BRIEF REPORT

# Menthol Cigarette Use Predicts Treatment Outcomes of Weight-Concerned Smokers

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## ABSTRACT

**Background:** Studies have shown that individuals who smoke menthol cigarettes are less likely to quit smoking and more likely to relapse during a quit attempt. The current study investigated menthol cigarette use as a potential predictor of smoking cessation outcomes in a sample of treatment-seeking smokers.

**Methods:** This is a secondary analysis of data from a randomized controlled trial of low-dose naltrexone augmentation of nicotine replacement designed to examine smoking cessation and postcessation weight gain in weight-concerned smokers.

**Results:** Analyses revealed that menthol use predicted lower quit rates. Among menthol smokers ($N = 61$), 13% were abstinent at week 26, and among nonmenthol smokers ($N = 105$), 30% were abstinent (Wald = 4.15, $p = .04$; odds ratio [*OR*] = 2.47; 95% CI = 1.04–5.90). Further, menthol smokers who quit smoking gained significantly more weight at week 26 ($M = 14.87$ lbs, $SD = 9.08$; $t(37) = –2.22$, $p = .03$) than nonmenthol smokers who quit ($M = 7.95$ lbs, $SD = 7.53$).

**Conclusions:** Menthol cigarette use has not typically been evaluated as a predictor of smoking cessation outcomes, but emerging evidence suggests that consumption of menthol may make cessation more difficult. This study adds to the literature supporting the claim that smoking menthol cigarettes can have adverse effects on smoking cessation efforts and on other cessation-related outcomes, such as postcessation weight gain.

## INTRODUCTION

Mentholated tobacco products were first introduced in the late 1920s and became popular due to the cooling sensation experienced when smoked (Anderson, 2011). Many of the aversive properties (e.g., burning sensations) are masked by the cooling effects of menthol and many menthol cigarette smokers believe they are at a reduced risk for negative effects of smoking (Anderson, 2011; Yerger, 2011). Unfortunately, all cigarettes have been shown to cause harm and have adverse effects on health (U.S. Department of Health and Human Services, 2010). Not only is menthol cigarette use a health hazard, but emerging evidence suggests that menthol cigarette smokers may be at risk for poor cessation outcomes.

The current literature evaluating the relationship between smoking menthol cigarettes and smoking cessation outcomes has resulted in mixed findings. For example, Fu and colleagues (2008) found no significant differences in 7-day point prevalence for menthol cigarette smoking ($N = 1,343$; odds ratio [*OR*] = 1.14, 95% CI = 0.85–1.53, $p = .39$) or ethnicity (*OR* = 0.93, 95% CI = 0.63–1.37, $p = .713$) on smoking abstinence rates. On the other hand, several studies have shown that those who smoke menthol cigarettes are less likely to quit smoking and more likely to relapse (Delnevo, Gundersen, Hrywna, Echeverria, & Steinberg, 2011; Gundersen, Delnevo, & Wackowski, 2009; Levy et al., 2011; Okuyemi et al., 2003; Okuyemi, Faseru, Cox, Bronars, & Ahluwalia, 2007). In addition, an analysis of data from the 2003 and 2006/2007 Tobacco Use Supplement to the Current Population Survey found that menthol cigarette smokers were less likely to quit smoking, despite having a greater percentage of quit attempts, compared with nonmenthol cigarette smokers (Levy et al., 2011). Statistical models revealed an effect of ethnicity and quit success, indicating lower quit rates for non-Hispanic Black menthol smokers.

In light of the emerging evidence that menthol cigarette smokers are less likely to quit smoking and more likely to relapse during a quit attempt, the current study investigated menthol cigarette use as a potential predictor of smoking cessation outcomes in a sample of treatment-seeking smokers. This is a secondary analysis of data from a randomized controlled trial of low-dose naltrexone augmentation of nicotine replacement designed to examine smoking cessation and postcessation weight gain in weight-concerned smokers (Toll et al., 2010). Based on the extant literature, we hypothesized that menthol smokers would be less likely to quit smoking compared with nonmenthol smokers.

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## METHODS

### Participants

To be eligible, all smokers needed to be classified as weight-concerned smokers based on two criteria: (a) concern about gaining weight after quitting and (b) smoking to manage weight. Concern about gaining weight after quitting was assessed using the questions "How concerned are you about gaining weight after quitting?" and "How concerned would you be if quitting smoking caused you to permanently gain 10 lbs?" (Perkins et al., 2001). A rating of 50 or higher on a 100-mm scale on either question qualified the subject on this criterion. Smoking to manage weight was assessed with the five-item weight control subscale of the Smoking Consequences Questionnaire (Copeland, Brandon, & Quinn, 1995) on which participants rate their expectations about the consequences of smoking a cigarette on a scale of 0 (*completely unlikely*) to 9 (*completely likely*). A mean score of 6 (*somewhat likely*) or above qualified participants on this criterion. Other inclusion and exclusion criteria can be found in the primary publication (Toll et al., 2010). The institutional review board of the Yale University School of Medicine approved this study.

### Procedure

Eligible participants were randomized to conditions, with blocked stratified (for gender) randomization due to the fact that weight-concerned samples are primarily female (Perkins et al., 2001). Participants received placebo or 25 mg naltrexone daily beginning the week before quitting. Naltrexone (Depade, Mallinckrodt Pharmaceuticals) was titrated for the first 2 days (i.e., 12.5 mg for 1 day, then 25 mg thereafter) then taken for a total of 27 weeks (1 week prequit and 26 weeks postquit). Naltrexone medication encapsulated in opaque capsules was dispensed in bottles. Participants received 21 mg transdermal nicotine patches (Nicoderm CQ, GlaxoSmithKline) for 6 weeks, then 14 mg patches for 2 weeks, beginning on their quit date. The counseling was adapted from the cognitive-behavioral therapy protocol for weight-concerned smokers created by Perkins and colleagues (2001). Counseling occurred weekly for the first 4 weeks, biweekly twice, then monthly.

### Assessments

Participants completed a core battery with questions about demographics and smoking variables such as the Fagerström Test for Nicotine Dependence (FTND; Fagerström & Schneider, 1989; Heatherton, Kozlowski, Frecker, & Fagerström, 1991). At each study appointment, weight, carbon monoxide (CO) levels, and reports of daily tobacco were obtained, the latter using the timeline followback interview beginning 30 days prior to screening (Brown et al., 1998; Sobell & Sobell, 1992). Participant weight (in street clothes, without shoes) was measured using a calibrated balance beam scale.

### Data Analysis

Three primary smoking outcomes were examined: (a) point prevalence abstinence over the past 7 days at 26 weeks after the quit date, (b) point prevalence abstinence over the past 7 days at 14 weeks after the quit date (a midpoint between the quit date and the end of the treatment period), and (c) latency to smoking lapse during the 26-week treatment period (defined as number of days since the first day of abstinence within the first 7 days after the quit day to the first instance of self-reported smoking). Smoking abstinence was coded categorically (0 = smoking, 1 = abstinent) and defined as self-reported abstinence and an expired-air CO level ≤10 ppm. If a participant dropped out, smoking data were collected by phone. If they reported abstinence, they were only coded as abstinent when an in-person breath CO measurement was obtain biologically verifying their self-report. Participants who dropped out or missed multiple appointments were coded as smoking. Data for a single missed appointment were coded abstinent if participants reported not smoking and had expired-air CO levels ≤10 ppm at the sessions before and after the missed appointment. Because the primary study was an intervention for weight-concerned smokers, we also assessed weight gain from baseline to Week 26 among those who were classified as abstinent at Week 26.

For the present study, logistic regression analyses were conducted to evaluate the effects of menthol cigarette use on 7-day point prevalence abstinence at Week 14 and Week 26. Menthol cigarette use was defined by a response on a smoking history questionnaire of "menthol" (vs. nonmenthol) when asked about the cigarettes participants currently smoke most of the time. Post-hoc probing of significant interactive effects was conducted using chi-square analyses. Independent samples *t* tests were used to investigate group differences in time to first lapse and weight gain from baseline. Missing assessment data were excluded from analyses.

## RESULTS

### Participant Demographics

Any of the 172 original participants who had missing data or did not self-report menthol use were dropped from the analysis, leaving a remaining sample of 166 participants. There were 61 menthol cigarette smokers (35%). As shown in Table 1, menthol smokers were mostly female (68.9%) and White (93.3%). They were also younger than nonmenthol smokers (41.3 [± 10.8] vs. 46.0 [± 10.5], $p = .007$) and less likely to be married (24.6% vs. 45.7%, $p = .007$), but otherwise were very similar demographically. With the exception of age and marital status, there were no differences by *t* test for continuous variables and chi-square test for categorical variables including employment status, baseline CO, years of daily smoking, FTND scores, time to first cigarette, and measures used to assess the weight concern intake criteria.

### Menthol Use and Outcomes

In the primary study, 7-day point prevalence smoking abstinence rates at 26 weeks postquit date were not significantly different between the two treatment groups (naltrexone: 22% vs. placebo: 27%, $p = .43$; Toll et al., 2010). Because menthol and nonmenthol smokers differed in age, all analyses were conducted controlling for age. While marital status differed between menthol and nonmenthol smokers, when this variable was included in the model, it was not significant. Therefore, our final model only controlled for age.

**Table 1. Participant Demographics**

| Characteristics | Menthol no. (%) | Nonmenthol no. (%) |
|---|---|---|
| *n* | 61 | 105 |
| Age* | 41.3 ± 10.8 | 46.0 ± 10.5 |
| Gender (female) | 42 (68.9) | 77 (73.3) |
| Race | | |
| White | 56 (93.3) | 84 (86.6) |
| Black | 3 (5.0) | 9 (9.3) |
| Other | 1 (1.7) | 2 (4.1) |
| Married* | 15 (24.6) | 48 (45.7) |
| Employed | 48 (78.7) | 84 (80.0) |
| Cigarettes per day | 22.6 ± 10.6 | 21.8 ± 8.3 |
| Baseline CO | 20.4 ± 10.4 | 22.9 ± 10.2 |
| Years daily smoking | 16.7 ± 5.9 | 17.7 ± 5.6 |
| FTND | 5.5 ± 2.3 | 5.5 ± 2.2 |
| Time to first cigarette | | |
| 30 min or less | 47 (82.5) | 83 (79.8) |
| Greater than 30 min | 10 (17.5) | 21 (20.2) |
| Perkins Scale | | |
| Question 1 | 90.6 ± 12.2 | 89.7 ± 12.1 |
| Question 2 | 72.9 ± 28.9 | 78.5 ± 23.7 |
| SCQ subscale | 7.6 ± 1.0 | 7.7 ± 1.0 |

*Note.* CO = carbon monoxide; FTND = Fagerström Test for Nicotine Dependence; SCQ = Smoking Consequences Questionnaire. Time to first cigarette is the first item on the FTND questionnaire. The Perkins Scale and the SCQ refer to scores on the measures used to assess the intake criteria: (a) concern about gaining weight after quitting and (b) smoking to manage weight. Missing data were dropped from the analyses. There were no differences by *t* test for continuous variables and chi-square test for categorical variables, with the exception of Age and Married. Averages are presented with standard deviations.
*$p < .01$.

At Week 14, 14.8% of menthol smokers ($N = 61$) were abstinent compared with 33.3% of nonmenthol smokers ($N = 105$; Wald = 4.18, $p = .04$; $OR = 2.40$; 95% CI = 1.04–5.55). At Week 26, 13% of menthol smokers were abstinent compared with 30% of nonmenthol smokers (Wald = 4.15, $p = .04$; $OR = 2.47$; 95% CI = 1.04–5.90). Further, menthol smokers who quit smoking gained significantly more weight at Week 26 ($N = 8$; $M = 14.87$ lbs, $SD = 9.08$; $t(37) = –2.22$, $p = .03$) than nonmenthol smokers who quit ($N = 32$; $M = 7.95$ lbs, $SD = 7.53$). There were no significant differences between menthol and nonmenthol smokers on latency to smoking lapse during the 26-week treatment period.

## DISCUSSION

Menthol has not typically been evaluated as a predictor of smoking cessation outcomes, but emerging evidence suggests that use of menthol cigarettes may make smoking cessation more difficult. This study contributes to the existing literature supporting the claim that smoking menthol cigarettes can have adverse effects on smoking cessation efforts (Delnevo et al., 2011; Gundersen et al., 2009; Levy et al., 2011; Okuyemi et al., 2003, 2007). For example, Okuyemi and colleagues (2003) demonstrated lowered smoking cessation rates among menthol smokers in a clinical trial assessing the efficacy of bupropion SR among Black smokers. In the present study, among a population of weight-concerned participants, menthol smokers were less likely to be abstinent at the midway point of the study as well as at the end of treatment, suggesting difficulty quitting throughout the intervention.

In addition, this study is the first to demonstrate a relationship between menthol cigarette use and postcessation weight gain. Consistent with this finding, data from the 2005 National Health Interview Survey suggest that former menthol smokers are more likely to have a higher body mass index (31.2 vs. 29.3, $p \leq .001$) than former nonmenthol smokers (Mendiondo, Alexander, & Crawford, 2010). The mechanism underlying the relationship between menthol use and weight is currently unknown, but future studies evaluating menthol cigarette use should consider an examination of health outcomes, including weight gain.

Previous research has demonstrated that a higher proportion of menthol smokers are Black and Hispanic, and female compared with nonmenthol smokers (Gandhi, Foulds, Steinberg, Lu, & Williams, 2009; Stahre, Okuyemi, Joseph, & Fu, 2010). In studies exclusively examining Black smokers, the majority are menthol smokers (Okuyemi et al., 2003, 2007; Okuyemi, Ebersole-Robinson, Nazir, & Ahluwalia, 2004). Menthol smokers are also more likely to be younger and single. The present sample of menthol smokers (mostly female, single, and approximately 40 years of age) is somewhat similar. However, one unique aspect of the menthol smokers in the present study is that they were predominantly White. A recent analysis of the Tobacco Use Supplements to the Current Population Surveys found that, at the population level, menthol smokers were mainly non-Hispanic White (Fagan et al., 2010). Thus, while menthol cigarette use has a high prevalence within historically targeted subgroups (i.e., Blacks), menthol cigarette use appears to also be common among other racial groups. As demonstrated in the present study, cessation may present a challenge to them as well.

One limitation of the present study is that an evaluation of mechanisms was not conducted. Thus, the mechanism by which cessation rates and postcessation weight gain were influenced by menthol cigarette use remains to be determined in future research. Additional research on menthol and other additives may shed light on the role such additives play in a smoking cessation attempt. A second limitation is that the sample was limited to weight-concerned smokers. Future studies should evaluate menthol as a predictor of smoking cessation outcomes in other groups of smokers. A third limitation is that the menthol smokers were slightly younger on average than the nonmenthol smokers. Menthol smoking status still significantly contributed to the model when controlling for age, but we cannot be sure if or in what way age and menthol status interact to contribute to cessation outcomes.

The impact of menthol cigarette use on public health has come under scrutiny. The findings from this study add to the mounting body of evidence demonstrating decreased cessation rates among menthol smokers, as well as highlighting other cessation-related difficulties (i.e., higher postcessation weight gain). Additional studies evaluating the relationship between menthol and smoking cessation are needed to contribute to the evaluation, and our understanding, of this additive.

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## DECLARATION OF INTERESTS

*SSO: member, American College of Neuropsychopharmacogy workgroup, the Alcohol Clinical Trial Initiative, sponsored by Alkermes, Abbott Laboratories, Eli Lilly & Company, GlaxoSmithKline, Johnson & Johnson Pharmaceuticals, Lundbeck, Pfizer and Schering Plough; partner, Applied Behavioral Research; medication supplies, Pfizer; contract, Nabi Biopharmaceuticals; Advisory Board/Consultant, Gilead Pharmaceuticals, Pfizer; consultant, Scientific Panel of Advisors, Hazelden Foundation. Dr. BAT has received research grants and support in excess of $10,000 from Pfizer for medicine only.*

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