery indicated no significant difference in treatment effects ($Q = .20$, $df = 1$, $p = .651$). Combining studies with participants in addictions treatment and recovery, the summary RR was 1.82 (95% CI, 1.45–2.29).

Smoking Outcomes at Long-Term Follow Up

At long-term follow up, 8 of 15 studies demonstrated a trend towards greater abstinence among intervention participants (see Figure 2). For participants in addictions treatment, abstinence rates were 7% in the intervention group and 6% in the comparison condition with a summary RR of 1.00 (95% CI, 0.64–1.57; for test of heterogeneity, $p = .577$). For participants in recovery, abstinence rates were 20% in the intervention group and 15% in the comparison condition, with a summary RR of 1.31 (95% CI, 0.92–1.86; for test of heterogeneity, $p = .535$). The

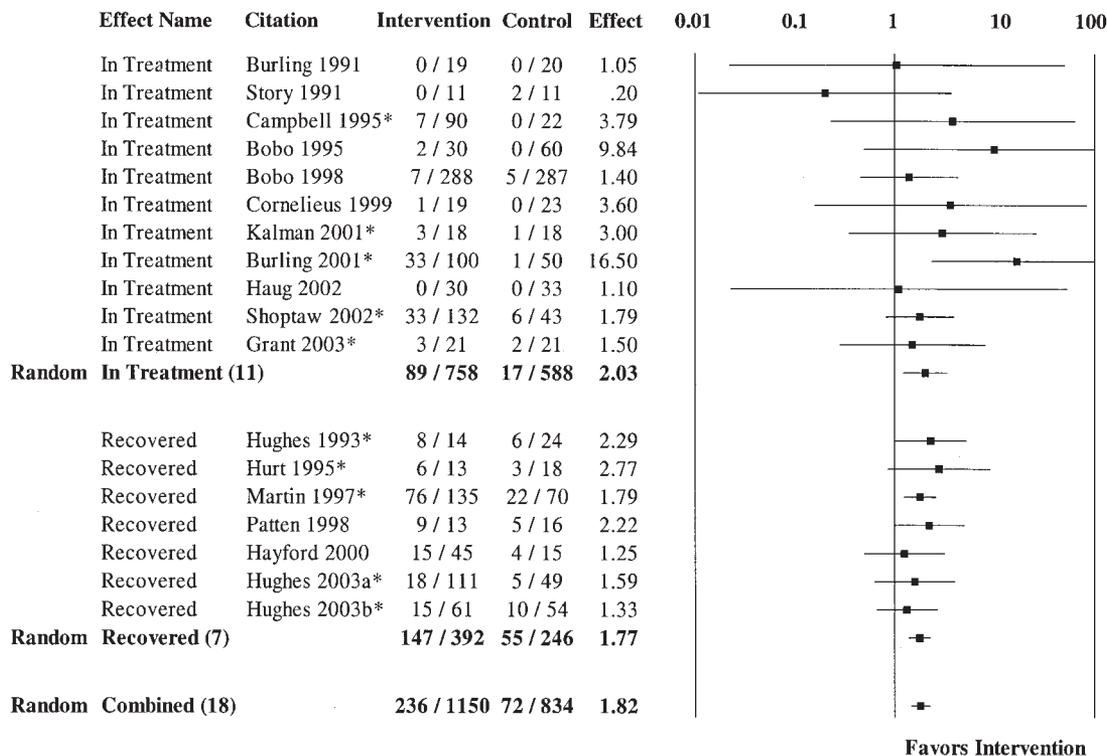


Figure 1. Posttreatment smoking abstinence rates for intervention and control conditions and abstinence relative risk estimates. Abstinence rates are equal to the number of smoking abstinent participants divided by the total number of participants assigned to the treatment group. Asterisks indicate nicotine replacement therapy provided to intervention and/or control participants. The 95% confidence interval to the right of 1.00 indicates a significant treatment effect. The following references were abbreviated because of space constraints: Hughes 2003a = Hughes, J. R., & Callas, P. W. (2003); Hughes 2003b = Hughes, J. R., Novy, P., Hatsukami, D. K., Jensen, J., & Callas, P. W. (2003).

summary 95% CIs for participants in addictions treatment and recovery crossed 1.00, indicating no significant difference in long-term smoking outcomes by condition. Combining studies with participants in addictions treatment and recovery, the

summary RR was 1.18 (95% CI, 0.89–1.56), with no significant difference in intervention effects between study groups ($Q = .83, df = 1, p = .362$).

Table 2
Subgroup Analysis of Relative Risks (95% CI) for Participants in Addictions Treatment

Source	No. of studies	Summary RR (95% CI)
All studies, participants in current treatment	11	2.03 (1.21–3.39) ^a
Quality score		
0–2	5	1.78 (0.77–4.11)
3–5	6	2.19 (0.85–6.86)
Year of publication		
1991–1999	6	1.62 (0.67–3.90)
2000–2002	4	2.49 (1.12–5.53) ^a
Provision of nicotine replacement therapy		
No	6	1.45 (0.59–3.57)
Yes	5	2.63 (1.21–5.70) ^a

Note. RR = relative risk; CI = confidence interval.
^a 95% confidence interval does not contain 1.00, indicating a significant treatment effect.

Substance Use Outcomes (treatment trials only, not recovery trials)

Studies with participants in addictions treatment reported use of alcohol and illicit drugs at posttreatment and long-term follow up. Abstinence rates and summary estimates are presented in Figure 3. At posttreatment assessment, substance use abstinence rates were 52% in the intervention group and 54% in the comparison condition with a nonsignificant summary RR of 1.10 (95% CI, 0.93–1.29; for test of heterogeneity, $p = .264$). At long-term follow up, abstinence rates were 37% in the intervention group and 31% in the comparison condition. The summary RR was 1.25 (95% CI, 1.07–1.46; for test of heterogeneity, $p = .496$), indicating a significant increase of 25% in the likelihood of abstinence from drugs and alcohol among participants receiving a smoking cessation intervention relative to participants in the control condition.

Substance use outcomes were reported in only three studies conducted with participants in recovery. Martin et al. (1997) reported relapse of 1% and 4% at posttreatment and 12 months,

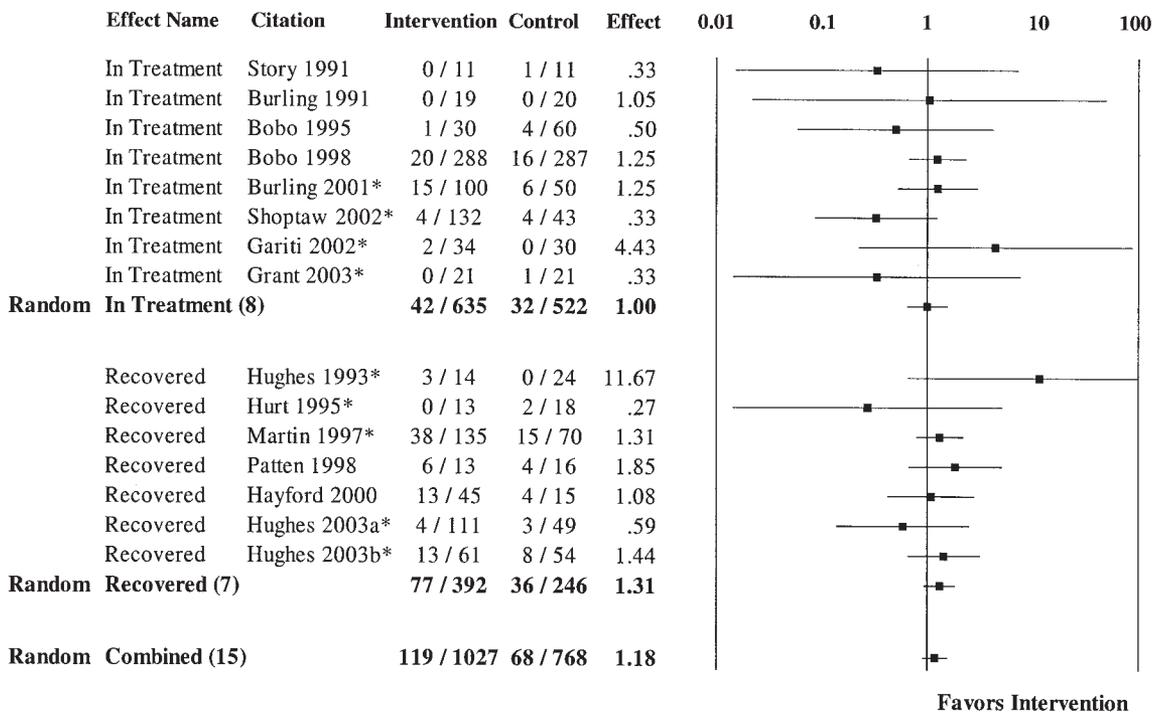


Figure 2. Follow-up smoking abstinence rates for intervention and control conditions and abstinence relative risk estimates. Abstinence rates are equal to the number of smoking abstinent participants divided by the total number of participants assigned to the treatment group. Asterisks indicate nicotine replacement therapy provided to intervention and/or control participants. The 95% confidence interval to the right of 1.00 indicates a significant treatment effect. The following references were abbreviated because of space constraints: Hughes 2003a = Hughes, J. R., & Callas, P. W. (2003); Hughes 2003b = Hughes, J. R., Novy, P., Hatsukami, D. K., Jensen, J., & Callas, P. W. (2003).

respectively, across both conditions. Patten, Martin, Myers, Calfas, and Williams (1998) reported relapse of 0% and 17% at the same assessment time points. Both studies reported no differences in relapse rates by condition. Hughes, Novy, Hatsukami, Jensen, and Calles (2003) reported 0% relapse but lacked follow-up data on 73% of participants.

Analysis for Publication Bias

The potential for publication bias was evaluated as the correlation between study sample size and the treatment effects for smoking cessation at posttreatment and follow up. A significant positive correlation would indicate that large studies with positive results were more likely to be published. Studies with participants in addictions treatment and recovery were examined together. The correlations for sample size with smoking summary estimates at posttreatment ($r = .02$) and long-term follow up ($r = -.15$) were nonsignificant ($ps > .55$), indicating no apparent problem with publication bias.

Comparison of Studies With Participants in Addictions Treatment Versus Recovery

Weighted by study sample size, participants in recovery tended to be older (M age = 42 years vs. 36 years), non-Hispanic

Caucasian ($M = 94\%$ vs. 60%), female ($M = 54\%$ vs. 32%), and heavier smokers (M cigarettes per day = 31 vs. 21) compared with participants in addictions treatment (all $ps < .001$). Sample size across the 19 studies ranged from 22 to 575 ($Mdn = 63$) and did not differ by study population. Interventions were delivered in residential treatment (7 of 12 studies with participants in addictions treatment) or outpatient settings (7 of 7 trials with participants in recovery). Recruitment of participants in addictions treatment occurred within 48 hr to 60 days of treatment entry. For studies with participants in recovery, the average length of sobriety exceeded 1 year.

Psychosocial smoking cessation interventions were provided in all but 1 study and included brief advice/educational (4 studies), skill-based/behavioral (6 studies), cognitive-behavioral (4 studies), and motivational or stage-based (4 studies) interventions. Six studies indicated smoking cessation strategies were generalized to drug and alcohol recovery. Eleven studies provided NRT to the intervention and/or control group, 1 study evaluated different dosages of bupropion, and 1 study evaluated fluoxetine. The number of intervention contacts ranged from 1 to 36 ($M = 12$, $SD = 10$), lasting from 5 min to 2 hr ($M = 42$ min, $SD = 33$), over a period of 1 day to more than a year ($M = 13$ weeks, $SD = 16$ weeks). Total intervention contact time ranged from 15 min to 24 hr ($M = 8.3$ hr, $SD = 8.7$) and did not differ significantly ($p = .705$) for studies conducted with participants in treatment ($M = 7.6$

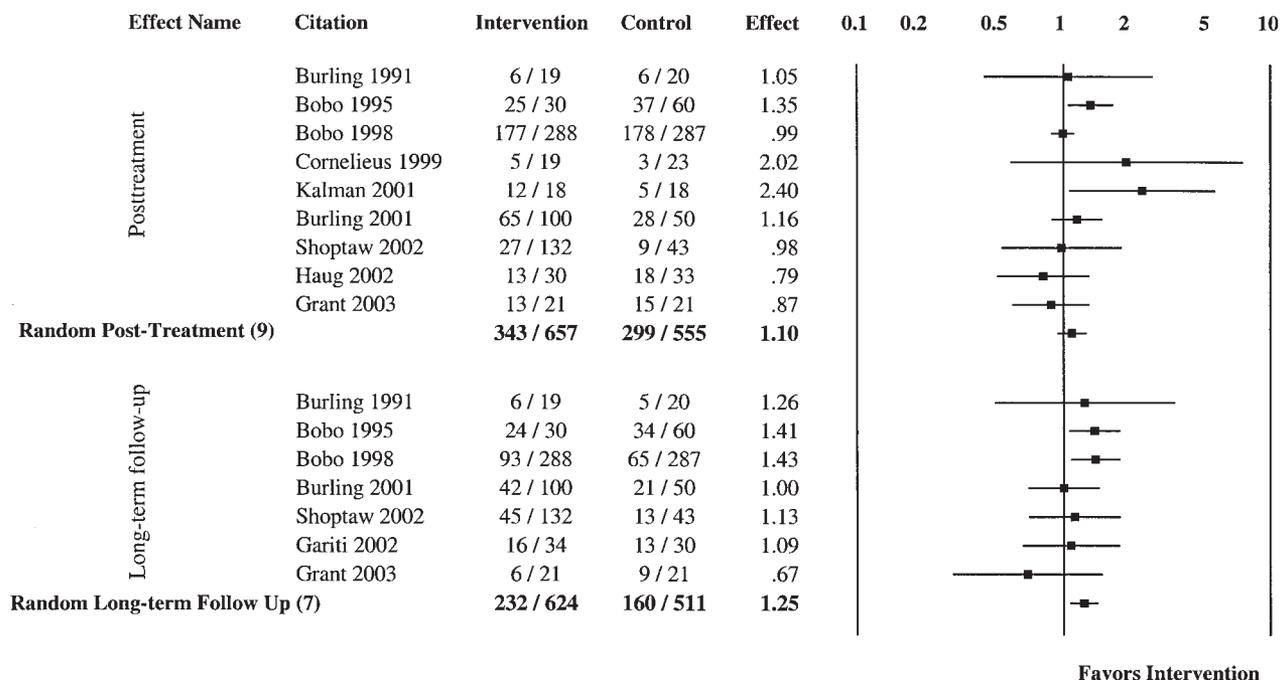


Figure 3. Substance use abstinence rates and relative risk estimates for participants in addictions treatment. Abstinence rates are equal to the number of participants abstinent from drugs and alcohol divided by the total number of participants assigned to the treatment group. The 95% confidence interval to the right of 1.00 indicates a significant treatment effect.

hr, *SD* = 8.3 hr) versus recovery (*M* = 9.3 hr, *SD* = 9.9 hr). Total intervention contact time, however, differed significantly by intervention theoretical framework (*p* = .003): cognitive-behavioral (*M* = 20 hr), skill-based/behavioral (*M* = 9 hr), brief advice/educational (*M* = 3 hr), and stage-based/motivational (*M* = 1.5 hr). The more extended the intervention was, the lower was the percentage of participants completing it in entirety (*r* = -.53, *p* = .043).

The control group received some form of immediate smoking cessation intervention in 4 of 12 studies with participants in addictions treatment and in all studies with participants in recovery. Four studies conducted with participants in addictions treatment used a waitlist or delayed treatment design and reported that 23% to 100% of the deferred group never received the intervention.

Quality Ratings

All of the trials were selected to have a randomized controlled design. Only 3 studies described the randomization procedure. Six trials were double blind and placebo controlled. Blinding of allocation was not possible in tests of nonpharmacological interventions. Studies conducted with participants in treatment were less likely to control for contact time using a balanced design (3 of 12) versus studies with participants in recovery (7 of 7). Study attrition at longest term follow up ranged from 0% to 73% (*M* = 21%). Only 3 studies detailed the reasons that participants were lost to follow up. Biochemical verification of smoking was used in 8 of 12 studies with participants in treatment and in all studies with

participants in recovery. Biochemical verification of drug and alcohol use was obtained in 6 of 12 studies with participants in treatment and in only 1 trial with participants in recovery. Summary quality ratings are presented by study in Table 1. Quality scores were significantly greater (*p* = .039) for studies with participants in recovery (*M* = 4.6, *SD* = 1.3) versus addictions treatment (*M* = 2.8, *SD* = 1.8).

Discussion

Posttreatment Smoking Cessation Outcomes

This meta-analytic review revealed short-term success with treating tobacco dependence among individuals in addictions treatment and recovery. When study findings were combined, the summary estimates indicated a significant increase in smoking abstinence among intervention participants relative to participants in the control conditions. For participants in addictions treatment, subgroup analyses revealed stronger effects among studies that provided NRT and were more recently published. NRT may be particularly important for smokers with substance abuse problems, a group characterized by higher levels of nicotine dependence. In all of the studies reviewed, NRT was provided in conjunction with psychosocial intervention. Thus, multimodal strategies may be needed. The greater treatment effect observed among more recently published studies may relate to increasing support for treating tobacco dependence in chemical dependency settings.

The current review included studies that reported short-term (<6 months) outcomes, which contrasts with previous meta-

analyses of smoking cessation interventions in the general population (i.e., Cochrane Reviews). For complex populations of smokers, we suggest such strict criteria not be applied as important effects may be missed. When analyses were restricted to studies that reported both short- and long-term smoking outcomes, the findings were parallel.

Long-Term Smoking Cessation Outcomes

At long-term follow up, intervention effects were no longer significant. In clinical trials and population surveys, active or past substance abuse problems have predicted lower rates of success with quitting smoking compared with those with no history of problematic use (Breslau et al., 1996; Hays et al., 1999; Hughes, 1993). Other studies have reported no difference between those with and without past addictive disorders (Hughes & Callas, 2003; Humfleet, Muñoz, Sees, Reus, & Hall, 1999) or significant differences only in the presence of comorbid depression (Covey et al., 1993). The current findings indicate good success at stopping smoking but difficulty with maintaining long-term cessation. A few of the identified trials described tailoring intervention strategies to the characteristics of smokers with substance use problems (e.g., Burling, Burling, & Latini, 2001; Martin et al., 1997), and more specialized treatments may be needed for this high-risk group. Identification of mediators and moderators of treatment outcome may be useful for developing and tailoring future cessation interventions. Two of the trials had follow-up studies that identified participant factors predictive of quit attempts (Bobo, Lando, Walker, & McIlvain, 1996) and successful long-term cessation (Frosch, Nahom, & Shoptaw, 2002), which included lower baseline levels of nicotine dependence and substance use, greater readiness to quit, and better NRT compliance.

Differences Among Smokers in Addictions Treatment Versus Recovery

Intervention efficacy was found to be comparable for the two groups. That is, the relative difference between intervention and control conditions was similar for participants in addictions treatment and recovery. Cessation rates, however, were consistently higher among participants in recovery versus current addictions treatment, with a three-fold difference in overall cessation rates at posttreatment and long-term follow up.

There are many potential explanations for these differences. Individuals in recovery may be considered a subgroup of those in treatment—the subgroup that demonstrated success with abstinence—which may provide increased confidence with smoking cessation efforts. Quitting smoking while quitting other drugs of abuse may be too much to tackle at once. Although over 70% of smokers in addiction treatment programs report interest in quitting smoking, only 20% to 30% intend to quit both substances concurrently (Ellingstad et al., 1999; Sees & Clark, 1993). Furthermore, sample selectivity may account for the differences observed. Studies in addiction treatment settings were more likely to include smokers not ready to quit, which likely contributed to reduced short-term cessation rates, whereas all studies with participants in recovery actively recruited participants who were motivated for cessation. Notably, the trial with participants in addictions treatment that had the greatest posttreatment intervention effect (Bur-

ling et al., 2001) reported that participants were highly interested in and optimistic about quitting (Irving et al., 1994). Future studies ought to report participation rates and readiness to quit smoking among recruited participants.

The samples also differed on a variety of demographic factors and on primary drug of abuse. Individuals in recovery were more likely to be older and Caucasian, factors associated with a greater probability of success with quitting, but they also were heavier smokers and more likely to be women, factors associated with lower rates of success. Studies with participants in recovery focused on individuals with a history of problematic alcohol use, whereas studies with participants in treatment included alcohol and illicit drug use. Future studies should recruit large enough samples to examine outcomes by primary drug of abuse, as well as poly-drug use.

Lastly, the impact of addictions treatments on smoking behavior needs to be considered. Among opioid abusers, Story and Stark (1991) found that rather than supporting smoking cessation, increased methadone levels were associated with greater craving of cigarettes, increased withdrawal, and increased smoking. Of note, this was the only trial to report a higher cessation rate in the comparison condition at posttreatment.

Substance Use Outcomes

Among individuals in addictions treatment, smoking cessation interventions were associated with a significant increase in long-term sobriety relative to the control condition. The current findings suggest smoking cessation interventions may help with long-term sobriety even if long-term smoking cessation is not achieved.

Potential mechanisms may relate to the extended intervention contact time, reduced cues to substance use, practice with relapse prevention skills, increased sense of mastery, positive overall change in lifestyle, or some other factor. Larger sample sizes would be required to examine potential mechanisms of effect. The findings are consistent with published observational studies (e.g., Kohn, Tsoh, & Weisner, 2003; Lemon, Friedmann, & Stein, 2003).

Though not supported by the current findings, patients' and treatment providers' concerns about sobriety may still serve as substantial barriers to smoking cessation efforts and must be addressed. In focus groups conducted with 78 patients recruited from methadone clinics, about a third reported being advised by friends, treatment staff, and Alcoholics Anonymous (AA)/Narcotics Anonymous (NA) sponsors to delay quitting smoking (Richter, McCool, Okuyemi, Mayo, & Ahluwalia, 2002). Furthermore, in the current review, summary estimates of relapse rates among participants in addictions treatment were substantial at posttreatment (>45%) and long-term follow up (>60%). Though conservatively defined as any use, these relapse rates suggest the need for strategies to maintain sobriety while treating tobacco dependence.

Study Limitations

A recognized limitation of meta-analytic reviews is the potential to miss unpublished trials that may be more likely to have negative findings. This does not appear, however, to be a problem in the current review. In fact, most studies were underpowered and reported null effects, and study sample size was not associated with summary estimates. Study heterogeneity was not a problem,

Table 3
Studies in Progress (*N* = 8)

Source	Recruitment	Participants	Conditions	Measures
Studies with participants in addictions treatment (<i>n</i> = 6)				
Abrams (personal communication, 2003); Hitsman et al. (2002)	Recruited from two outpatient treatment programs in Rhode Island; RR: 88% of study eligible	<i>N</i> = 253 (59% men); Age <i>M</i> = 40; 85% Caucasian; CPD <i>M</i> = 28; 22% psychiatric history; 91% intending to quit;	I: Motivational intervention; C: Brief intervention; Up to 3 month duration	NR
Cooney et al. (2002)	Recruited 1 week after admission to a day treatment program in Connecticut; RR: NR	<i>N</i> = 99; 100% intending to quit	I: Behavioral counseling plus NRT; C: Brief advice (10-min)	NR
Joseph et al. (2002)	Recruited from three treatment programs offering intensive rehab for 3–5 weeks followed by aftercare in Minnesota; RR: 26%	<i>N</i> = 499; 100% intending to quit	I: Individual 1-hr behavior therapy plus NRT, 1-year follow-up, 21% never received treatment; C: Delayed treatment, 35% never received treatment	Smoking: PPA, CO; Substance use: self-reported, collaterals, breathalyzer
Karam-Hage (personal communication, 2003)	Recruited from 4–6 week outpatient treatment programs in Michigan	<i>N</i> = 120	I: Bupropion 300 mg; C: Placebo	Smoking: PPA, continuous abstinence, CO, cotinine; Substance use: self-reported, breathalyzer
Stein et al. (2003)	Recruited from two methadone programs in Rhode Island	<i>N</i> = 408 (target); Primarily Caucasian; CPD ≥ 10	I: NRT, brief nurse advice and follow-up plus a tailored motivational intervention (45-min), behavioral skills counseling session, and continued telephone counseling; C: NRT, brief nurse advice and follow-up	Smoking: 7-day PPA; Substance use: UTOX
Rohsenow et al. (2002)	Recruited from 30-day state funded residential program in Rhode Island during 1st week of admission; RR: 73%	<i>N</i> = 126 (67% men); Age <i>M</i> = 35; 86% Caucasian; CPD ≥ 10	I: Motivational intervention (50-min) with stage-specific goal setting; C: Brief advice (10-min); Crossed with two 15-min booster sessions; All provided access to smoking cessation groups and NRT	Smoking: continuous abstinence; CO; Substance use: self-reported
Studies with participants in recovery (<i>n</i> = 2)				
Hurt (2002)	Study conducted in Minnesota; RR: NR	<i>N</i> = 292 (target); Recovering alcoholics	Participants abstinent following 8 weeks of NRT randomized to: I: Bupropion for 44 weeks; C: Placebo for 44 weeks	Smoking: 76 week follow-up
Patten (2002)	Recruited through community media and flyers at Alcoholics Anonymous meetings in Minnesota; RR: 45% (preliminary)	<i>N</i> = 154 target (77 to date); Alcohol recovery > 3 months; 100% MDD+ history	Eight weekly group based sessions; I: Behavioral counseling plus CBT mood management; C: Behavioral counseling; Both: NRT patch	Smoking: PPA, CO; Substance use: self-reported

Note. RR = recruitment rate; CPD = cigarettes per day; I = intervention; C = comparison condition; NR = not reported; NRT = nicotine replacement therapy; PPA = point prevalence abstinence; CO = carbon monoxide; UTOX = urine toxicology drug test; MDD+ = major depressive disorder; CBT = cognitive-behavioral therapy.

supporting the method behind combining study findings. Identified methodological limitations of some of the reviewed studies included small sample sizes; lack of diversity among participants; lack of biochemical verification for smoking cessation, which is recommended with substance abusing populations (Benowitz et al., 2002); use of unbalanced, unblinded designs; and high rates of attrition. Overall, quality scores tended to be low. Additionally, the measures of smoking abstinence varied across studies (see Table 1) and investigators are encouraged to move toward a common standard.

Treatment Implications

The higher cessation rates among smokers in recovery versus current addictions treatment might lead one to conclude that interventions on smoking should be delayed until participants are clean and sober from other drugs of abuse. If treatments for tobacco dependence are delayed, however, a large number of smokers will be left unserved. **Studies with waitlist or delayed treatment control groups reported 23% to 100% of smokers never received treatment.** Perhaps more detrimental, **continued absence of smoking cessation from addictions treatment services will give the implicit message that quitting smoking is not a priority** for recovery or health. Additionally, the strikingly low overall quit rate (3%) among smokers recruited from addiction treatment settings and assigned to control conditions suggests that few participants will likely attempt cessation on their own.

Enrollment in addictions treatment presents a unique opportunity to address nicotine dependence. Initial efforts may focus on building motivation for change and supporting progress in the process of quitting. Four studies examined use of stage-based or motivationally tailored interventions with smokers in addictions treatment. Compared with other intervention frameworks, stage-based/motivational interventions were less time intensive, they were evaluated with participants who were less motivated, and cessation rates were lower. The stage-based trials, however, achieved the highest rates of long-term abstinence from drugs and alcohol among intervention participants (Bobo et al., 1996; Bobo, McIlvain, Lando, Walker, & Leed-Kelly, 1998). Stage-based strategies may provide a useful way for intervening with both behaviors concurrently, without requiring simultaneous action, which may be overwhelming. For smokers in addictions treatment, a stepped-treatment approach may be appropriate whereby stage-based strategies are applied to prepare smokers to become ready to quit followed by cognitive-behavioral and pharmacological treatments. More research is needed. For smokers who are ready to quit, the current findings support providing cessation treatments without threat to sobriety.

Future Studies

Substance abusing populations are heavy consumers of cigarettes in the United States (Lasser et al., 2000), yet an extensive literature search identified only 19 randomized controlled trials evaluating cessation interventions with this high-risk population. Furthermore, individuals with addictive disorders are among the most likely to be excluded from clinical trials. Clearly, this population has not been well served by the research community. Barriers to research include pessimism that substance abusing

populations would be interested in or able to quit smoking and concern in the treatment community that quitting smoking may compromise sobriety. This systematic review revealed initial success with smoking cessation at posttreatment as well as evidence that smoking cessation efforts may actually support long-term sobriety.

Prior reviews have emphasized the need for greater empirical study in this area (Hughes, 1996; Hurt & Patten, 2003; Sussman, 2002), and a number of important clinical questions remain. Research is needed to identify (a) the optimal timing and method for engaging substance abusers into smoking treatments, particularly if treatments are delayed; (b) effective treatment strategies for this population, including motivational, cognitive and behavioral, and pharmacological interventions; (c) methods for integrating smoking cessation interventions within treatments for substance abuse; (d) effective strategies for supporting cessation, while preventing relapse to other drugs of abuse; and (e) the feasibility of treatment staff delivery of smoking cessation interventions. As the literature grows, more refined subgroup analyses will be possible in future updates to this meta-analysis to address some of these questions. Additionally, more studies, with larger samples sizes, will help with precision of the estimates. Eight ongoing smoking cessation trials were identified and results are pending their completion (see Table 3). These studies will contribute information on another 1,500 participants in current treatment and 450 in recovery. Future updates to this meta-analysis will incorporate these and other trials as their final results become available.

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- References marked with an asterisk indicate studies included in the meta-analysis. *Study conducted with participants in addictions treatment. **Study conducted with participants in recovery. ***Study in process.
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