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Contingency management for smoking cessation among treatment-seeking patients in a community setting

Roberto Secades-Villa*, Olaya García-Rodríguez, Carla López-Núñez, Fernando Alonso-Pérez, José R. Fernández-Hermida

Department of Psychology, University of Oviedo, Plaza Feijoo, s/n, 33003 Oviedo, Spain

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ABSTRACT

Background: Contingency management (CM) is an efficacious intervention for reducing cigarette smoking. However, CM is rarely adopted as a smoking cessation treatment in the community. This study analyzed the effectiveness of a CM procedure in combination with a cognitive-behavioral treatment (CBT) for smoking cessation among treatment-seeking patients from the general population.
Methods: A total of 92 patients were randomly assigned to one of two treatment conditions: CBT ($N = 49$) or CBT + CM ($N = 43$). The CM procedure included a voucher program through which nicotine abstinence was reinforced on a schedule of escalating magnitude of reinforcement with a reset contingency. Self-reported smoking status was confirmed with both carbon monoxide (CO) level in expired air and cotinine levels in urine.
Results: Of the patients who received CBT + CM 97.7%, completed 6 weeks of treatment, versus 81.6% of those who received CBT ($p = .03$). At the post-treatment assessment, 95.3% of the patients assigned to the CBT + CM condition achieved abstinence in comparison to the 59.2% in the CBT group ($p = .000$). At the one-month follow-up, 72.1% of the patients who received CBT + CM maintained smoking abstinence, versus 34.7% in the CBT group ($p = .001$). At the six-month follow-up, 51.2% of the patients who received CBT + CM maintained smoking abstinence in comparison to the 28.6% in the CBT group ($p = .04$).
Conclusions: Results from this randomized clinical trial showed that adding CM to a CBT is effective, and is feasible as an intervention approach with treatment-seeking patients in a community setting.

1. Introduction

Tobacco smoking is the leading preventable cause of premature death worldwide (World Health Organization, 2012), and the societal costs in terms of smoking-attributable productivity losses and smoking-related health care are substantial (WHO and Guidon, 2006). Despite the many therapies available for smoking cessation (Fiore et al., 2008), additional efficacious interventions are sorely needed (Sigmon and Patrick, 2012), since many quit attempts are unsuccessful (Rafful et al., 2013), and a high percentage of patients relapse within the months following a quit attempt (Fiore et al., 2008; García-Rodríguez et al., 2013).

Contingency management (CM) is an empirically-supported behavioral treatment with demonstrated effectiveness across a wide range of drugs and in diverse types of population (Knapp et al., 2007; Lussier et al., 2006; Prendergast et al., 2006; Stitzer and Petry, 2006). This approach typically involves financial incentives delivered contingent upon the patient meeting a predetermined therapeutic target (usually abstinence from drug use; Higgins et al., 2008; Sigmon and Patrick, 2012). CM has shown itself to be successful in reducing tobacco use in both non-treatment-seeking and complacent smokers (Alessi et al., 2004; Heil et al., 2003; Lamb et al., 2007; Roll and Higgins, 2000) and in treatment-seeking adults (Dallery et al., 2007; Lamb et al., 2004, 2010). CM is also an efficacious intervention for special populations, such as young smokers (Cavallo et al., 2010; Correia and Benson, 2006; Krishnan-Sarin et al., 2006), pregnant and post-partum smokers (Donatelle et al., 2000; Higgins et al., 2004, 2012) or substance dependent populations (Dunn et al., 2010; Robles et al., 2005; Shoptaw et al., 1996; Wiseman et al., 2005).

However, previous CM studies in general population have tended to be aimed at assessing feasibility or exploring various experimental issues other than smoking cessation per se, and the

* Corresponding author at: Facultad de Psicología, Universidad de Oviedo, Plaza Feijoo, s/n, 33003 Oviedo, Spain. Tel.: +34 98 5104139; fax: +34 98 5104144.
E-mail address: secades@uniovi.es (R. Secades-Villa).

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scarce work that has evaluated the efficacy of CM in promoting smoking cessation has been carried out in special populations of smokers. Barriers to their widespread adoption include their perceived cost, complexity and staff burden (Ledgerwood, 2008). In naturalistic settings, the use of financial incentives has generally been limited to organizations-based settings using "captive" study participants (Cahill and Perera, 2011), such as Veterans hospital clinics (Volpp et al., 2006), methadone clinics (Dunn et al., 2008, 2009, 2010; Shoptaw et al., 1996), schools (Correia and Benson, 2006; Krishnan-Sarin et al., 2006, 2013) or workplace contexts (Volpp et al., 2009). Community clinics have been used to a lesser extent. While using a organizational approach has the potential to reach many smokers, not all smokers are part of an organization large enough to warrant a full-scale CM program (Ledgerwood, 2008). In addition, these studies have generally involved non-treatment-seeking smokers and frequent study visits (between 1 and 3 visits per day), since abstinence reinforcement procedures require frequent objective evidence of smoking status. These procedures may be too burdensome and infrequent for clinical practice and for effective implementation in an outpatient clinic. Although requiring patients to make visits to the clinic on a daily basis may be more practical and rigorous, this requirement represents a substantial cost response for most patients, and this may limit the access to the treatment and its success. Also, because most clinics are only open on working days, such visits can occur only five days a week (Dallery and Raiff, 2011).

To our knowledge, no published studies have examined the effectiveness of using a CM-based intervention in promoting smoking cessation with treatment-seeking smokers from the general population, without other special characteristics or comorbid conditions.

The present study aims to address these gaps in the literature. Given the preliminary evidence supporting the utility of cognitive behavioral therapy (CBT) in reducing tobacco use (Killen et al., 2008; McDonald et al., 2003; Webb et al., 2010), we sought to develop an efficacious approach that combined CM with group-based CBT. The main goal of this randomized controlled trial was to analyze whether adding a CM protocol to CBT intervention would significantly increase rates of program completion and smoking cessation among treatment-seeking patients in a community setting.

2. Methods

2.1. Participants

This study was conducted at the Addictive Behaviors Clinic of the University of Oviedo (Spain). Participants were treatment-seeking smokers from the general population, recruited through advertisements in the local media and flyers posted in the community and by word of mouth. Inclusion criteria were age over 18, meeting the diagnostic criteria for nicotine dependence according to the Diagnostic and Statistical Manual of Mental Disorders (fourth ed., text rev.; DSM–IV–TR; American Psychiatric Association, 2000) as assessed using the Structured Clinical Interview for DSM-IV (SCID), and having smoked 10 or more cigarettes per day for the previous 12 months. Objective verification of smoking status was also required. We excluded patients who presented a severe psychiatric disorder (including substance use disorder) or who were receiving any other smoking cessation treatment, such as pharmacotherapy.

Participants provided informed consent, and the procedures followed were in accordance with the ethical standards of our institution. Fig. 1 shows the flow of participants through the enrollment, treatment, post-treatment and one-month follow-up phases. Of a total of 103 people screened, 92 (35.9% men and 64.1% women) met the inclusion criteria and were enrolled in the study. The mean age was 45.8 years (SD = 12.1), mean number of cigarettes smoked per day at intake was 21.7 (SD = 8.7), and mean score on the Fagerström Dependence Test was 5.7 (SD = 1.8).

Eligible participants were randomly assigned to a CBT group ($n = 49$) or a CBT plus CM group ($n = 43$), in accordance with a computer-generated randomization list. Patients' baseline characteristics in each of the experimental groups are shown in Table 1. There were no significant differences ($p < .05$) in baseline characteristics between the two groups.

Table 1
Sample characteristics.

	CBT ($n = 49$)	CBT + CM ($n = 43$)	p value
Age (years)[a]	46.9 ± 12.3	44.4 ± 11.9	.92
Gender (% women)	59.2	69.8	.40
Years of education[a]	12.1	12.6	.35
Employed full time (%)	35.4	55.8	.08
Previous quit attempts[a]	2.47 ± 2.1	2.21 ± 2.4	.77
Cigarettes per day[a]	21.8 ± 8.14	21.6 ± 9.01	.49
Age first used tobacco[a]	15.7 ± 2.4	14.8 ± 2.5	.69
Years of smoking[a]	26.7 ± 12.0	25.2 ± 11.6	.50
CO (ppm)[a]	15.9 ± 7.4	14.7 ± 6.2	.18
Cotinine (ng/ml)[a]	2170.02 ± 1101.75	2203.92 ± 1226.85	.89
Fagerström Test[a]	5.7 ± 1.8	5.6 ± 1.8	.74

CBT = cognitive-behavioral treatment; CM = contingency management; CO (ppm) = carbon monoxide (parts per million); ng/ml = nanograms per milliliter.
[a] Means ± SD.

2.2. Assessment

During the intake session, which lasted for approximately 90 min, participants filled out a clinical history form to provide data on sociodemographic and smoking-related characteristics. The Fagerström Dependence Test (Heatherton et al., 1991) was used to assess nicotine dependence, in addition to the DSM-IV-TR criteria. Participants also provided a baseline CO sample in expired air using a Micro Smokerlyzer (Bedfont Scientific Ltd., Rochester, UK) for objective verification of self-reported smoking status. A BS-120 fully-automated and computer-controlled chemistry analyzer (Shenzhen Mindray Bio-medical Electronics, Co., Ltd., Shenzhen, PR China) designed for in vitro determination of clinical chemistries was used to determine quantitative urine cotinine levels through a homogeneous enzyme immunoassay system. All cotinine specimens were obtained under direct supervision by a same-gender staff member, and measured immediately.

2.3. Treatment interventions

Therapists were members of the staff at the institution, all masters-level psychologists with previous intensive training in the specific protocols. Each therapist practiced with two or three training cases before treating any study participant. To ensure the therapist's adherence to the protocols and competence in implementing the techniques, all sessions were audio-recorded and there was a 1-h weekly supervision session throughout the entire treatment program. Table 2 shows a detailed description of the treatment interventions by session.

2.3.1. CBT. This consisted of an intervention based on previous studies (Becona and Vazquez, 1997; Secades-Villa et al., 2009), implemented in group-based sessions of five or six patients. Each session took about 1 h, and sessions were carried out once a week over a six-week period. The main component of the CBT program was nicotine fading. From the first to the fourth week, patients are asked to gradually reduce their nicotine intake, and they have an individualized pattern of nicotine intake for each week based on a weekly reduction of 30%. To achieve this objective, a maximum number of cigarettes per day and also specific cigarette brands with lower nicotine levels are recommended. From the fifth week onwards, abstinence is required. Other components of the CBT program included: information about tobacco, a behavioral contract through which the patients pledged to attend the sessions and quit smoking, self-monitoring and graphical representation of cigarette smoking, stimulus control, strategies for controlling nicotine withdrawal symptoms, physiological feedback (measured by CO and cotinine), training in alternative behaviors, social reinforcement of objectives completion and abstinence, and relapse prevention strategies.

CO and cotinine specimens were collected twice a week. One of the measures coincided with the weekly CBT session and the other was scheduled midweek between sessions. A total of eleven samples were collected for each participant during the treatment. Participants were informed of their CO level and urinalysis results (cotinine) immediately after submitting their specimens, but received no type of incentive in exchange for obtaining or maintaining abstinence.

2.3.2. CBT plus CM. The CBT plus CM was provided as in the above CBT condition, but with the addition of a CM procedure. CO and cotinine samples were collected in accordance with the procedure explained above. The CM procedure included a voucher program through which nicotine abstinence was reinforced on a schedule of escalating magnitude of reinforcement with a reset contingency. The voucher program was implemented as follows: points were earned for specimens testing negative for cotinine collected in the fifth CBT session (first session after the patient was required to be abstinent), between the fifth and sixth CBT sessions, and in the sixth CBT session. A negative urine cotinine test was defined as less than 80 nanograms per milliliter (ng/ml), in order to avoid residual effects. Points were worth the equivalent of 1€ each. The first cotinine-negative specimen earned 80 points, with a 20-point increase for each subsequent and consecutive

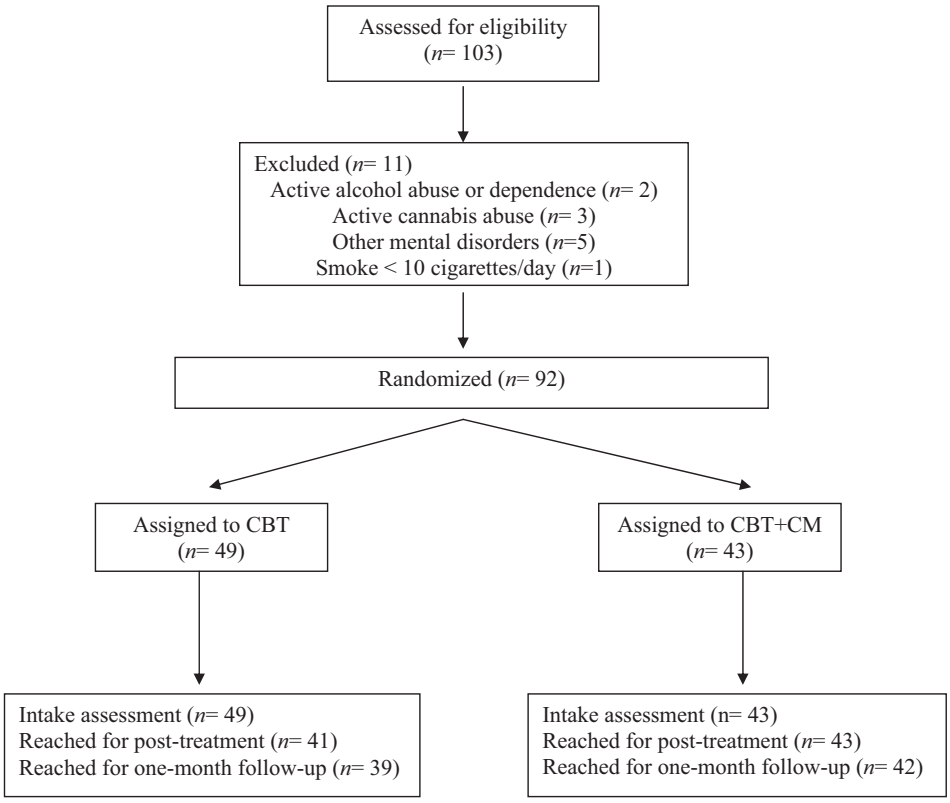

Fig. 1. Participants flow diagram.

Table 2
CBT and CM procedures by session.

Week/session	Samples	CBT components	CM procedure
1	COCotinine	Self-monitoring and graphical representation Feedback consumption Information about tobacco Behavioral contract 30% nicotine fading	–
1b	COCotinine	Feedback consumption	–
2	COCotinine	Self-monitoring and graphical representation Feedback consumption 30% nicotine fading Stimulus control	–
2b	COCotinine	Feedback consumption	–
3	COCotinine	Self-monitoring and graphical representation Feedback consumption 30% nicotine fading Stimulus control Training in alternative behaviors	–
3b	COCotinine	Feedback consumption	–
4	COCotinine	Self-monitoring and graphical representation Feedback consumption Smoking abstinence Stimulus control Training in alternative behaviors Nicotine withdrawal control	–
4b	COCotinine	Feedback consumption	–
5	COCotinine	Self-monitoring and graphical representation Feedback consumption Smoking abstinence Nicotine withdrawal control Relapse prevention strategies	Abstinence reinforcement (80€)
5b	COCotinine	Feedback consumption	Abstinence reinforcement (100€)
6	COCotinine	Self-monitoring and graphical representation Feedback consumption Smoking abstinence Nicotine withdrawal control Relapse prevention strategies	Abstinence reinforcement (120€)

cotinine-negative specimen. Failure to submit a urine specimen as scheduled rendered it cotinine positive if the patient failed to provide some sort of official justification (job-related or medical) and failed to attend to the clinic by the following day to submit a specimen. Cotinine-positive specimens or failure to submit a scheduled specimen set the value back to the initial 80 points. The schedule of incentive delivery did not allow participants to return to the value they had obtained prior to the reset. Points could not be lost once earned. The maximum amount that patients could earn was 300€ (US$ 412) (80€/US$ 110 + 100€/US$ 137 + 120€/US$ 165), and the average amount earned in vouchers was 238.22€ (US$ 326.83).

Points were exchangeable for vouchers with a variety of uses, including leisure activities, cinema, theater, museums, sports events, gyms, adventure sports, meals in restaurants, training, purchases in department stores, bookshops, clothes shops and art shops, and spa and beauty services.

2.4. Outcome measures

The outcome variables were three: treatment retention: percentage of participants who attended all the sessions during the six weeks of treatment; point-prevalence: the percentage of participants abstinent at the post-treatment assessment at the one-month follow-up (after the completion of treatment), and at the six-month follow-up (both defined as abstinence for a minimum of seven days before the interview (Cavallo et al., 2007; Hughes et al., 2003); and continuous abstinence: the percentage of patients who had achieved continuous smoking abstinence at the one-month follow-up and at the six-month follow-up. Self-reported abstinence was validated by a negative result for CO (less than 4 parts per million, ppm) and a negative urine cotinine test (less than 80 ng/ml). Agreement was between all three measures was required.

2.5. Statistical analysis

Various descriptive and frequency analyses were carried out in relation to the participants' characteristics. Comparisons between the treatment groups for baseline characteristics were performed using the Student's t test for the continuous variables and the χ^2 test with the Yates continuity correction for the dichotomous variables. Treatment comparisons between percentage of participants who quit smoking (point-prevalence abstinence and continuous smoking abstinence) and percentage of participants who completed the treatment were also performed using the χ^2 test. Missing urine and CO samples were considered as positives.

Effect sizes of principal comparisons were calculated using eta square (η^2) for t tests and phi (Φ) for χ^2 tests. It should be borne in mind that values for small, medium and large effects are not the same for eta square (.01, .06 and .14) and phi (.10, .30 and .50; Cohen, 1988).

Confidence level was 95%, and the statistical package used was the SPSS (V19; SPSS, Inc., Chicago, IL).

3. Results

3.1. Treatment retention

Of those patients assigned to the CBT + CM group, 97.7% attended all treatment sessions over six weeks (42/43), compared to 81.6% (40/49) of patients in the CBT group ($\chi^2 = 4.540$, $p = .03$). The magnitude of the differences in retention was small ($\Phi = .257$), according to the phi statistic.

3.2. Post-treatment

Patients assigned to the CBT + CM condition achieved higher rates of abstinence (point-prevalence) than those in the CBT group (95.3% versus 59.2%; $\chi^2 = 14.535$, $p = .000$). The magnitude of the differences in point-prevalence abstinence at post-treatment was medium-large ($\Phi = .423$). Most of the successful patients initiated abstinence from the fifth session onwards, according to the program schedule (75.9% in the CBT group and 76.6% in the CBT + CM group). A small percentage of participants initiated abstinence before the fifth session (24.1% in the CBT group and 24.4% in the CBT + CM group) ($\chi^2 = 0.001$, $p = .981$).

3.3. One-month follow-up

At the one-month follow-up, 72.1% (31/45) of the patients assigned to the CBT + CM condition were abstinent, as compared to 34.7% (17/49) of the patients assigned to the CBT treatment ($\chi^2 = 11.382$, $p = .001$). Effect size for this variable was also medium-large ($\Phi = .374$). Of those participants who quit smoking at post-treatment, 75.6% (31/41) of those assigned to the CBT + CM condition remained abstinent at the one-month follow-up, compared to 55.2% (16/29) of the patients assigned to the CBT group ($\chi^2 = 2.356$, $p = .125$, $\Phi = .214$). That is, 24.4% of the participants who gave up smoking in the CBT + CM group and 44.8% of the CBT patients who quit relapsed one month after the end of the treatment.

At the one-month follow-up, 58.1% (25/43) of patients receiving CBT + CM had achieved continuous abstinence, compared to 30.6% (15/49) of patients receiving CBT ($p = .014$). Magnitude of the differences in point-prevalence was small-medium ($\Phi = .277$).

3.4. Six-month follow-up

At the six-month follow-up, 51.2% (22/43) of the patients assigned to the CBT + CM condition were abstinent, as compared to 28.6% (14/49) of the patients assigned to the CBT treatment ($\chi^2 = 4.005$, $p = .045$). Effect size for this variable was small ($\Phi = .231$). Of those participants who quit smoking at post-treatment, 53.7% (22/41) of those assigned to the CBT + CM condition remained abstinent at the six-month follow-up, compared to 48.3% (14/29) of the patients assigned to the CBT group ($\chi^2 = .040$, $p = .841$, $\Phi = .053$). That is, 46.3% of the participants who gave up smoking at post-treatment in the CBT + CM group and 51.7% of the CBT patients who quit relapsed six months after the end of the treatment.

At the six-month follow-up, 39.5% (17/43) of patients receiving CBT + CM had achieved continuous abstinence, compared to 26.5% (13/49) of patients receiving CBT ($p = .269$; $\Phi = .138$).

4. Discussion

The main objective of the present study was to analyze the effectiveness of a voucher-based CM treatment for smoking cessation among treatment-seeking patients in a community setting. While incentives can clearly have robust effects on smoking behavior, previous literature was based on limited samples and tight experimental control. Clearly, accessible and effective smoking cessation treatments are needed, and assessment of the development of voucher-based intervention in community settings is an important step in support of this treatment approach.

Despite the fact that both the CBT and the CBT plus CM treatment brought about reductions in smoking at the post-treatment and at the follow-ups, adding a CM protocol produced differentially better smoking outcomes (retention and abstinence). These results represent an extension of what we already knew about the role of CM in smoking cessation treatment, because this intervention is rarely adopted in the community (Ledgerwood, 2008), and extend the previous findings by documenting CM as a feasible smoking cessation treatment in the context of more standard conditions.

Abstinence rates in the CM group are in the upper limit of those observed in previous studies (Krishnan-Sarin et al., 2013; Stoops et al., 2009; Volpp et al., 2006; White et al., 2013). The reason for these high rates of abstinence here is unknown, but they could be due to differences in the samples (in our study, treatment seekers), to the combination with an empirically-supported CBT protocol, and to the addition of two biochemical measures of smoking with stronger monitoring effects.

An interesting implication of our findings is that daily monitoring is not required for a CM intervention with cigarette smokers to be effective. Attending a clinic for smoking cessation two or three times a day is an unreasonable commitment for most people (Donatelle et al., 2004; Ledgerwood, 2008). Less monitoring

frequency than was the case in the present study (two urine cotinine tests per week) appears to have no negative effect on abstinence outcomes, and can help make smoking cessation treatments within the community more accessible.

A common criticism of CM procedures is that treatment effects may dissipate when the intervention is discontinued. In the present study, although abstinence rates decreased, continued beneficial effects were demonstrated even one and six months after of the conclusion of the CM procedure (more than half of the participants remained abstinent). However, we cannot be certain that the effects observed at the follow-ups are due to the CM procedure, since the maintenance of the results may also be due to the combination of CM with other interventions, in this case, CBT. Nevertheless, the percentage of participants in the CM group who had quit by the end of the treatment but relapsed by the follow-ups was smaller than in the CBT group (though the differences were not statistically significant at 6-month follow-up). This finding suggests that the behavioral support provided by the CBT in combination with the motivation provided by the abstinent-contingent incentives kept participants smoking-free for longer periods of time (Krishnan-Sarin et al., 2013). Future studies might focus on the long-term benefits (i.e., one year) and on developing methods to extend the short-term benefits and durability of incentive-based interventions.

The costs of incentive treatments are acknowledged as a barrier to their dissemination to community clinics. However, the costs associated with CM in this study are low compared with alternative smoking cessation interventions (e.g., pharmacological treatments), and could bring significant savings to the healthcare system. Although this study has not calculated cost-effectiveness, a higher cost per quit or per life-years saved using incentives versus other types of intervention is not expected. Nonetheless, we considered that an alternative way of reducing the costs of the treatment might be to use a group-based format of the CBT procedure. In the light of the data obtained, it does not seem that the group format adversely affects the effectiveness of the CM program.

Our study has limitations which mean that the results need to be interpreted with caution. First, the study enrolled more women than men, which could limit the representativeness of the smoking population – though research has found that females are more likely than males to attempt to quit (Rafful et al., 2013). Second, the relatively small sample size may have made it difficult to find statistically significant differences in some variables (e.g., continuous abstinence at six-month follow-up). Third, the relatively low frequency of biochemical monitoring meant the possibility of unreported low levels of smoking that might have been detected with more frequent monitoring. Nevertheless, a cotinine monitoring frequency of 2–3 days per week should be sufficient to detect recent smoking (Sigmon and Patrick, 2012).

Despite these limitations, the present study reports several novel findings concerning the feasibility and dissemination of CM treatments for smoking cessation. Our results provide empirical support for the notions that CM for smoking cessation among treatment-seeking patients is a viable intervention in the context of more standard conditions (community settings) and that this model of intervention can be generalized beyond controlled laboratory studies or organizational settings. The development and dissemination of such smoking cessation interventions could represent a significant step toward reducing the burden of tobacco use among the relevant populations.

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Contributors

Secades-Villa R designed the study, García-Rodríguez O and López-Nuñez C managed the literature searches and wrote the first draft of the manuscript, Fernández-Hermida JR conducted the statistical analyses. All authors contributed to and have approved the final manuscript.

Conflict of interest

No conflict declared.

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