Evaluating the association between menthol cigarette use and the likelihood of being a former versus current smoker

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ABSTRACT

Menthol in cigarettes has been examined for its potential to affect smoking dependence, measured primarily as number of cigarettes smoked per day and time to first cigarette after waking; the ability to quit smoking constitutes an additional measure of dependence. Successful quitting among menthol compared to non-menthol cigarette smokers is difficult to determine from the literature, due in part to the various definitions of quitting used by researchers. Nevertheless, intervention and follow-up studies of smoking cessation treatments generally indicate no differences in quitting success among menthol compared to non-menthol smokers, while cross-sectional studies suggest some differences within race/ethnicity groups. The association between menthol cigarette use and likelihood of being a former versus current smoker was examined based on data from the National Health Interview Survey and Tobacco Use Supplement to the Current Population Survey. Analyses stratified by race/ethnicity and limited to smokers who had quit at least one year prior to survey participation provided inconsistent results with regard to menthol cigarette use and quitting, both within surveys (*i.e.*, comparing race/ethnicity groups) and between surveys (*i.e.*, same race/ethnicity group across surveys). Evidence suggesting the existence or direction of an association between menthol in cigarettes and quitting depended on the data source.

1. Introduction

Menthol in cigarettes has been previously examined for its potential to affect smoking dependence, measured primarily as number of cigarettes smoked per day and time to first cigarette after waking (Curtin et al., 2014); the ability or inability to quit smoking constitutes an additional measure of dependence. Evidence on whether menthol in cigarettes adversely affects a smoker's ability to quit smoking is provided by intervention studies, cohort studies and cross-sectional analyses. Intervention and cohort studies may not be generalizable to the U.S. population overall, but are potentially valuable due to their longitudinal nature. Conversely, cross-sectional analyses are limited by lack of a time dimension, but can have the advantage of being generalizable to a larger population, depending upon the sampling strategy used.

This paper reviews the available evidence from intervention studies, cohort studies and cross-sectional analyses on menthol versus non-menthol cigarette use and quitting smoking, and presents original findings from cross-sectional analyses that examine the association between menthol cigarette use and likelihood of being a former versus current smoker. The new analyses are based on data from the National Health Interview Survey (NHIS) and Tobacco Use Supplement to the Current Population Survey (TUS-CPS), which are the only U.S. government surveys that provide relatively detailed information on past smoking habits among former smokers, including the use of menthol or non-menthol cigarettes and time since quitting.

2. Methods

2.1. Literature review

The U.S. National Library of Medicine's PubMed database was actively searched using the terms "menthol" and "cigarette" to identify pertinent literature (1990 to present). Articles found on screening to be relevant to menthol cigarette use and quitting smoking were reviewed and evaluated for methodological quality, particularly with respect to adequate control for confounding and likelihood of bias, and generalizability to the U.S. population. For this paper, studies are categorized according to their design and purpose (*e.g.*, evaluation of smoking cessation treatments, general population surveys), and their particular strengths and weaknesses are described.

2.2. Statistical materials and methods

Analyses of two nationally representative surveys examine whether menthol cigarette use is associated with an increased or decreased likelihood of being a former versus current smoker. NHIS and TUS-CPS provide data on current and past smoking habits, including usual cigarette type (menthol or non-menthol), among adult current and former smokers, respectively. The current analyses focused on recent administrations of each survey, *i.e.*, 2005 and 2010 (combined) for NHIS and 2010/11 for TUS-CPS. Data from 2006/07 TUS-CPS were evaluated, but differences from the 2010/11 administration in the wording of key questions and requirements for duration of smoking cessation[1] would have introduced extra variability into the results without adding information; thus, these data were not included.

One-way frequency distributions and cross-tabulations based on menthol versus non-menthol cigarette use were performed to determine whether there were adequate numbers of current and former smokers within socio-demographic strata to complete the regression analyses, as well as to create response categories. Consistent with findings from previous studies (Gundersen et al., 2009; Hyland et al., 2002; Lawrence et al., 2010; Muscat et al., 2002; Stahre et al., 2010), these analyses indicated that menthol versus non-menthol cigarette use is strongly associated with race/ethnicity, and that race/ethnicity is associated with the likelihood of being a former versus current smoker. Thus, separate logistic regression models were developed for each of the identified race/ethnic groups to estimate the association between menthol cigarette use and being a former versus current smoker independent of race/ethnicity. Analyses compared current smokers with former smokers who had quit smoking at least one year prior to survey participation in order to focus on those former smokers most likely to remain abstinent (*e.g.*, Gilpin et al., 1997).

For each race/ethnicity category, potential confounders independently associated with menthol versus non-menthol cigarette use and being a former versus current smoker were identified using two-variable models, consisting of the menthol indicator and each potential covariate. All covariates with a *p*-value of ≤0.20 were included in the first candidate multi-variable model; terms with *p*-values >0.05 in the candidate multi-variable model were then sequentially excluded, with the covariates having the highest *p*-values being excluded first. This process was repeated until only covariates with a *p*-value of ≤0.05 remained in the multi-variable model. Each of the removed covariates was then

returned to the model, individually, and the percent change in the regression coefficient for menthol was calculated. Those covariates resulting in at least a 15% change in the menthol coefficient were reinstated (Hosmer and Lemeshow, 1989).

Prior to modeling, highly correlated variables were identified ($R \geqslant 0.50$), and one member of each correlated pair was chosen for inclusion in the model building process. As a last step, the final multi-variable model was run with the alternate member of the correlated pair of covariates included (*i.e.*, instead of the original variable), and differences in the results were described (Hosmer and Lemeshow, 1989). Definitions of the parameters used in the current analyses are provided in Table 1.

All analyses employed survey methods to account for the sample design, as specified in the analytic guidelines for each data set, including the use of replicate weights for the TUS-CPS. The use of these survey methods and weights allowed for proper variance estimation, and the estimation of nationally representative summary statistics.

3. Results of literature review

3.1. Intervention studies

Examination of short-term versus long-term abstinence, continuous versus point-prevalence of abstinence (*i.e.*, measured at differing intervals after the conclusion of treatment), and biochemically verified versus self-reported abstinence were considered during this evidence review, as quitting may have been defined differently across studies. For intervention studies, it was also important to assess whether differences in treatment-seeking behaviors may be correlated with factors that are likewise associated with cigarette type preference, and whether the efficacy or effectiveness of a given intervention translates directly to the likelihood of quitting smoking among a population of smokers not seeking treatment. Nevertheless, differences in intervention success among menthol versus non-menthol cigarette smokers may provide some insights regarding the association between cigarette type and quitting success.

Two intervention studies that provide data on menthol versus non-menthol cigarette use and quitting were based on the same population of treatment-seeking African–American smokers ($n = 600$) participating in a cessation trial at an inner-city health center (Harris et al., 2004; Okuyemi et al., 2003). Okuyemi et al. (2003) reported that 7-day point-prevalence of abstinence at 6 weeks was statistically significantly lower among menthol versus non-menthol cigarette smokers, but not statistically significantly different at 6 months. This suggests that menthol cigarette smokers may be somewhat slower to quit (*i.e.*, within the first weeks of attempting to quit) than non-menthol smokers, but that longer-term quitting success is not different between these groups. A subsequent study (Harris et al., 2004), using logistic regression to assess 21 factors as potential predictors of short-term abstinence (*i.e.*, 7-day point-prevalence of abstinence following 7 weeks of treatment), did not identify menthol cigarette use as a statistically significant independent predictor of abstinence. Neither study evaluated long-term quitting success (*i.e.*, longer than 6 months) among menthol versus non-menthol cigarette smokers; and, the evidence provided on whether menthol cigarette use adversely affects short-term quitting success was inconsistent. Thus, it is not possible to conclude from these studies that menthol cigarette use affects either short- or long-term quitting success.

A second set of studies reported findings from somewhat larger populations of treatment-seeking smokers attending the same regional cessation clinics (Foulds et al., 2006; Gandhi et al., 2009). Based on analyses that controlled for variables statistically

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[1] In the 2006/07 administration of TUS-CPS, detailed information on prior smoking habits was collected from former smokers who had quit smoking up to five years prior to the survey; for the 2010/11 administration, information on prior smoking habits was collected for those who had quit smoking up to three years prior to the survey.