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### Authors

Prochaska, Judith J  
Delucchi, Kevin  
Hall, Sharon M

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

Judith J. Prochaska, Ph.D., M.P.H., Kevin Delucchi, Ph.D., Sharon M. Hall, Ph.D.

Department of Psychiatry, University of California, San Francisco

Correspondence concerning this article should be addressed to Judith Prochaska, PhD,  
University of California, San Francisco, 401 Parnassus Avenue – TRC 0984, San Francisco, CA  
94143-0984, phone: (415) 476-7695; fax: (415) 476-7719; email: [jodijpr@itsa.ucsf.edu](mailto:jodijpr@itsa.ucsf.edu).

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

*Abstract*

A systematic review was conducted to examine the effectiveness of smoking cessation interventions for individuals with substance abuse problems. An extensive literature search (1966 – 2003) identified 19 randomized controlled trials of smoking cessation interventions with individuals in current addictions treatment ( $n = 12$ ) or recovery ( $n = 7$ ). Smoking and substance use outcomes at post-treatment and long-term follow up (6- to 12-months) were abstracted by two independent reviewers and summarized with random-effects models. Intervention effects for smoking cessation were significant at post-treatment and comparable for participants in addictions treatment and recovery. Effects were no longer significant at 6- to 12-months follow up. For participants in addictions treatment, smoking cessation interventions were associated with a 25% increased likelihood of long-term abstinence from alcohol and illicit drugs. The findings suggest short-term success with smoking cessation and the need for innovative strategies for long-term cessation. Contrary to previous concerns, smoking cessation efforts delivered 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 to 23% in the general population (Centers for Disease Control and Prevention [CDC], 2002). Substance abusers tend to start smoking at a younger age, 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 [USDHHS], 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 et al. (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).

The past 10 years has seen growing interest in treating nicotine dependence among individuals with substance abuse problems (Bowman & Walsh, 2003; Hurt & Patten, 2003; Richter & Ahluwalia, 2000). While the magnitude of the problem of tobacco use in this patient population is clear, questions of when and how best to intervene remain. Further, 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 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 due to 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, PsychINFO, Biosis, the Cochrane Library, EMBASE, ECO (Electronic Collections Online), 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 CRISP 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 (4) 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. PsychINFO 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 three 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 1410 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 publication, 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 post-treatment 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 (two points), concealment of randomization (two points), and completeness of follow up (one point). Two additional items were added, relevant to the area of interest: use of biochemical verification of smoking and substance use abstinence (one point each) and use of a balanced contact comparison condition (one point), for a maximum of eight 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 x 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 (*CI*s) 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 post-treatment and the farthest follow up assessment reported (6- to 12-months). For studies with multiple intervention conditions, intervention groups were collapsed and compared to 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*

### *Post-Treatment Smoking Outcomes*

Figure 1 summarizes post-treatment abstinence rates by treatment condition and summary estimates for studies conducted with participants in addictions treatment ( $n = 11$ ) and recovery ( $n = 7$ ). The findings for 14 of the 18 trials demonstrated a trend towards greater abstinence at post-treatment among intervention participants. Collapsing across studies, the post-treatment 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 test comparing intervention effects 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*, .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*, .92 – 1.86; for test of heterogeneity,  $p = .535$ ). The summary 95% *CI*s 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*, .89, 1.56), with no significant difference in intervention effects between study groups ( $Q = .83$ ,  $df = 1$ ,  $p = .362$ ).

#### *Substance Use Outcomes*

Studies with participants in addictions treatment reported use of alcohol and illicit drugs

at post-treatment and long-term follow up. Abstinence rates and summary estimates are presented in Figure 3. At post-treatment 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*, .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 post-treatment and 12 months 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 post-treatment 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 post-treatment ( $r = .02$ ) and long term follow up ( $r = -.15$ ) were nonsignificant ( $p$ 's  $> .55$ ), 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 (age  $M = 42$  vs. 36), non-Hispanic Caucasian ( $M = 94\%$  vs. 60%), female ( $M = 54\%$  vs. 32%), and heavier smokers (cigarettes per day  $M = 31$  vs. 21) compared to participants in addictions treatment (all  $p$ 's < .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 one 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, one study evaluated different dosages of bupropion, and one 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,  $SD = 16$ ). 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 ( $M = 7.6$  hr,  $SD = 8.3$ ) versus recovery ( $M = 9.3$  hr,  $SD = 9.9$ ). 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); stage-based/motivational ( $M = 1.5$  hr). The more

extended the intervention, the lower 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 three studies described the randomization procedure. Six trials were double-blind, 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 three studies detailed the reasons subjects 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 one 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*

#### *Post-Treatment 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 to 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 (Humfleet, Muñoz, Sees, Reus, & Hall, 1999; Hughes & Callas, 2003) 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 post-treatment 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: while 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). Further, 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 post-treatment intervention effect (Burling et al., 2001) reported 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 female, 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 polydrug 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 post-treatment.

### *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 AA/NA sponsors to delay quitting smoking (Richter, McCool, Okuyemi, Mayo, & Ahluwalia, 2002). Further, in the current review, summary estimates of relapse rates among participants in addictions treatment were substantial at post-treatment (>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 under-powered and reported null effects, and study sample size was not associated with summary estimates. Study heterogeneity was not a problem, supporting the methodology 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 towards 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 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 to 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 U.S. (Lasser et al., 2000), yet an extensive literature search identified only 19 randomized controlled trials evaluating cessation interventions with this high-risk population. Further, 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 post-treatment, 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 methods 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 1500 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: (\*) denotes a study conducted with participants in addictions treatment; (\*\*) indicates a study conducted with participants in recovery; (\*\*\*) indicates a study in process.

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Table 1. Included studies (N = 19)

| Source(s)   | Recruitment  | Participants  | Conditions  | Outcomes   | Quality |
|---|--|---|---|--|---------|
| <i>Studies with participants in addictions treatment (n = 12)</i> |  |   |   |  |         |
| Bobo et al. (1995); (1996)  | Recruited from four residential 28-day treatment centers in NE after 3 wks of treatment<br>RR: 93% | N = 90 (74% male)<br>Age M = 35<br>90% Caucasian<br>CPD $\geq$ 1 (M = 22)<br>57% no intention to quit<br>76% depression | I: One 15-min stage-tailored individual counseling session delivered by clinical staff prior to discharge, 100% completed<br>C: Usual care  | <u>Smoking</u> : 7-day PPA, cotinine (not used)<br><u>Substance use</u> : collaterals (not contacted)<br><u>Attrition @</u> 6 mo: 10%                                | 0       |
| Bobo et al. (1998)  | Recruited from 12 treatment centers in IA, KS, and NE after 3 wks of treatment<br>RR: 74%          | N = 575 (67% male)<br>Age M = 33<br>67% Caucasian<br>CPD $\geq$ 1 (M = 20)<br>63% no intention to quit                  | I: Four 10-15 min stage-tailored sessions over 4-mo delivered onsite by clinical staff and over the phone by research staff, 31% completed all sessions<br>C: Usual care                          | <u>Smoking</u> : 7 day PPA, cotinine<br><u>Substance use</u> : collaterals<br><u>Attrition @</u> 12 mo: 21%  | 1       |
| Burling et al. (1991)   | Recruited from 4-mo VA residential treatment program in CA after 30 days in treatment,<br>RR: NR   | N = 39 (100% male)<br>Age M = 32<br>64% Caucasian<br>CPD $\geq$ 1 (M = 19)  | I: Daily 15-min individual skill-based counseling over 3-4 wks, generalized to alcohol and drugs, 74% completed treatment<br>C: Waitlist control, 0% sought the treatment after the study ended   | <u>Smoking</u> : 30-day PPA, CO<br><u>Substance use</u> : 30-day PPA, UTOX & breathalyzer (not used)<br><u>Attrition @</u> 6 mo: 0%                                  | 1       |
| Burling et al. (2001)   | Recruited from 6-mo VA residential treatment program in CA after 30 days in treatment<br>RR: 95%   | N = 150 (95% male)<br>Age M = 40<br>44% Caucasian,<br>45% African American<br>CPD $\geq$ 7 (M = 18)                     | I: Thirty-six 30-45 min individual CBT sessions over 9 wks with NRT with or without generalization to quitting drugs and alcohol, 45% completed all sessions<br>C: Usual care                     | <u>Smoking</u> : 7-day PPA, cont. abstinence, CO cotinine<br><u>Substance use</u> : 30-day PPA, cont. abstinence, UTOX, breathalyzer<br><u>Attrition @</u> 12 mo: 8% | 3       |
| Campbell et al. (1995)  | Recruited from private nonprofit residential and outpatient clinics in OR<br>RR: 26%               | N = 112 (38% male)<br>Age M = 35<br>86% Caucasian<br>CPD $\geq$ 1 (M = 23)  | I: Nineteen 90-min CBT groups (17% completed all), individual contacts and booster calls over 16 wks, NRT, generalized to drugs and alcohol<br>C: Delayed treatment, 48% never received treatment | <u>Smoking</u> : PPA, CO<br><u>Substance use</u> : self-report<br><u>Attrition at</u> 16 wks: 26%  | 2       |

| Source(s)                       | Recruitment  | Participants  | Conditions  | Outcomes  | Quality |
|---------------------------------|--|---|---|---|---------|
| Cornelius et al. (1997); (1999) | Recruited from dual diagnosis inpatient psychiatric unit in PA after 1 wk washout<br>RR: NR  | N = 42 (48% male)<br>Age M = 35<br>50% Caucasian<br>50% African American<br>CPD $\geq$ 1 (M = 20)   | I: Fluoxetine (20-40 mg)<br>C: Placebo<br>% completion: NR  | <u>Smoking</u> : 7-day PPA<br><u>Substance use</u> : UTOX, blood alcohol content<br><u>Attrition</u> @ 3 mo: 0%                                     | 5       |
| Gariti et al. (2002)            | Recruited from VA inpatient treatment program in PA within 48 hrs of admission<br>RR: 49%  | N = 64 (100% male)<br>Age M = 44<br>60% African American<br>CPD $\geq$ 10 (M = 24)  | I: One MET session, video class encouraged, cessation clinic referral averaged five sessions (Range: 2-8)<br>C: Usual care<br>Both access to NRT                        | <u>Smoking</u> : 7-day PPA, CO, cotinine<br><u>Substance use</u> : 30-day PPA, UTOX, breathalyzer<br><u>Attrition</u> @ 6 mo: 14%                   | 3       |
| Grant et al. (2003)             | Recruited from VA outpatient treatment program in NE<br>RR: 32%  | N = 42 (92% male)<br>Age M = 45<br>65% Caucasian<br>33% African American<br>CPD $\geq$ 10   | I: Five educational groups (30 min) followed by 1-hr process groups; 29% completed all sessions<br>C: Usual care<br>Both access to NRT                                  | <u>Smoking</u> : 7-day PPA, collaterals (6 mo only)<br><u>Substance use</u> : self-report, collaterals (6 mo only)<br><u>Attrition</u> @ 12 mo: 38% | 1       |
| Haug et al. (2002)              | Recruited from 7-day residential perinatal treatment program in MD within 48 hrs of admission, $\leq$ 26 wk gestational age<br>RR: 82% | N = 63 (100% women)<br>Age M = 30<br>84% African American<br>CPD $\geq$ 5 (M = 20)<br>56% no intention to quit<br>32% MDD in past month<br>Methadone maintained | I: Four 60-min MET sessions over 6 wks, 77% completed all sessions<br>C: Usual care   | <u>Smoking</u> : 24-hr PPA, CO, cotinine<br><u>Substance use</u> : UTOX<br><u>Attrition</u> @ 10 wks: 14%   | 4       |
| Kalman et al. (2001)            | Recruited from 21-day inpatient VA treatment program in RI the first wk of admission<br>RR: 21%  | N = 36 (100% male)<br>age and ethnicity: NR<br>CPD $\geq$ 10 (M = 33)<br>All ready to quit smoking  | I: Three 45-min individual behavioral sessions, NRT, generalized to drugs and alcohol, 67% completed all sessions<br>C: Delayed treatment, 23% never received treatment | <u>Smoking</u> : 7-day PPA, CO<br><u>Substance use</u> : self-report<br><u>Attrition</u> @ 1 mo: 20%  | 4       |
| Shoptaw et al. (2002)           | Recruited from three methadone clinics in CA, reported desire to quit  | N = 175 (61% male)<br>Age M = 44<br>39% Caucasian   | 12-wk long treatments:<br>I: Relapse prevention and contingency management alone or in combination, NRT   | <u>Smoking</u> : 7-day PPA, CO, cotinine<br><u>Substance use</u> : UTOX   | 5       |

| Source(s)  | Recruitment  | Participants   | Conditions   | Outcomes   | Quality |
|--|--|--|--|--|---------|
|  | smoking<br>RR: 68%   | 38% Hispanic<br>22% African American<br>CPD $\geq$ 10 (M = 22)   | C: NRT only<br>12% completed all sessions  | <u>Attrition @ 12 mo:</u> 19%  |         |
| Story et al. (1991)                                  | Recruited from a methadone clinic in OR after 8 wks in treatment<br>RR: 67%  | N = 22 (29% male)<br>Age M = 36<br>100% Caucasian<br>CPD $\geq$ 20 (M = 35)  | I: Eight hour CBT group over 3 wks with 20% increase in methadone dose<br>C: CBT group only<br>77% completed interventions   | <u>Smoking:</u> PPA, collaterals<br><u>Substance use:</u> NR<br><u>Attrition @ 10 mo:</u> 18%  | 5       |
| <i>Studies with participants in recovery (n = 7)</i> |  |  |  |  |         |
| Hayford et al. (1999); Hurt et al. (1997)            | Secondary analysis of a larger trial, recruited from ads and press releases in CA, MN, and WV<br>RR: NR                                    | N = 60 (55% male)<br>Age M = 43<br>96% Caucasian<br>CPD $\geq$ 15 (M = 29)<br>Alcohol recovery > 1 yr (M = 8 yrs)<br>32% MDD+ history<br>All ready to quit smoking | I: Bupropion: 300, 150, 100 mg<br>C: Placebo<br>Both: MD advice followed by 11 brief (10-15 min) counseling visits with research staff over 52 wks<br>64% completion rate (for parent trial)             | <u>Smoking:</u> 7-day PPA, CO<br><u>Substance use:</u> NR<br><u>Attrition @ 12 mo:</u> NR  | 5       |
| Hughes (1993); et al. (1989)                         | Secondary analysis of a larger trial, recruited by MD referral and word of mouth from two family medicine clinics in MN<br>RR: NR          | N = 38 (55% male)<br>Age M = 34<br>CPD $\geq$ 1 (M = 32)<br>Single item report of past problems with alcohol<br>All ready to quit smoking                          | I: NRT gum<br>C: Placebo<br>Both: 10-min individual MD and RN counseling visits<br>% completion: NR  | <u>Smoking:</u> cont. abstinence, CO, cotinine, thiocyanate, collaterals<br><u>Substance use:</u> NR<br><u>Attrition @ 12 mo:</u> NR | 6       |
| Hughes et al. (2003a); (1999)                        | Secondary analysis of a larger trial, recruited from ads and outpatient medical facilities at 12 U.S. sites and one in Australia<br>RR: NR | N = 160 (66% male)<br>Age M = 42<br>94% Caucasian<br>CPD $\geq$ 30 (M = 38)<br>Alcohol recovery > 1 yr<br>All ready to quit smoking                                | I: NRT patch<br>C: Placebo<br>Both: stop smoking booklet and precessation visit, 6 weekly 30-60 min behavioral groups followed by 5 biweekly < 10 min individual behavioral sessions<br>% completion: NR | <u>Smoking:</u> prolonged abstinence, CO<br><u>Substance use:</u> NR<br><u>Attrition @ 6 mo:</u> 32%                                 | 4       |

| Source(s)                                    | Recruitment  | Participants   | Conditions  | Outcomes   | Quality |
|--|--|--|---|--|---------|
| Hughes et al (2003b);<br>Novy et al., (1999) | Recruited with ads and flyers at treatment centers and AA meetings in VT and MN<br>RR: NR                | N = 115 (68% male)<br>Age M = 43<br>93% Caucasian<br>CPD $\geq$ 20 (M = 30)<br>Alcohol recovery $\geq$ 1 mo (median = 5 yrs)<br>All ready to quit smoking                | I: NRT patch<br>C: Placebo<br>Both: 6 weekly 1-hr behavioral groups followed by 3 biweekly $\leq$ 15 min individual behavioral sessions<br>77% use of NRT   | <u>Smoking</u> : prolonged abstinence, CO<br><u>Substance use</u> : self-report, breathalyzer<br><u>Attrition @ 6 mo</u> : 73%                   | 5       |
| Hurt et al. (1994);<br>(1995)                | Secondary analysis of three trials in primary care clinics in AZ, FL, MN<br>RR: NR                       | N = 43 (63% male)<br>Age M = 46<br>99% Caucasian<br>CPD $\geq$ 20 (M = 34)<br>Alcohol recovery $\geq$ 1 yr<br>All ready to quit smoking                                  | I: NRT patch<br>C: Placebo<br>Both: MD advice (2 visits) and RN follow-up (8 visits) over 8 wks<br>Findings reported for 31 (72%) who received consistent treatment                               | <u>Smoking</u> : 7-day PPA, CO<br><u>Substance use</u> : NR<br><u>Attrition @ 12 mo</u> : NR   | 6       |
| Martin et al. (1997)                         | Recruited from AA meetings to attend an outpatient smoking cessation clinic in CA<br>RR: 93% of eligible | N = 205 (55% male)<br>Age M = 42<br>93% Caucasian<br>CPD $\geq$ 10 (M = 27)<br>Alcohol recovery $\geq$ 3 mo (M = 4 yrs)<br>33% MDD+ history<br>All ready to quit smoking | Eight 60-75 min groups over 12 wks<br>I: Behavioral counseling plus exercise or NRT, generalized to recovery issues<br>C: Standard treatment plus Nicotine Anonymous<br>37% attended all sessions | <u>Smoking</u> : 24-hr PPA, 7-day PPA at post-treatment, CO, collaterals<br><u>Substance use</u> : collaterals<br><u>Attrition @ 12 mo</u> : 24% | 3       |
| Patten et al. (1998)                         | Recruited from AA meetings to attend an outpatient smoking cessation clinic in CA<br>RR: 62%             | N = 29 (48% male)<br>Age M = 42<br>97% Caucasian<br>CPD $\geq$ 10 (M = 30)<br>Alcohol recovery $\geq$ 3 mo (M = 7 yrs)<br>100% MDD+ history<br>All ready to quit smoking | 12 weekly 2-hr groups<br>I: Behavioral counseling plus CBT mood management, generalized to recovery issues<br>C: Behavioral counseling alone<br>38% attended all 12 groups                        | <u>Smoking</u> : 24-hr PPA, CO, collaterals<br><u>Substance use</u> : 90-day PPA, collaterals<br><u>Attrition @ 12 mo</u> : 14%                  | 3       |

*Note.* RR = recruitment rate; VA = veteran's administration; NR = not reported; CPD = cigarettes per day; I = intervention; C = comparison condition; MD = physician; RN = nurse; CBT = cognitive behavioral therapy; MET = motivational enhancement therapy; PPA = point prevalence abstinence; CO = carbon monoxide; MDD+ = major depressive disorder; AA = Alcoholics Anonymous

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)* |
| Quality score                                  |                |                     |
| 0 to 2   | 5              | 1.78 (.77 – 4.11)   |
| 3 to 5   | 6              | 2.19 (.85 – 6.86)   |
| Year of publication                            |                |                     |
| 1991 – 1999                                    | 6              | 1.62 (.67 – 3.90)   |
| 2000 – 2002                                    | 4              | 2.49 (1.12 – 5.53)* |
| Provision of nicotine replacement therapy      |                |                     |
| No   | 6              | 1.45 (.59 – 3.57)   |
| Yes  | 5              | 2.63 (1.21 – 5.70)* |

\* 95% Confidence interval does not contain 1.00, indicating a significant treatment effect

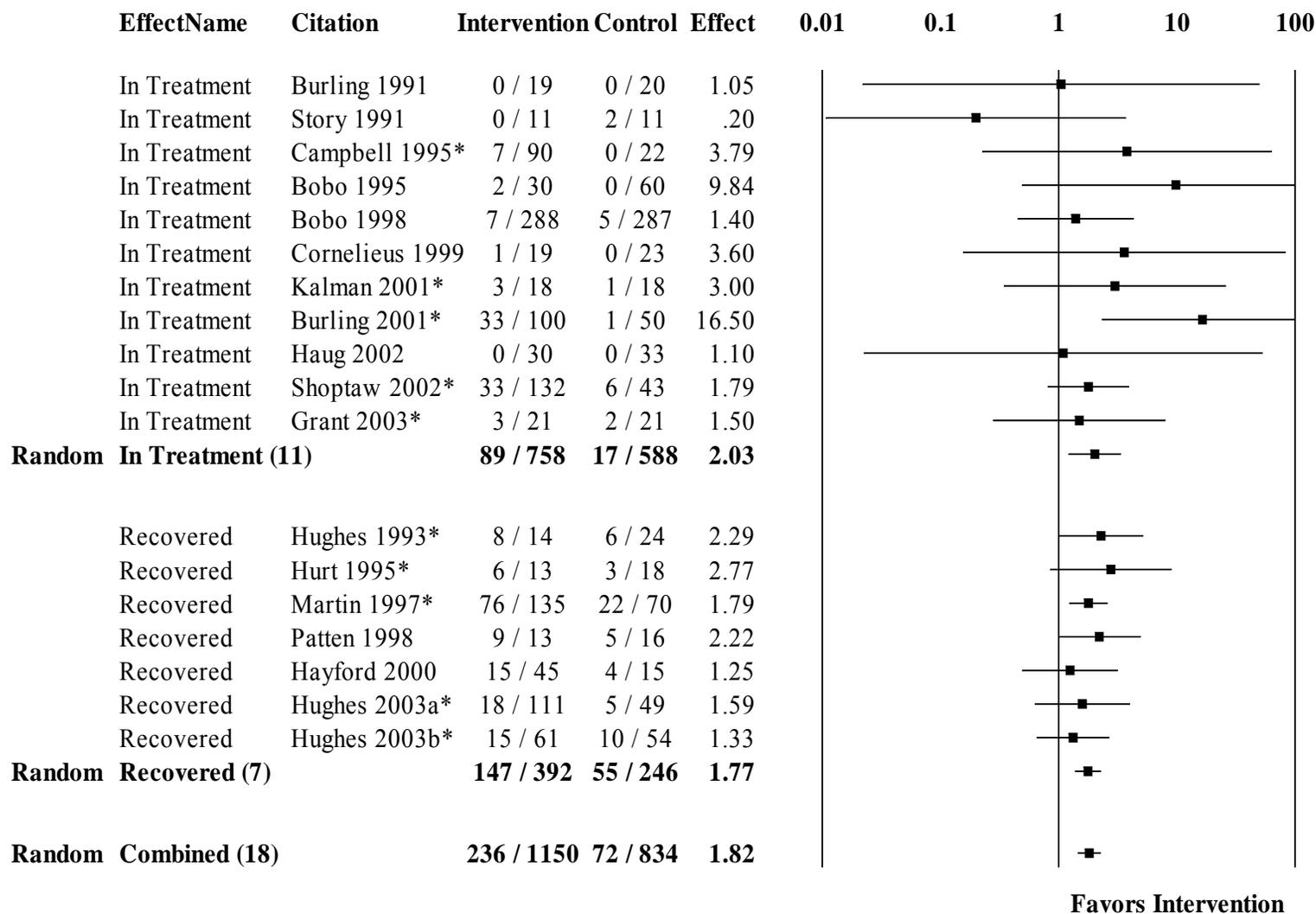
Table 3. Studies in progress ( $N = 8$ )

| Source   | Recruitment   | Participants  | Conditions  | Measures   |
|--|---|---|---|--|
| <i>Studies with participants in addictions treatment (n = 6)</i> |   |   |   |  |
| Abrams (personal communication, 2003); Hitsman et al. (2002)     | Recruited from two outpatient treatment programs in RI<br>RR: 88% of study eligible                                 | N = 253 (59% male)<br>Age M = 40<br>85% Caucasian<br>CPD M = 28<br>22% psychiatric history<br>91% intending to quit | I: Motivational intervention<br>C: Brief intervention<br>Up to 3 mo duration  | NR   |
| Cooney et al. (2002)   | Recruited 1 wk after admission to a day treatment program in CT<br>RR: NR   | N = 99<br>100% intending to quit  | I: Behavioral counseling plus NRT<br>C: Brief advice (10-min)   | NR   |
| Joseph et al. (2002)   | Recruited from three treatment programs offering intensive rehab for 3-5 wks followed by aftercare in MN<br>RR: 26% | N = 499<br>100% intending to quit   | I: Individual 1-hr behavior therapy plus NRT, 1-year follow up, 21% never received treatment<br>C: Delayed treatment, 35% never received treatment  | <u>Smoking</u> : PPA, CO<br><u>Substance use</u> : self-reported, collaterals, breathalyzer                |
| Karam-Hage (personal communication, 2003)                        | Recruited from 4-6 wk outpatient treatment programs in MI   | N = 120   | I: Bupropion 300 mg<br>C: Placebo   | <u>Smoking</u> : PPA, cont. abstinence, CO, cotinine<br><u>Substance use</u> : self-reported, breathalyzer |
| Stein et al. (2003)  | Recruited from two methadone programs in RI   | N = 408 (target)<br>Primarily Caucasian<br>CPD $\geq 10$  | I: NRT, brief RN advice and follow up plus a tailored motivational intervention (45-min), behavioral skills counseling session, and continued telephone counseling<br>C: NRT, brief RN advice and follow up | <u>Smoking</u> : 7-day PPA<br><u>Substance use</u> : UTOX  |
| Rohsenow et al. (2002)   | Recruited from 30-day state funded residential  | N = 126 (67% male)<br>Age M = 35  | I: Motivational intervention (50-min) with stage-specific goal setting  | <u>Smoking</u> : cont. abstinence, CO  |

| Source   | Recruitment  | Participants   | Conditions   | Measures   |
|--|--|--|--|--|
|  | program in RI during first wk of admission<br>RR: 73%                                      | 86% Caucasian<br>CPD $\geq$ 10   | C: Brief advice (10-min)<br>Crossed with two 15-min booster sessions<br>All provided access to smoking cessation groups and NRT        | <u>Substance use</u> : self-reported                             |
| <i>Studies with participants in recovery (n = 2)</i> |  |  |  |  |
| Hurt (2002)  | Study conducted in MN<br>RR: NR  | N = 292 (target)<br>Recovering alcoholics                                    | Participants abstinent following 8 wks of NRT randomized to:<br>I: Bupropion for 44 wks<br>C: Placebo for 44 wks                       | <u>Smoking</u> : 76 wk follow up                                 |
| Patten (2002)  | Recruited through community media and flyers at AA meetings in MN<br>RR: 45% (preliminary) | N = 154 target (77 to date)<br>Alcohol recovery > 3 mos<br>100% MDD+ history | Eight weekly group based sessions:<br>I: Behavioral counseling plus CBT mood management<br>C: Behavioral counseling<br>Both: NRT patch | <u>Smoking</u> : PPA, CO<br><u>Substance use</u> : self-reported |

*Note.* RR = recruitment rate; NR = not reported; CPD = cigarettes per day; CBT = cognitive behavioral therapy; PPA = point prevalence abstinence; CO = carbon monoxide; MDD+ = major depressive disorder; AA = Alcoholics Anonymous

Figure 1. Post-treatment smoking abstinence rates<sup>†</sup> for intervention and control conditions and abstinence relative risk estimates

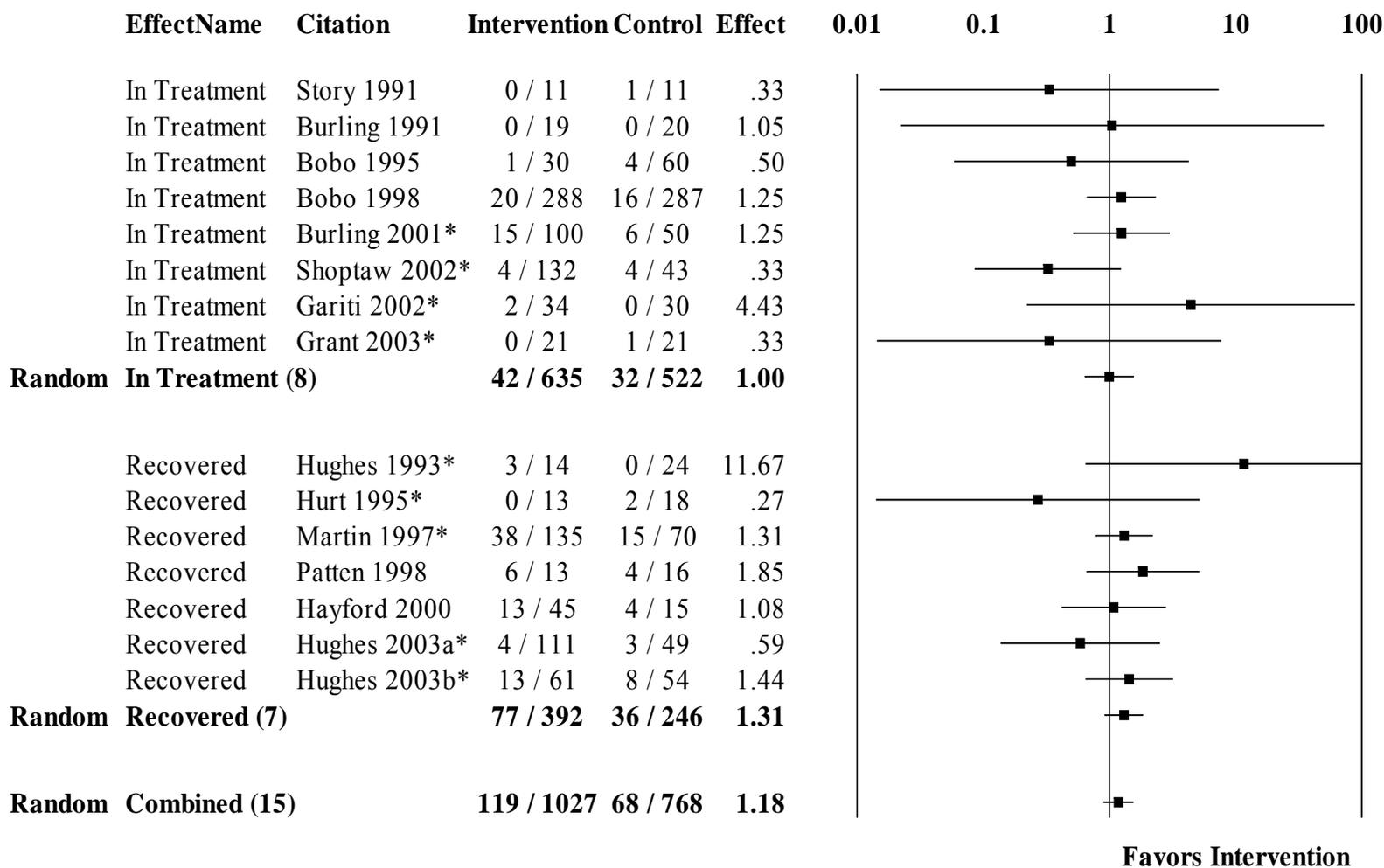


<sup>†</sup> Number of participants smoking abstinent / total number of participants assigned to the treatment group.

\* Indicates nicotine replacement therapy (NRT) provided to intervention and/or control participants.

Note. 95% Confidence interval to the right of 1.00 indicates a significant treatment effect.

Figure 2. Follow-up smoking abstinence rates† for intervention and control conditions and abstinence relative risk estimates

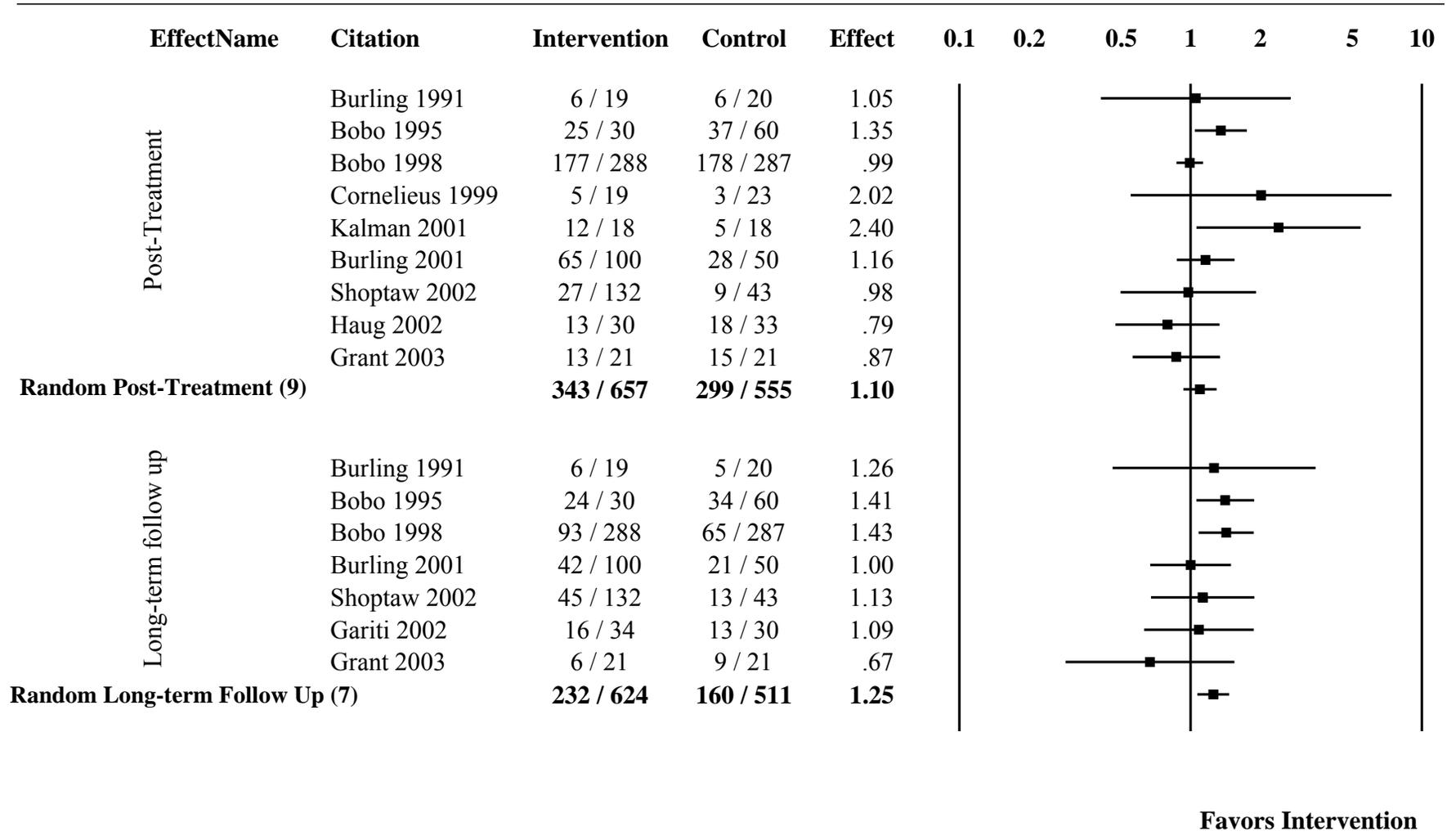


† Number of participants smoking abstinent / total number of participants assigned to the treatment group.

\* Indicates nicotine replacement therapy (NRT) provided to intervention and/or control participants.

Note. 95% Confidence interval to the right of 1.00 indicates a significant treatment effect.

Figure 3. Substance use abstinence rates† and relative risk estimates for participants in addictions treatment



† Number of participants abstinent / total number of participants assigned to the treatment group.  
 Note. 95% Confidence intervals to the right of 1.00 indicates a significant treatment effect