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Do smoking reduction interventions promote cessation in smokers not ready to quit?

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Abstract

Background—Limited treatment options exist for smokers who are not ready to make a quit attempt. Smoking reduction may be a viable treatment approach if proven to increase the rates of long-term abstinence from smoking.

Method—A systematic review of randomized, controlled trials that tested smoking-reduction interventions (pharmacological, behavioral, or both combined) among smokers who were not ready to make a quit attempt (immediately or in the next month) was conducted to assess the efficacy of these strategies in promoting future smoking abstinence. The primary outcome was the 7-day point-prevalence smoking abstinence at longest follow-up (≥ 6 months). Ten trials were included; six tested pharmacologic interventions, one evaluated a behavioral intervention, and three evaluated combined interventions.

Results—Pharmacologic (2732 participants; OR 2.33, 95% CI 1.43 to 3.79) and combined (638 participants; OR 2.14, 95% CI: 1.28 to 3.60) smoking-reduction interventions significantly increased long-term abstinence from smoking. Insufficient evidence was available on the efficacy of behavioral smoking-reduction interventions (320 participants; OR 1.49, 95% CI 0.56 to 3.93).

Conclusions—Further research to evaluate the efficacy of smoking reduction should have cessation as an endpoint, focus on clarity and consistency in patient selection, and identify the

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Contributors

Authors A, B, and C designed the study. Author A conducted literature searches, provided summaries of previous research studies, identified potentially eligible articles, and extracted data from these articles. Authors B and C contributed to the idea of the study, and participated in the planning of analysis and editing the manuscript. Author D checked the extracted data for accuracy and conducted the statistical analysis. Author A wrote the first draft of the manuscript and all authors contributed to and have approved the final manuscript.

Conflict of Interest

The author(s) declare that they have no conflicts of interest.

mechanism through which nicotine replacement therapy assisted smoking reduction in increasing abstinence rates.

Keywords

Smoking reduction; controlled smoking; reduce smoking; NRT assisted smoking reduction; promote abstinence; smokers unwilling/unable to quit smoking

1. Introduction

In the United States, 20.6% of adults report that they smoke cigarettes (CDC, 2009). Quitting smoking significantly reduces risk of smoking-related illnesses (USDHHS, 2004). However, 80% of smokers are not ready or willing to quit smoking immediately or during the next month (Velicer, et al., 1995).

The United States Public Health Service's (USPHS's) Clinical Practice Guideline (USPHS, 2008) recommends that smokers who are currently unwilling to make a quit attempt be given a brief motivational intervention. However, this assertion is based on limited evidence about the potential benefit of such a strategy (Carpenter, Hughes, & Keely, 2003; Carpenter, Hughes, Solomon, & Callas, 2004), and reports of its efficacy are inconsistent (Burke, Arkowitz, & Menchola, 2003; Dunn, Deroo, & Rivara, 2001; Rubak, Sandbaek, Lauritzen, & Christensen, 2005).

One strategy not mentioned by the USPHS Clinical Practice Guideline is smoking reduction. This strategy aims to engage smokers not ready to make a quit attempt in several behavioral strategies to reduce the number of cigarettes smoked per day (Shiffman, et al., 2002). Smoking reduction has been explored as a route to quitting (Cinciripini, et al., 1995) and as a "harm-reduction" strategy having the goal of decreasing smoking-related morbidity and mortality (Kunze, 2000). However, the value of this approach is controversial for several reasons: (a) uncertainty about its net health benefits (Godtfredsen, Osler, Vestbo, Andersen, & Prescott, 2003; Hatsukami, Hecht, Hennrikus, Joseph, & Pentel, 2003; Pisinger & Godtfredsen, 2007; Tverdal & Bjartveit, 2006); (b) concern that short-term decreases in smoking will not be maintained; and (c) concern that future quit attempts will be undermined (Glasgow, Morray, & Lichtenstein, 1989). Yet, a previous review on smoking reduction (Hughes & Carpenter, 2006) indicates that many smokers are able to reduce their smoking and maintain significant reductions for long periods and that this reduction does not appear to undermine cessation. In addition, smoking reduction may engage a broader population of smokers than traditional smoking-cessation interventions (Glasgow, et al., 2006; Shiffman, et al., 2007).

We conducted a systematic review assessing the efficacy of smoking reduction interventions in promoting future abstinence among cigarette smokers not ready to make a quit attempt immediately or in the next month. Four previous reviews of smoking-reduction interventions for smokers not ready to make a quit attempt have been conducted (Hughes & Carpenter, 2006; Moore, et al., 2009; Stead & Lancaster, 2007; Wang, et al., 2008). One (Hughes & Carpenter, 2006) is a qualitative review that included studies having several different designs (e.g., RCTs, cross-sectional, and prospective studies); we restricted our analysis to only randomized, controlled clinical trials RCTs evaluating interventions to promote smoking reduction as a means of increasing future abstinence. This review and a Cochrane review (Stead & Lancaster, 2007) included one study (Kralikova, Kozak, Rasmussen, Gustavsson, & Le Houezec, 2009) that recruited smokers who were willing to quit smoking and those who were unwilling; we limited our study to trials that recruited only smokers not ready to quit smoking. In addition, most of the previous reviews (Moore, et al., 2009; Stead

& Lancaster, 2007; Wang, et al., 2008) include only pharmacological intervention trials (i.e., nicotine replacement therapy [NRT] or bupropion versus placebo), and ours includes three categories of intervention with effect sizes calculated separately: pharmacological, behavioral, and combined. Our review also makes available new evidence (Glasgow, et al., 2009; Joseph, et al., 2008) not included in previous reviews. We sought to determine if smoking reduction facilitates smoking abstinence in individuals who are currently not ready to quit smoking rather than evaluating this method as a way to quit among smokers actively trying to quit (i.e., reduction as a means of gradual cessation) (Lindson, Aveyard, & Hughes, 2010).

2. Methods

We searched MEDLINE, Google Scholar, Embase, CINAHL, PsycINFO, Web of Science citation databases, and the Cochrane Tobacco Addiction Group's specialized register by using "smoking reduction", "controlled smoking", "reduction in cigarettes", or "reduce smoking" as the search terms. One author abstracted data from included studies, and a second checked the abstracted data for accuracy.

The RCTs included met the following criteria: (a) had at least one comparison group (defined as placebo, no treatment, or minimal psychological interventions); (b) recruited adult smokers (age ≥ 18 years); (c) recruited only smokers who were not ready to make a quit attempt either immediately or in the next month; and (d) applied interventions to reduce the number of cigarettes smoked per day. We defined smokers unwilling to quit as those not ready to quit "either immediately or in the next month" to be consistent with the USPHS Clinical Practice Guideline's (USPHS, 2008) definition of this group.

The primary outcome of interest was the 7-day point-prevalence smoking abstinence at the longest follow-up period, which had to be at least six months after randomization. The 6-month follow-up minimum was chosen to be consistent with published recommendations (Hughes, et al., 2003; Pierce & Gilpin, 2003).

Studies were grouped into three categories according to intervention type: pharmacological, behavioral, or combined (Table 1). We used odds ratios (ORs) to represent the point estimates of the magnitude of the association between intervention exposure and treatment outcomes such that an OR greater than one indicates that the odds of quitting were higher in the intervention group than in the control or comparison group. To represent the precision around this point estimate, 95% confidence intervals (CIs) were used. In studies in which the OR was not reported, we calculated it from abstinence rates by using cross-tabulation. We calculated the average weighted-effect size (OR) for each intervention group to accommodate for differences in sample size. To calculate the 95% CIs for the weighted ORs, we used the formula [100(1−α)% = OR**(1−z/sqrt(chi-square)], where z is the standard normal critical value (1.96 for α = .05, two-tailed) (Daniel, 2009). Specialized programs written in SAS/IML (Interactive Matrix Language) (bSAS Institute Inc, 2008b) were used to calculate the statistics, and SAS/Graph (Proc GANNO) was used to generate the forest plots (aSAS Institute Inc, 2008a).

Two studies had 3-arm designs (Carpenter, et al., 2004; Etter, Laszlo, & Perneger, 2004). The first such study (Carpenter, et al., 2004) had a control group (no intervention), a motivational intervention to quit plus nicotine replacement therapy (NRT) if participant decided to quit group, and a smoking reduction plus NRT group. For consistency, we analyzed the differences in quit rates between the combined smoking-reduction intervention and the control group. The second study (Etter, et al., 2004) also had a control group (no intervention), a placebo group, and an active NRT group. For consistency, we analyzed the

differences between NRT and placebo. For these two studies, we used the sum of only the two comparison groups as a sample weight because of the possibility that including the third group would bias the weighted-effects' size downward and increase the 95% CI. Heterogeneity was quantified by using the I^2 statistic (Higgins, Thompson, Deeks, & Altman, 2003).

3. Results

Six trials tested the efficacy of pharmacological interventions to reduce smoking rates (Table 1). Five trials examined NRT (Batra, et al., 2005;Bolliger, et al., 2000;Etter, et al., 2004;Rennard, et al., 2006;Wennike, Danielsson, Landfeldt, Westin, & Tonnesen, 2003); only one trial used bupropion(Hatsukami, et al., 2004). The pooled results of these trials show that the odds of abstinence from smoking are more than doubled by pharmacological interventions as compared with the odds under control conditions(2732 participants; OR 2.33, 95% CI 1.43–3.79). Mild heterogeneity was suggested among the six trials (I^2= 14.95%) (Fig 1).

We identified only one trial examining the efficacy of behavioral intervention in reducing smoking rates (Glasgow, et al., 2009). The smoking abstinence rate favored the rate reduction group (6.7% vs. 4.4%) but was not significantly different than that in the control group (320 participants; OR 1.49, 95% CI 0.56 to 3.93) (Table 1).

We identified three studies examining the efficacy of combining behavioral and pharmacological interventions in reducing smoking rates (Carpenter, et al., 2003; Carpenter, et al., 2004; Joseph, et al., 2008) (Table 1). The average weighted-effects' size for the intervention was significantly greater than the effect of the minimal care (638 participants; OR 2.14, 95% CI: 1.28–3.60). We did not find evidence of heterogeneity among these trials (I^2 = 0%) (Fig 1).

4. Discussion

Our results suggest that NRT and combined smoking-reduction interventions increase long-term cessation among smokers who are not ready to quit smoking. Insufficient evidence is available regarding the efficacy of behavioral smoking-reduction interventions in promoting future abstinence among this group.

Although it is encouraging that NRT alone may promote abstinence in smokers not ready to quit, a major barrier to implementing such protocols is the long duration of therapy given to participants in these studies, ranging from 6 (Etter, et al., 2004) to 18 months (Bolliger, et al., 2000). This may be a costly treatment plan given that the majority of patients receiving it will not quit smoking. The Clinical Practice Guidelines recommend that nicotine gum should be used for up to 12 weeks, nicotine inhalers for up to 6 months, and nicotine patches for 8 weeks to achieve optimal treatment for tobacco users interested in cessation (Fiore, et al., May 2008). Future studies should determine whether this treatment length is sufficient to produce a substantial treatment effect among smokers not ready to quit.

In the only study evaluating a behavioral smoking-reduction intervention (Glasgow, et al., 2009), the results favored the behavioral intervention but did not achieve statistical significance. The study's authors attributed this to two factors: increased tobacco-control strategies during the study and high drop-out rates in the intervention group. Participants in this study were scheduled for either outpatient surgeries or diagnostic procedures which may have had a significant effect on their motivation before and after the medical procedure and on study retention. Future studies should evaluate smoking-reduction behavioral

interventions in a general population of smokers not ready to quit and explore ways to enhance retention.

The three studies examining combined intervention methods showed a significant effect of smoking reduction aided by NRT. However, two of these studies observed negative results (Carpenter MJ, 2003; Joseph AM, 2008), which may have been due to small sample sizes. The remaining study (Carpenter, et al., 2004) observed a positive result. However, because the reduction intervention in this study consisted of two interventions (i.e., reduction counseling and the provision of free NRT), it is not clear whether the increase in quitting with NRT-assisted reduction is related to NRT availability, reduction itself, or both. Future studies should compare three groups: behavioral reduction intervention alone, NRT–assisted reduction with minimal behavioral support, and reduction intervention plus NRT to determine if behavioral counseling augments the effect of providing NRT.

An additional challenge in the literature is the lack of an operational definition of what constitutes a smoker who is “unwilling, unable, or not ready to quit smoking.” For the studies included in this review, the time frame for intention-to-quit varied from “not ready to quit in the next 6 months” to “not ready to quit immediately.” One possible approach would be to use the stages-of-change definitions of pre-contemplators and contemplators as a common definition for smokers who are “unwilling to quit” (Prochaska, Velicer, DiClemente, & Fava, 1988). A sample of contemplators may be more amenable to a rate-reduction intervention than pre-contemplators are. Another challenge is that most rate-reduction studies report only point-prevalence smoking abstinence. Future studies should follow the published recommendations for measuring abstinence (Hughes, et al., 2003) in trials of smokers not currently trying to quit by tying follow-up to the start of the intervention. An appropriate report would consist of prolonged abstinence as the primary outcome measure and point-prevalence abstinence as a secondary measure at 6-month follow-up.

In conclusion, pharmacological and combined smoking-reduction interventions double the odds of long-term smoking abstinence. Additional research is needed to further refine the behavioral interventions and the duration of pharmacotherapy that are most effective for smoking reduction.

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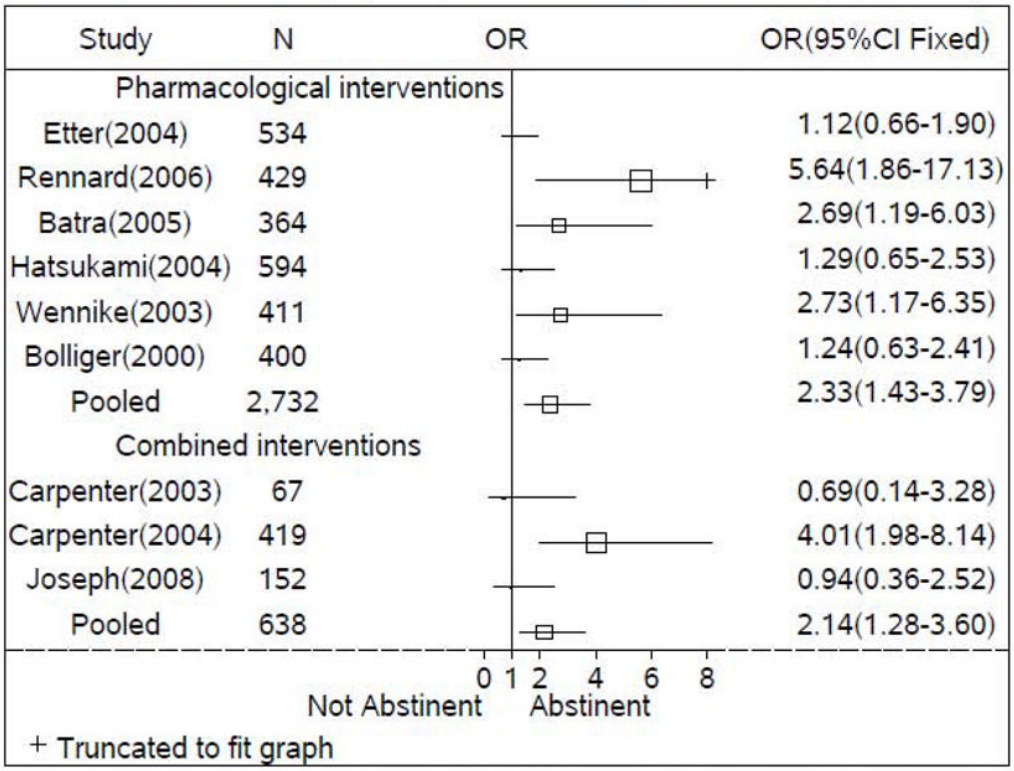

Figure 1.

Pharmacological (NRT and buproprion) rate reduction interventions vs placebo, and combined (pharmacological + behaviorial) rate reduction interventions vs usual care, point-prevalence abstinence at longest follow-up.

Legend: Odds Ratios drawn as boxes with size inversely proportional to their standard error and lines represent the 95% CI of ORs.

Table 1

bstinence in studies testing pharmacological interventions, behavioral intervention, and combined (pharmacological and behavioral) interventions to duce smoking rates among smokers not ready to quit.

Reference & Country	Sample Size	Eligibility Criteria	Control/Treatment conditions	Other Treatment Components	Follow-up (months)	Outcome	Smoking Abstinence Rates		Effect Size OR (95% CI)
							Treatment %(n/N)[a]	Control %(n/N)[a]	
Pharmacological Interventions									
Bolliger 2000; Switzerland	400	Smoke >15 CPD for ≥ 3 years Have an exhaled-air CO level for at least 10 ppm Failed at least 1 serious quit attempt in past 12 months Unwilling or unable to quit	Placebo Nicotine inhaler for 18 months	Counseling on reduction in 9 clinic visits	24	PP *d*	10.5% (21/200)	8.5% (17/200)	1.24 (0.63 – 2.41)
Vennike 2003; Denmark	411	Smoke ≥ 15 CPD for >=3 years Failed at least 1 serious quit attempt in past 2 years Have an exhaled-air CO level for at least 15 ppm Not intending to quit in next month	Placebo Nicotine gum for 12 months	Counseling on reduction in 9 clinic visits	24	PP	9% (19/205)	3% (7/206)	2.73 (1.17 – 6.35)
Etter[b] 2004; Switzerland	534[c]	Smoke ≥20 CPD Not intending to quit in next 6 months	No-intervention Placebo NRT (free choice; patch, inhaler, or gum) for 6 months	20-page booklets on reduction	26	PP	12% (32/265)	12% (29/269)	1.12 (0.66 – 1.90)[e]
Hatsukami 2004; USA	594	Smoke ≥20 CPD Not quit for >3 months in previous year Have at least 2 failed quit attempts including 1 with NRT	Placebo Bupropion for 26 weeks	Written materials Counseling on reduction in 3 telephone contacts	6	CA	7% (20/295)	5% (16/299)	1.29 (0.65 – 2.53)
Batra 2005; Germany	364	Smoke >20 CPD for ≥3 years Have an expired-air CO level of at least 15 ppm Have at least 1 failed quit attempt within 2 years but	Placebo Nicotine gum for 12 months	Counseling on reduction in 9 clinic visits. Telephone support	13	PP *d*	12% (22/184)	5% (8/180)	2.69 (1.19 – 6.03)[e]

Reference & Country	Sample Size	Eligibility Criteria	Control/Treatment conditions	Other Treatment Components	Follow-up (months)	Outcome	Smoking Abstinence Rates		Effect Size OR (95% CI)
							Treatment %(n/N)[a]	Control %(n/N)[a]	
		not within the previous 6 months Not intending to quit in next month							
Rennard 2006; USA	429	Smoke ≥20 CPD for ≥ 3 years Failed at least 1 serious quit attempt in past 2 years Exhaled-air CO level for at least 15 ppm Not intending to quit in next month	Placebo Nicotine inhaler for 12 months	Counseling on reduction in 9 clinic visits	15	PP	8% (17/215)	2% (3/214)	5.64 (1.86–17.13)[e]
Behavioral Interventions									
Glasgow 2009 USA	320	Smoke >10 CPD Not interested in quitting	Enhanced usual care Telephone counseling + tailored newsletters	--	12	PP	6.7% (11/164)	4.4% (7/156)	1.49 (0.57 – 3.93)
Combination of Behavioral and Pharmacological Interventions									
Carpenter 2003 USA	67	Smoke >10 CPD Interest in quitting eventually but not in the next 30 days At least 1 previous quit attempt	Usual-care (i.e., brief advice to quit) + NRT (if participant decided to quit) Smoking reduction + free choice of NRT (gum or patches) for 6 months + brief advice to quit	--	6	PP	13%(3/35)	9%(4/32)	0.69 (0.14 – 3.28)[e]
Carpenter 2004[b] USA	419 [c]	Smoke ≥10 CPD No interest in quitting	No-intervention Motivational intervention (brief advice to quit + NRT if participant decided to quit) Smoking reduction + free choice of NRT (gum or patches) for 6 months + brief advice to quit	--	6	PP	18%(37/212)	4% (9/207)	4.01 (1.98 – 8.14)
Joseph 2008 USA	152	Smokers with cardiovascular disease Not interested in quitting in the next 30 days	Usual care (i.e., brief advice to quit) Rate reduction + nicotine gum for 18 months	--	18	PP	12% (9/78)	12% (9/74)	0.94 (0.36 – 2.52)[e]

Abbreviations: CA, Continuous Abstinence in the last 4 weeks; CO, Carbon monoxide; CPD, Cigarette(s) per day; NRT, Nicotine Replacement Therapy; PP Point-Prevalence Abstinence; ppm, parts per million

[a] Number of events/Number in group

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[b] This study had a 3-arm design. For consistency with other studies, only 2 arms were included in the analysis

[c] Number of subjects in the two comparison groups

[d] Verified by CO level

[e] Calculated from the abstinence rate