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# Measures of initiation and progression to increased smoking among current menthol compared to non-menthol cigarette smokers based on data from four U.S. government surveys

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ABSTRACT

There are no large-scale, carefully designed cohort studies that provide evidence on whether menthol cigarette use is associated with a differential risk of initiating and/or progressing to increased smoking. However, questions of whether current menthol cigarette smokers initiated smoking at a younger age or are more likely to have transitioned from non-daily to daily cigarette use compared to non-menthol smokers can be addressed using cross-sectional data from U.S. government surveys. Analyses of nationally representative samples of adult and youth smokers indicate that current menthol cigarette use is not associated with an earlier age of having initiated smoking or greater likelihood of being a daily versus non-daily smoker. Some surveys likewise provide information on cigarette type preference (menthol versus non-menthol) among youth at different stages or trajectories of smoking, based on number of days smoked during the past month and/or cigarettes smoked per day. Prevalence of menthol cigarette use does not appear to differ among new, less experienced youth smokers compared to established youth smokers. While there are limitations with regard to inferences that can be drawn from cross-sectional analyses, these data do not suggest any adverse effects for menthol cigarettes on measures of initiation and progression to increased smoking.


## 1. Introduction

This paper provides a review of the available studies that examine the potential effects of menthol compared to non-menthol cigarette use on initiation and/or progression to increased smoking. In addition to the literature review, this paper presents analyses of data from four U.S. government surveys to examine smoking initiation ages and likelihoods of being a daily versus non-daily smoker among current smokers who use menthol compared to non-menthol cigarettes; and, prevalence of menthol cigarette use among new, less experienced compared to more established smokers. These analyses attempt to address inconsistencies and/or fill gaps identified as a result of the literature review.

## 2. Materials and methods

### 2.1. Literature review

Studies examining ages of smoking initiation and progression to increased smoking among current menthol compared to non-menthol cigarette smokers, as well as those examining menthol cigarette preference among younger compared to older smokers were identified by searching the U.S. National Library of Medicine's PubMed database, using the terms "menthol" and "cigarette" (1990 to present). Papers that provided relevant data on these measures were further reviewed and evaluated for generalizability

*Abbreviations:* ALLTURS, American Legacy Longitudinal Tobacco Use Reduction Survey; NHANES, National Health and Nutrition Examination Survey; NSDUH, National Health Interview Survey; NHIS, National Survey on Drug Use and Health; NYTS, National Youth Tobacco Survey; TUS-CPS, Tobacco Use Supplement to the Current Population Survey.

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and methodological quality. For the current review, studies based on nationally representative samples and that presented analyses that appropriately controlled for covariates, *i.e.*, to minimize the potential for bias and confounding, were considered to provide the most relevant and reliable information. A summary of the inferences that can be drawn from these studies is presented.

### 2.2. Analyses of survey data

The National Health and Nutrition Examination Survey (NHANES), National Survey on Drug Use and Health (NSDUH), National Health Interview Survey (NHIS) and Tobacco Use Supplement to the Current Population Survey (TUS-CPS) provide nationally representative samples of smokers in sufficient numbers to examine ages of smoking initiation and likelihoods of being a daily versus non-daily smoker. In addition, TUS-CPS allows for descriptive analyses of menthol cigarette prevalence among new, less experienced smokers compared to more established smokers. Detailed descriptions of the surveys, *i.e.*, NHANES (1999–2010), NSDUH (2000–2009), NHIS (2005 and 2010) and TUS-CPS (2003 and 2006/07), and additional information on the methods used for the current analyses are provided elsewhere (Supplemental Materials and Methods). All calculations were weighted to the U.S. population, and used survey statistics to account for the complex sampling design of each survey to properly estimate variances; analyses were constructed with the goal of maximizing comparability across data sets.

In descriptive analyses, differences between menthol and non-menthol cigarette smokers were considered statistically significant if tests indicated $p < 0.05$, or if 95% confidence intervals from Rao–Scott chi-square tests did not overlap in comparisons of distributions across multiple strata. For analyses that examined differences in smoking initiation ages among current menthol compared to non-menthol cigarette smokers and controlled for demographic variables, means were compared using linear regression. To assess differences among current menthol compared to non-menthol cigarette smokers in the odds of being a daily versus non-daily smoker, logistic regression models were used to adjust for demographic and smoking-related (*e.g.*, time to first cigarette after waking, number of cigarettes smoked per day, desire to quit, intent to quit and quit attempts) covariates. For both linear and logistic regression analyses, individual preliminary models containing an indicator for menthol compared to non-menthol cigarette use and each potential covariate were used to identify terms to be included in multivariable models. Unadjusted, descriptive results are presented for comparison with data reported in the literature, and adjusted results from the final regression models are summarized in this report; results of preliminary models are provided as Supplemental Tables.

Additional descriptive analyses that examine the prevalence of menthol compared to non-menthol cigarette use among new, less experienced versus more established smokers were based on data from TUS-CPS (2003 and 2006/07). These analyses were limited to respondents 15–19 years of age who started smoking up to two years prior to the survey, based on the calculated difference between age at survey and reported age at first regular smoking. Following the methods suggested by Caraballo and Asman (2011), stages of progression from experimentation to established smoking were defined by number of days smoked during the past month (1–30 days) and usual number of cigarettes smoked per day (1, 2–5, 6–10, 11–19 and $\geqslant$20 cigarettes/day). To include as many experimenting smokers as possible, no minimum number of days smoked during the past month or cigarettes smoked per day was required. Frequency counts, weighted frequencies, weighted percentages and 95% confidence intervals around the weighted percentages are provided to examine the prevalence of menthol cigarette use at different stages or trajectories of smoking progression; there were insufficient numbers of new smokers included in the survey sample to construct regression models.

#### 2.2.1. Definitions

Three different definitions were used to identify current smokers, based on the number of days smoked during the past month, as follows: (1) past-month smokers, or individuals who had smoked part or all of a cigarette on $\geqslant$1 day during the month preceding participation in the survey; (2) regular smokers, or those who had smoked on $\geqslant$ 10 days during the month prior to the survey; and, (3) daily smokers, or those who had smoked on all 30 days prior to the survey. All surveys except for NSDUH and NHANES (youth only) limit smoking-related questions to those individuals who reported having smoked $\geqslant$100 cigarettes lifetime (*i.e.*, lifetime smokers). Menthol cigarette smokers were defined on the basis of their usual or current type of cigarette, depending on the wording of the survey question. Age of smoking initiation was defined by age of first cigarette smoked or age of first regular/daily smoking, again depending on the wording of the survey question (Supplemental Materials and Methods).

Current age for adult smokers participating in NHANES, NSDUH, NHIS and TUS-CPS was categorized as 20–25 years, 26–29 years and $\geqslant$30 years; current age categories for youth smokers in NHANES were 12–15 years and 16–19 years, while a single category of 15–19 years was used for youth smokers participating in TUS-CPS (proxy data excluded from analyses). For all four surveys, race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black and other race/ethnicity.

## 3. Results

### 3.1. Literature review

Cross-sectional data have been used to examine ages of smoking initiation among current menthol compared to non-menthol cigarette smokers (*e.g.*, Cubbin et al., 2010; Fernander et al., 2010; Lawrence et al., 2010), as well as prevalence of menthol cigarette use among younger compared to older smokers (*e.g.*, Delnevo et al., 2011; Fernander et al., 2010; Lawrence et al., 2010). Findings of an earlier age of smoking initiation among menthol compared to non-menthol smokers and/or a higher prevalence of menthol cigarette use among younger compared to older smokers could be interpreted as evidence that menthol cigarettes are disproportionately used to initiate smoking and/or that the availability of menthol cigarettes has increased the likelihood of initiating smoking. Such inferences would be inappropriate, as smokers first initiate cigarette smoking at different ages and then progress to increased smoking by different trajectories (*e.g.*, Caraballo and Asman, 2011). Stronger inferences on the potential effect of menthol cigarette use on smoking initiation would be supported by, for example, cross-sectional analyses examining the prevalence of menthol cigarette use among smokers who had recently initiated smoking, compared to those who had progressed to increased (*i.e.*, regular or daily) smoking.

#### 3.1.1. Age of smoking initiation

A number of published studies have examined age of smoking initiation among current smokers of menthol compared to non-menthol cigarettes based on nationally representative survey samples and appropriately controlling for covariates. Adjusted analyses based on data from the 2005 NHIS, stratified by race or gender, showed no statistically significant difference in age of smoking initiation among adults who currently smoke menthol compared to non-menthol cigarettes (Cubbin et al., 2010). Similar results were

reported based on unadjusted analyses of data from the same survey (Stahre et al., 2010).

Analyses of TUS-CPS (2003 and 2006/07), adjusting for demographic and smoking-related variables, indicated a weak association between current menthol cigarette use and an older age of first regular smoking (Fernander et al., 2010). A second analysis of data from the same survey likewise indicated that, among smokers overall, current menthol cigarette use was not associated with an earlier age of having initiated regular smoking (Lawrence et al., 2010). The reported findings depended on demographic characteristics, with no statistically significant differences in age of smoking initiation among non-Hispanic White, non-Hispanic Black, Hispanic or male menthol compared to non-menthol cigarette smokers; among females, menthol versus non-menthol smokers were statistically significantly more likely to have initiated regular smoking at an older age ($\geqslant$18 years versus 15–17 years). A third, unadjusted analysis of this data set indicated that statistically significantly lower proportions of current menthol compared to non-menthol cigarette smokers had initiated regular smoking at <15 years and 15–17 years of age (Fagan et al., 2010).

#### 3.1.2. Progression to increased smoking

There are no published analyses of nationally representative survey data that examine the association between menthol compared to non-menthol cigarette use and progression to increased smoking. Data from the American Legacy Longitudinal Tobacco Use Reduction Survey (ALLTURS), a study designed to evaluate a school-based smoking prevention program, have been examined twice, once in a report submitted to the Food and Drug Administration's Center for Tobacco Products (FDA-CTP) (Nonnemaker et al., 2010) and later in a peer-reviewed publication (Nonnemaker et al., 2013). Attempts to generalize these findings to the U.S. youth population overall would be inappropriate, as the study sample was not designed to be nationally representative (Davis et al., 2009).

The analyses reported to FDA-CTP provided evidence of a statistically significant association between menthol cigarette use and the odds of transitioning to daily smoking (OR = 1.71, 95% CI: 1.01–2.92), but not transitioning to having smoked $\geqslant$20 days during the past month to become an established smoker (OR = 1.68, 95% CI: 1.00–2.82) or having smoked >100 cigarette lifetime to become a "lifetime" smoker (OR = 1.61, 95% CI: 0.93–2.76) during the 3-year study period (Nonnemaker et al., 2010). The published findings suggested that smokers who used menthol cigarettes had a higher odds of transitioning to established smoking (OR = 1.80, 95% CI: 1.02–3.16), but no results were reported for daily smoking or lifetime smoking (Nonnemaker et al., 2013). Analyses provided in the peer-reviewed publication appear to be based on a revised, smaller data set than was used for the report submitted to FDA-CTP.

#### 3.1.3. Menthol cigarette preference among less experienced compared to established smokers

The 2004, 2006 and 2009 National Youth Tobacco Survey (NYTS) includes information on duration of smoking and prevalence of menthol versus non-menthol cigarette use among less experienced and more experienced smokers, based on number of days smoked during the past month and cigarettes smoked per day; Caraballo and Asman (2011) examined these data among youth who had begun cigarette use within two years prior to the survey. Findings from this study showed that menthol cigarette use was less prevalent among youth who had smoked <1 cigarette per day on 1–5 days during the past month compared to those who had smoked 1–5 cigarettes per day on either 1–5 days or 20–29 days during the past month; and, menthol cigarette use was similar among youth in other stages or trajectories of smoking progression. In addition, youth who reported the highest smoking rate and greatest smoking frequency (*i.e.*, smoked $\geqslant$20 cigarettes/day on all 30 days during the past month) were more likely to report menthol cigarette use compared to those in all other stages or trajectories of smoking progression.

Analyses based on data from earlier administrations of the NYTS (2000 and 2002) suggested that, among middle and high school students who had initiated smoking <1 year prior to the survey, those who had smoked <20 days during the past month and those who smoked <6 cigarettes per day were more likely to report smoking menthol versus non-menthol cigarettes (Hersey et al., 2006). Differences were not statistically significant, and the proportions were nearly identical when menthol smokers were restricted to those who also specified use of a predominantly mentholated brand of cigarettes (smoked <20 days during the past month: 49.0% menthol versus 48.6% non-menthol; smoked <6 cigarettes per day: 67.7% menthol versus 66.4% non-menthol). Status as a menthol versus non-menthol cigarette smoker was uncertain due to missing or inconsistent information about cigarette brand for nearly half of the students overall, and for 60% or more (depending on exclusions) of those who had smoked for <1 year (Hersey et al., 2006).

Analyses based on data from TUS-CPS (2003 and 2006/07) suggested that current menthol cigarette smokers tend to be younger than non-menthol smokers, but that menthol cigarette use is not statistically significantly different among some day compared to every day smokers (Fernander et al., 2010). Similarly, analyses of the National Survey on Drug Use and Health (NSDUH; 2004–2010) indicated that the odds of being a menthol cigarette smoker are not statistically significantly different among those who smoke less frequently (*i.e.*, 1–5 days versus 6–29 days smoked in the past month), after adjusting for covariates but not accounting for duration of smoking (Giovino et al., 2013).

### 3.2. Analyses of survey data

#### 3.2.1. Age of smoking initiation

*3.2.1.1. National Health and Nutrition Examination Survey (1999–2010).* The unadjusted mean ages of first regular smoking among adult current past-month, regular and daily menthol cigarette smokers are approximately 0.4–0.5 years older compared to non-menthol smokers (Supplemental Tables 1A–1C), with the difference among daily smokers being statistically significant. Within demographic strata, current menthol cigarette smokers are generally more likely to report numerically, but not statistically significantly older ages of first regular smoking compared to non-menthol smokers. Regression analyses that control for demographic variables (Supplemental Tables R1A–R1C) indicate no statistically significant differences in mean age of first regular smoking among adult past-month, regular or daily smokers who currently use menthol compared to non-menthol cigarettes (0.06 years, 0.10 years and 0.21 years older, respectively).

Specific to youth, unadjusted mean ages of first whole cigarette smoked among current past-month, regular and daily menthol cigarette smokers are approximately 0.5–0.6 years older compared to non-menthol smokers (Supplemental Tables 2A–2C); the difference among past-month smokers is statistically significant. After stratifying by demographic characteristics, current menthol cigarette smokers generally report numerically, but not statistically significantly older ages of first whole cigarette smoked compared to non-menthol smokers. Regression analyses that control for demographic variables (Supplemental Tables R2A–R2C) indicate an older mean age of first whole cigarette smoked among daily menthol compared to non-menthol cigarette smokers (11.05 versus 10.32 years, respectively; $p = 0.03$). Adjusted results are similar among current past-month and regular menthol versus

non-menthol cigarette smokers (12.31 versus 11.55 years, $p < 0.0001$; and, 11.90 versus 11.14 years, $p = 0.004$, respectively).

*3.2.1.2. National Survey on Drug Use and Health (2000–2009).* Among adult past-month, regular and daily smokers, unadjusted mean ages of first part or whole cigarette smoked for current menthol cigarette smokers are statistically significantly older (approximately 0.5–0.6 years) compared to non-menthol smokers (Supplemental Tables 3A–3C). In addition, statistically significant, older mean ages of first part or whole cigarette smoked are reported for current menthol versus non-menthol smokers who are male, female, non-Hispanic White, aged 20–25 years, aged 26–29 years and aged ⩾30 years. Regression analyses that control for demographic variables (Supplemental Tables R3A–R3C) suggest a slightly older mean age for first part or whole cigarette smoked among daily smokers who currently use menthol compared to non-menthol cigarettes (13.65 versus 13.51 years, respectively; $p = 0.05$); no statistically significant differences are indicated among past-month or regular smokers (0.06 years older for both definitions of current smoking).

NSDUH likewise provides data on age of first daily smoking. Adult past-month, regular and daily smokers who currently use menthol cigarettes report statistically significantly older ages of first daily smoking (approximately 0.5–0.6 years) compared to those who use non-menthol cigarettes (Supplemental Tables 4A–4C). In addition, statistically older mean ages of first daily smoking are reported for current menthol versus non-menthol smokers who are male, female, non-Hispanic White, aged 26–29 years and aged ⩾30 years. Regression analyses (Supplemental Tables R4A–R4C) suggest that current daily menthol cigarette smokers initiated first daily smoking at a slightly older mean age than non-menthol smokers (15.95 versus 15.80 years, respectively; $p = 0.06$). Past-month and regular smokers who currently use menthol versus non-menthol cigarettes were statistically older at first daily smoking (16.16 versus 16.00 years, $p = 0.03$; and, 16.17 versus 16.00 years, $p = 0.03$, respectively), after adjustment.

*3.2.1.3. National Health Interview Survey (2005 and 2010).* Unadjusted mean ages of first regular smoking among adult past-month, regular and daily smokers are statistically older (approximately 0.5 years) among current menthol versus non-menthol cigarette smokers (Supplemental Tables 5A–5C). Within demographic strata, current menthol cigarette smokers generally report numerically, but not statistically older mean ages of first regular smoking compared to non-menthol smokers. Results from regression analyses that control for demographic variables (Supplemental Tables R5A–R5C) indicate no statistically significant differences in mean age of first regular smoking among past-month, regular or daily menthol compared to non-menthol smokers (0.11 years, 0.10 years and 0.14 years older, respectively).

*3.2.1.4. Tobacco Use Supplement – Current Population Survey (2003 and 2006/07).* Among youth and adult smokers, current menthol versus non-menthol cigarette smokers were statistically older, on average, when they initiated first regular smoking; the unadjusted differences were approximately 0.4 years among past-month, regular and daily smokers (Supplemental Tables 6A–6C). In addition, statistically older mean ages of first regular smoking are reported for current menthol versus non-menthol smokers who are male, female, non-Hispanic White, non-Hispanic Black, aged 26–29 years and aged ⩾30 years; statistically younger ages are suggested for current menthol smokers who are other race/ethnicity and aged 15–19 years.

Among adults, regression models that control for demographic variables (Supplemental Tables R6A–R6C) indicate that current daily menthol cigarette smokers initiated first regular smoking at a statistically significantly older mean age than non-menthol smokers (15.67 versus 15.44 years, respectively; $p < 0.0001$), after adjustment. Statistically significantly older ages of first regular smoking are likewise reported for past-month and regular smokers who currently use menthol versus non-menthol cigarettes (15.83 versus 15.63 years, $p < 0.0001$; and, 15.81 versus 15.60 years, $p < 0.0001$, respectively), after adjustment.

Specific to youth, regression analyses that control for gender and race/ethnicity (Supplemental Tables R7A–R7C) indicate a statistically younger mean age of initiating first regular smoking among current daily menthol versus non-menthol cigarette smokers (14.90 versus 15.06 years, respectively; $p = 0.01$). Statistically younger ages of first regular smoking are likewise reported for past-month and regular smokers who currently use menthol versus non-menthol cigarettes (15.12 versus 15.29 years, $p = 0.001$; and, 15.10 versus 15.30 years, $p < 0.0001$, respectively).

*3.2.1.5. Summary of data on age of smoking initiation.* These analyses provide estimates for mean age of first cigarette smoked (NHANES and NSDUH) and first regular/daily smoking (NHANES, NSDUH, NHIS and TUS-CPS) among current menthol compared to non-menthol smokers, based on nationally representative samples. Estimates from regression models that control for demographic variables demonstrate that adults who currently smoke menthol versus non-menthol cigarettes do not report an earlier mean age of first cigarette smoked (NSDUH), first regular smoking (NHANES, NHIS and TUS-CPS), or first daily smoking (NSDUH) (Table 1). Youth who currently use menthol cigarettes report smoking their first cigarette at a statistically older mean age (*i.e.*, approximately 9 months older) than those who use non-menthol cigarettes (NHANES); however, youth who currently use menthol cigarettes are suggested to have initiated first regular smoking approximately 2–3 months earlier than those who use non-menthol cigarettes (TUS-CPS).

*3.2.2. Likelihood of being a daily versus non-daily smoker*

*3.2.2.1. National Health and Nutrition Examination Survey (1999–2010).* Regression analyses that control for demographic variables indicate slightly higher odds of being a daily versus non-daily smoker among adults who currently use non-menthol compared to menthol cigarettes (OR: 1.21, 95% CI: 1.00, 1.46; $p = 0.05$; Table 2). There is no difference in the odds of being a daily versus non-daily smoker among those who currently use menthol compared to non-menthol cigarettes after adjustment for all statistically significant demographic variables and dependence measures that include time to first cigarette, age of first whole cigarette smoked, and cigarettes per day (OR: 0.97, 95% CI: 0.68, 1.39; $p = 0.88$).

Among youth smokers, analyses that control for demographic variables indicate that the odds of being a daily versus non-daily smoker are not statistically different among those who currently use non-menthol compared to menthol cigarettes (OR: 0.72, 95% CI: 0.49, 1.05; $p = 0.09$; Table 3). Adjustment for all statistically significant demographic variables and dependence measures reversed the direction of the association, with the odds of being a daily versus non-daily smoker among those who currently use non-menthol cigarettes estimated to be 63% higher, but not statistically different compared to those who use menthol cigarettes (OR 1.63, 95% CI: 0.95–2.78; $p = 0.07$).

*3.2.2.2. National Survey on Drug Use and Health (2000–2009).* Analyses that control for demographic variables indicate that the odds of being a daily versus non-daily smoker are statistically higher among adults who currently use non-menthol compared to menthol cigarettes (OR: 1.07, 95% CI: 1.01, 1.12; $p = 0.01$; Table 4). Controlling for all statistically significant demographic variables and dependence measures (*i.e.*, age of first part or whole cigarette smoked and cigarettes per day) provides similar findings, with

**Table 1**
Summary of regression analyses on age of smoking initiation among menthol compared to non-menthol cigarette smokers.

| | NHANES | | NSDUH | NHIS | TUS-CPS | |
|---|---|---|---|---|---|---|
| | Youth[a] | Adults[b] | Adults[b] | Adults[b] | Youth[c] | Adults[b] |
| *Age of smoking initiation* | | | | | | |
| First part/whole cigarette | Older ages[d,e,f] | – | Older age[f] | – | – | – |
| First regular smoking | – | No differences | – | No differences | Younger ages[d,e,f] | Older ages[d,e,f] |
| First daily smoking | – | – | Older ages[d,e,f] | – | – | – |

[a] Ages 12–19 years.
[b] Ages 20 years and older.
[c] Ages 15–19 years.
[d] Past-month smokers, defined as having smoked ⩾1 day during the past month.
[e] Regular smokers, defined as having smoked ⩾10 days during the past month.
[f] Daily smokers, defined as smoking all 30 days during the past month.

**Table 2**
Adjusted odds of being a daily versus non-daily smoker among adults, adjusted for demographic variables and dependence measures (NHANES, 1999–2010).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | 0.25 | | | 0.05 | | | 0.88 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 1.10 | 0.93, 1.30 | | 1.21 | 1.00, 1.46 | | 0.97 | 0.68, 1.39 | |
| Time to first cigarette | | | | | | | | | <0.0001 |
| ⩽5 min | | | | | | | -ref- | | |
| 6–30 min | | | | | | | 1.02 | 0.61, 1.73 | |
| 31–60 min | | | | | | | 0.72 | 0.43, 1.20 | |
| >60 min | | | | | | | 0.34 | 0.21, 0.55 | |
| Age at initiation[d] | | | | | | | | | 0.54 |
| Years | | | | | | | 0.99 | 0.97, 1.02 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| Average | | | | | | | 1.07 | 1.05, 1.09 | |
| Gender | | | | | | 0.04 | | | |
| Male | | | | -ref- | | | | | |
| Female | | | | 1.16 | 1.00, 1.33 | | | | |
| Race/ethnicity | | | | | | <0.0001 | | | 0.25 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 0.60 | 0.49, 0.74 | | 0.95 | 0.67, 1.33 | |
| Other | | | | 0.35 | 0.30, 0.42 | | 0.75 | 0.53, 1.05 | |
| Current age (years) | | | | | | <0.0001 | | | 0.25 |
| 20 to 25 | | | | -ref- | | | -ref- | | |
| 26 to 29 | | | | 0.92 | 0.69, 1.23 | | 0.82 | 0.51, 1.32 | |
| ⩾30 | | | | 1.79 | 1.48, 2.18 | | 1.13 | 0.75, 1.72 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old were [you] when [you] first started to smoke cigarettes fairly regularly?"

statistically higher odds of being a daily versus non-daily smoker among current non-menthol compared to menthol smokers (OR: 1.08, 95% CI: 1.03, 1.14; $p = 0.002$). The odds of being a daily versus non-daily smoker are similar when the variable for age of first part or whole cigarette smoked is replaced with the variable for age of first daily smoking (OR: 1.08, 95% CI: 1.02, 1.15; $p = 0.01$; Table 5).

*3.2.2.3. National Health Interview Survey (2005 and 2010).* There is no difference in the odds of being a daily versus non-daily smoker among adult current menthol compared to non-menthol cigarette smokers after adjusting for demographic characteristics (OR: 0.94, 95% CI: 0.81, 1.09; $p = 0.39$; Table 6). Additionally controlling for dependence measures (*i.e.*, age of first regular smoking, cigarettes per day, attempted quitting, and intent to quit) lowered the odds ratio, but the difference is not statistically significant (OR: 0.81, 95% CI: 0.65, 1.10; $p = 0.07$).

*3.2.2.4. Tobacco Use Supplement – Current Population Survey (2003 and 2006/07).* Among adults, regression analyses that control for demographic variables indicate no statistically significant differences in the odds of being a daily versus non-daily smoker among smokers who currently use non-menthol compared to menthol cigarettes (OR: 0.99, 95% CI: 0.96, 1.01; $p = 0.22$; Table 7). After adjustment for all statistically significant demographic variables and dependence measures (*i.e.*, time to first cigarette, age of first regular smoking, cigarettes per day, and attempted quitting), the odds of being a daily versus non-daily smoker among current non-menthol compared to menthol smokers are statistically lower (OR: 0.94, 95% CI: 0.91, 0.97; $p = 0.0004$).

Specific to youth, regression models indicate no statistically significant differences in the odds of being a daily versus a non-daily smoker among current menthol compared to non-menthol smokers when controlling for demographic variables (OR: 0.98, 95% CI: 0.87, 1.10; $p = 0.71$; Table 8), or when adjusting for all statistically significant demographic variables and dependence measures (*i.e.*, time to first cigarette, age of first regular smoking, cigarettes per day, and attempted quitting) (OR: 1.00, 95% CI: 0.83, 1.20; $p = 0.99$).

**Table 3**
Adjusted odds of being a daily versus non-daily smoker among youth, adjusted for demographic variables and dependence measures (NHANES, 1999–2010).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | 0.04 | | | 0.09 | | | 0.07 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 0.69 | 0.48, 0.98 | | 0.72 | 0.49, 1.05 | | 1.63 | 0.95, 2.78 | |
| Gender | | | | | | 0.99 | | | |
| Male | | | | -ref- | | | | | |
| Female | | | | 1.00 | 0.73, 1.37 | | | | |
| Race/ethnicity | | | | | | <0.0001 | | | 0.97 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 0.47 | 0.33, 0.67 | | 0.93 | 0.54, 1.61 | |
| Other | | | | 0.42 | 0.29, 0.63 | | 0.98 | 0.53, 1.80 | |
| Current age (years) | | | | | | <0.0001 | | | 0.001 |
| 12 to 15 | | | | -ref- | | | -ref- | | |
| 16 to 19 | | | | 3.03 | 1.85, 4.98 | | 3.76 | 1.78, 7.95 | |
| Time to first cigarette | | | | | | | | | <0.0001 |
| ⩽5 min | | | | | | | -ref- | | |
| 6–30 min | | | | | | | 1.78 | 0.77, 4.15 | |
| 31–60 min | | | | | | | 0.65 | 0.33, 1.28 | |
| >60 min | | | | | | | 0.10 | 0.05, 0.20 | |
| Age at initiation[d] | | | | | | | | | 0.57 |
| Years | | | | | | | 0.97 | 0.86, 1.08 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| Average | | | | | | | 1.22 | 1.14, 1.30 | |
| Attempted to quit | | | | | | | | | 0.13 |
| No | | | | | | | -ref- | | |
| Yes | | | | | | | 0.72 | 0.47, 1.10 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old were you when you smoked a whole cigarette for the first time?"

**Table 4**
Adjusted odds of being a daily versus non-daily smoker among adults, adjusted for demographic variables and dependence measures (first cigarette; NSDUH, 2000–2009).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | <0.0001 | | | 0.011 | | | 0.002 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 0.86 | 0.82, 0.90 | | 1.07 | 1.01, 1.12 | | 1.08 | 1.03, 1.14 | |
| Gender | | | | | | 0.0003 | | | <0.0001 |
| Male | | | | -ref- | | | -ref- | | |
| Female | | | | 0.92 | 0.87, 0.96 | | 0.75 | 0.71, 0.79 | |
| Race/ethnicity | | | | | | <0.0001 | | | <0.0001 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 2.19 | 2.03, 2.37 | | 1.39 | 1.28, 1.52 | |
| Other | | | | 2.51 | 2.35, 2.67 | | 1.62 | 1.52, 1.74 | |
| Current age (years) | | | | | | <0.0001 | | | <0.0001 |
| 20 to 25 | | | | -ref- | | | -ref- | | |
| 26 to 29 | | | | 0.94 | 0.88, 1.00 | | 1.02 | 0.94, 1.09 | |
| ⩾30 | | | | 0.60 | 0.58, 0.62 | | 0.78 | 0.75, 0.82 | |
| Age at initiation[d] | | | | | | | | | <0.0001 |
| Years | | | | | | | 1.02 | 1.01, 1.03 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| ⩽10 | | | | | | | -ref- | | |
| 11–20 | | | | | | | 0.14 | 0.13, 0.16 | |
| >20 | | | | | | | 0.15 | 0.14, 0.17 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old were you when you first smoked all or part of a cigarette?"

*3.2.2.5. Summary of data on likelihood of being a daily versus non-daily smoker.* Regression analyses that control for demographic variables demonstrate that current menthol compared to non-menthol cigarette use among adults (NHANES, NSDUH, NHIS and TUS-CPS) and youth (NHANES and TUS-CPS) is not associated with an increased odds of being a daily versus non-daily smoker

**Table 5**
Adjusted odds of being a daily versus non-daily smoker among adults, adjusted for demographic variables and dependence measures (first daily smoking; NSDUH, 2000–2009).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | <0.0001 | | | 0.01 | | | 0.01 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 0.86 | 0.82, 0.90 | | 1.07 | 1.01, 1.12 | | 1.08 | 1.02, 1.15 | |
| Gender | | | | | | 0.0003 | | | <0.0001 |
| Male | | | | -ref- | | | -ref- | | |
| Female | | | | 0.92 | 0.87, 0.96 | | 0.80 | 0.75, 0.84 | |
| Race/ethnicity | | | | | | <0.0001 | | | <0.0001 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 2.19 | 2.03, 2.37 | | 1.28 | 1.16, 1.42 | |
| Other | | | | 2.51 | 2.35, 2.67 | | 1.31 | 1.21, 1.42 | |
| Current age (years) | | | | | | <0.0001 | | | <0.0001 |
| 20 to 25 | | | | -ref- | | | -ref- | | |
| 26 to 29 | | | | 0.94 | 0.88, 1.00 | | 1.01 | 0.93, 1.09 | |
| ⩾30 | | | | 0.60 | 0.58, 0.62 | | 0.81 | 0.77, 0.85 | |
| Age at initiation[d] | | | | | | | | | <0.0001 |
| Years | | | | | | | 1.02 | 1.01, 1.02 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| ⩽10 | | | | | | | -ref- | | |
| 11–20 | | | | | | | 0.19 | 0.17, 0.20 | |
| >20 | | | | | | | 0.20 | 0.18, 0.22 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old were you when you first started smoking cigarettes every day?"

**Table 6**
Adjusted odds of being a daily versus non-daily smoker among adults, adjusted for demographic variables and dependence measures (NHIS, 2005 and 2010).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | 0.17 | | | 0.39 | | | 0.07 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 1.09 | 0.96, 1.24 | | 0.94 | 0.81, 1.09 | | 0.81 | 0.65, 1.01 | |
| Gender | | | | | | 0.79 | | | |
| Male | | | | -ref- | | | | | |
| Female | | | | 1.02 | 0.90, 1.14 | | | | |
| Race/ethnicity | | | | | | <0.0001 | | | 0.09 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 0.68 | 0.57, 0.81 | | 1.15 | 0.88, 1.50 | |
| Other | | | | 0.44 | 0.38, 0.52 | | 1.33 | 1.02, 1.73 | |
| Current age (years) | | | | | | <0.0001 | | | 0.42 |
| 20 to 25 | | | | -ref- | | | -ref- | | |
| 26 to 29 | | | | 1.04 | 0.82, 1.34 | | 0.87 | 0.59, 1.29 | |
| ⩾30 | | | | 1.74 | 1.44, 2.11 | | 1.08 | 0.82, 1.43 | |
| Age at initiation[d] | | | | | | | | | 0.12 |
| Years | | | | | | | 0.99 | 0.97, 1.00 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| Average | | | | | | | 1.42 | 1.36, 1.49 | |
| Tried quit smoking 1 + days (past 12 mos) | | | | | | | | | 0.17 |
| Yes | | | | | | | -ref- | | |
| No | | | | | | | 1.18 | 0.93, 1.49 | |
| Likely to completely quit smoking | | | | | | | | | 0.85 |
| Yes | | | | | | | -ref- | | |
| No | | | | | | | 0.98 | 0.76, 1.26 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old were you when you first started to smoke fairly regularly?"

(Table 9); in two instances, menthol cigarette smokers had lower odds of being a daily versus non-daily smoker (NHANES: 21% lower odds, $p = 0.05$; NSDUH: 7% lower odds, $p = 0.01$).

Similar findings are provided by regression models that control for both statistically significant demographic variables and dependence measures (Table 9). Among adults, there are either no statis-

**Table 7**
Adjusted odds of being a daily versus non-daily smoker among adults, adjusted for demographic variables and dependence measures (TUS-CPS, 2003 and 2006/07).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | <0.0001 | | | 0.22 | | | 0.0004 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 1.12 | 1.10, 1.15 | | 0.99 | 0.96, 1.01 | | 0.94 | 0.91, 0.97 | |
| Gender | | | | | | 0.03 | | | <0.0001 |
| Male | | | | -ref- | | | -ref- | | |
| Female | | | | 0.98 | 0.96, 1.00 | | 1.53 | 1.49, 1.57 | |
| Race/ethnicity | | | | | | <0.0001 | | | <0.0001 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 0.64 | 0.62, 0.66 | | 1.16 | 1.10, 1.22 | |
| Other | | | | 0.45 | 0.44, 0.47 | | 1.40 | 1.34, 1.46 | |
| Current age (years) | | | | | | <0.0001 | | | <0.0001 |
| 20 to 25 | | | | -ref- | | | -ref- | | |
| 26 to 29 | | | | 1.04 | 1.00, 1.08 | | 0.89 | 0.84, 0.94 | |
| ⩾30 | | | | 1.67 | 1.63, 1.72 | | 0.89 | 0.85, 0.93 | |
| Time to first cigarette | | | | | | | | | <0.0001 |
| ⩽5 min | | | | | | | -ref- | | |
| 6–30 min | | | | | | | 1.12 | 1.04, 1.20 | |
| 31–60 min | | | | | | | 0.80 | 0.75, 0.86 | |
| >60 min | | | | | | | 0.25 | 0.23, 0.26 | |
| Age at initiation[d] | | | | | | | | | <0.0001 |
| Years | | | | | | | 0.99 | 0.98, 0.99 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| Average | | | | | | | 1.30 | 1.29, 1.31 | |
| Attempted to quit | | | | | | | | | <0.0001 |
| No | | | | | | | -ref- | | |
| Yes | | | | | | | 0.71 | 0.69, 0.73 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old [were you] when [you] first started smoking cigarettes fairly regularly?"

**Table 8**
Adjusted odds of being a daily versus non-daily smoker among youth, adjusted for demographic variables and dependence measures (TUS-CPS, 2003 and 2006/07).

| Parameter | Menthol only | | | Menthol + demographic variables | | | Menthol + demographic[a] + dependency measures | | |
|---|---|---|---|---|---|---|---|---|---|
| | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value | OR[b] | 95% CI[c] | *P*-value |
| Menthol/non-menthol smoker | | | 0.42 | | | 0.71 | | | 0.99 |
| Menthol | -ref- | | | -ref- | | | -ref- | | |
| Non-menthol | 1.05 | 0.94, 1.17 | | 0.98 | 0.87, 1.10 | | 1.00 | 0.83, 1.20 | |
| Gender | | | | | | <0.0001 | | | <0.0001 |
| Male | | | | -ref- | | | -ref- | | |
| Female | | | | 1.38 | 1.25, 1.53 | | 1.46 | 1.27, 1.67 | |
| Race/ethnicity | | | | | | <0.0001 | | | 0.001 |
| Non-Hispanic White | | | | -ref- | | | -ref- | | |
| Non-Hispanic Black | | | | 0.69 | 0.57, 0.83 | | 1.26 | 0.91, 1.76 | |
| Other | | | | 0.52 | 0.45, 0.59 | | 0.76 | 0.63, 0.92 | |
| Time to first cigarette | | | | | | | | | <0.0001 |
| ⩽5 min | | | | | | | -ref- | | |
| 6–30 min | | | | | | | 1.58 | 1.12, 2.23 | |
| 31–60 min | | | | | | | 0.91 | 0.64, 1.31 | |
| >60 min | | | | | | | 0.44 | 0.32, 0.61 | |
| Age at initiation[d] | | | | | | | | | 0.23 |
| Years | | | | | | | 0.96 | 0.93, 1.00 | |
| Cigarettes per day | | | | | | | | | <0.0001 |
| Average | | | | | | | 1.25 | 1.21, 1.29 | |
| Attempted to quit | | | | | | | | | 0.14 |
| No | | | | | | | -ref- | | |
| Yes | | | | | | | 1.16 | 0.95, 1.42 | |

[a] Adjusting for all statistically significant demographic variables.
[b] Odds ratio.
[c] 95% confidence interval.
[d] "How old [were you] when [you] first started smoking cigarettes fairly regularly?"

**Table 9**
Summary of regression analyses on likelihood of being a daily versus non-daily smoker among menthol compared to non-menthol cigarette smokers.

| | NHANES | | NSDUH | NHIS | TUS-CPS | |
|---|---|---|---|---|---|---|
| | Youth[a] | Adults[b] | Adults[b] | Adults[b] | Youth[c] | Adults[b] |
| Daily versus non-daily smoker | | | | | | |
| Demographic variables | No difference | Lower odds | Lower odds | No difference | No difference | No difference |
| Demographic + dependence variables | No difference | No difference | Lower odds[d] | No difference | No difference | Higher odds |

[a] Ages 12–19 years.
[b] Ages 20 years and older.
[c] Ages 15–19 years.
[d] Statistical difference retained regardless of age of smoking initiation variable (*i.e.*, first part/whole cigarette or first daily smoking).

**Table 10**
Menthol and non-menthol cigarette use among youth smokers at different stages of smoking progression (TUS-CPS, 2003 and 2006/07).

| Parameter | | Menthol smokers[a] | | | | Non-menthol smokers[a] | | | |
|---|---|---|---|---|---|---|---|---|---|
| Days/month | Cigarettes/day | Frequency | Weighted frequency | Percent | 95% CI[b] | Frequency | Weighted frequency | Percent | 95% CI[b] |
| 1–10[c] | 1–5 | 16 | 16,795 | 36.91 | 19.7, 54.1 | 28 | 28,707 | 63.09 | 45.9, 80.3 |
| | 6–19 | n/s | n/s | n/s | n/s | n/s | n/s | n/s | n/s |
| | ⩾20 | 0 | n/a | n/a | n/a | 0 | n/a | n/a | n/a |
| 11–29 | 1–5 | 42 | 59,154 | 39.48 | 29.1, 49.9 | 88 | 90,688 | 60.52 | 50.1, 70.9 |
| | 6–19 | 10 | 9067 | 32.09 | 12.0, 52.1 | 19 | 19,187 | 67.91 | 47.9, 88.0 |
| | ⩾20 | n/s | n/s | n/s | n/s | n/s | n/s | n/s | n/s |
| Daily[d] | 1–5 | 40 | 47,498 | 40.54 | 28.9, 52.2 | 75 | 69,675 | 59.46 | 47.8, 71.1 |
| | 6–19 | 110 | 124,946 | 35.63 | 29.3, 41.9 | 215 | 225,759 | 64.37 | 58.1, 70.7 |
| | ⩾20 | 47 | 50,101 | 35.45 | 26.4, 44.5 | 86 | 91,217 | 64.55 | 55.5, 73.6 |

n/s = not shown; ⩽5 smokers in days/month or cigarettes/day category; percentage estimates unreliable.
n/a = not applicable; no weighted frequencies or percentages calculated for categories with no observations.
[a] Ages 15–19 years, smoking ⩽2 years prior to survey (*i.e.*, age at survey minus age started smoking ⩽2 years).
[b] 95% confidence interval of the percentage.
[c] For 1–29 day smokers, "On the average, of those [# of days smoked] days, how many cigarettes did you usually smoke each day?"
[d] For daily smokers, "On the average, about how many cigarettes do you now smoke each day?"

tically significant differences in the odds of being a daily versus non-daily smoker among current menthol compared to non-menthol cigarette smokers (NHANES and NHIS), or differences are small in magnitude (NSDUH: 8% lower odds, controlling for either age of first cigarette smoked or age of first daily smoking; TUS-CPS: 6% greater odds, controlling for age of first regular smoking). Analyses based on youth populations (NHANES and TUS-CPS) demonstrate no statistically significant differences in the odds of being a daily versus non-daily smoker among current menthol compared to non-menthol cigarette smokers, when controlling for either demographic variables or statistically significant demographic variables and dependence measures.

### *3.2.3. Menthol cigarette preference among less experienced compared to established smokers*

*3.2.3.1. Tobacco Use Supplement – Current Population Survey (2003 and 2006/07).* Descriptive analyses of data from TUS-CPS examine the prevalence of current menthol and non-menthol cigarette use among youth who had initiated smoking within two years prior to the survey and who are at different stages or trajectories of smoking progression, using the same categorization scheme proposed by Caraballo and Asman (2011). Smoking progression categories are based on number of days smoked during the past month (1–10 days, 11–29 days and daily), or number of cigarettes smoked per day (1–5 cigarettes, 6–19 cigarettes and ⩾20 cigarettes) within categories of days smoked during the past month (Supplemental Table 7); for this analyses, categories are subsequently combined due to small sample sizes, and data in cells with ⩽5 observations are not shown (Table 10).

The available data indicate no differences in the prevalence of menthol cigarette use among 15–19 year olds who initiated smoking within the past two years and who are at different stages of smoking progression. Specifically, prevalence of menthol cigarette use among youth who reported smoking 1–5 cigarettes per day on 1–10 days, 11–29 days and daily during the past month is 37%, 39% and 41%, respectively, while menthol cigarette prevalence among daily smokers who reported smoking 1–5 cigarettes, 6–19 cigarettes and ⩾20 cigarettes per day is 41%, 36% and 35%. Moreover, there is no difference in prevalence of menthol cigarette use among youth at a less established smoking stage (*i.e.*, smoked 1–5 cigarettes per day on 1–10 days in the past month) compared to more established smokers (*i.e.*, smoked ⩾20 cigarettes per day on all 30 days during the past month).

*3.2.3.2. Summary of data on menthol cigarette preference among less experienced compared to established smokers.* These data suggest that there is no association between prevalence of menthol cigarette use and stage of smoking progression, defined by categories of number of days smoked during the past month and number of cigarettes smoked per day. Due to the small numbers of observations for the smoking behavior categories examined, 95% confidence intervals around the weighted percentages are wide; nonetheless, these data corroborate the findings of Caraballo and Asman (2011). The current data are derived from a cross-sectional survey and not a prospective study, and thus can only provide suggestions regarding any association between cigarette type and progression to increased smoking among new smokers.

## 4. Conclusions

There are currently no large-scale, carefully designed cohort studies that provide evidence on whether menthol cigarettes are associated with a differential risk of initiating and/or progressing to regular smoking. In the absence of such studies, cross-sectional data can be used to compare smoking initiation age among current smokers of menthol and non-menthol cigarettes. If current menthol cigarette smokers report an earlier smoking initiation age, the inference is that menthol cigarettes are disproportionately

used to initiate smoking and/or that the availability of menthol cigarettes has increased the likelihood of initiating smoking. Such inferences would be inappropriate, as smokers first initiate cigarette smoking at different ages and then progress to increased smoking by different trajectories (*e.g.*, Caraballo and Asman, 2011).

Regression analyses based on data from four nationally representative samples, utilizing three different definitions for current smokers (*i.e.*, smoked on $\geqslant$1 day, $\geqslant$10 days or daily during the past month), demonstrate that current menthol cigarette use among adults is not associated with an earlier age of first cigarette smoked (NSDUH), first regular smoking (NHANES, NHIS and TUS-CPS) or first daily smoking (NSDUH), when controlling for gender, race/ethnicity and current age category. These findings are consistent with previously published analyses based on data from NHIS and TUS-CPS (Cubbin et al., 2010; Fernander et al., 2010; Lawrence et al., 2010); specifically, adults who currently use menthol cigarettes did not initiate smoking at an earlier age compared to non-menthol smokers.

Restricting analyses to younger smokers may be more informative, as youth would have initiated smoking more recently, on average, than adult smokers; however, describing current preferences for menthol or non-menthol cigarettes among youth can only approximate the cigarette type used during smoking initiation. Within that context, the data on youth smokers are somewhat mixed, with the mean age of first cigarette smoked reported to be approximately 9 months older and mean age of first regular smoking approximately 2–3 months younger, among current smokers of menthol compared to non-menthol cigarettes.

Analyses that examine the odds of being a daily versus non-daily smoker provide evidence on whether menthol compared to non-menthol cigarette smokers are more likely to have progressed to increased smoking, with non-daily smokers presumably being at an earlier stage or trajectory of smoking than daily smokers. This presumption may not always be correct among adults or youth with an established smoking behavior, as smokers could be transitioning to smoking less rather than more often. Nevertheless, regression analyses that control for demographic and dependence variables (including, in some instances, variables such as intention to quit) demonstrate that adult and youth menthol cigarette smokers are not more likely to be daily versus non-daily smokers compared to non-menthol smokers. These findings, in particular among youth smokers, are inconsistent with the results presented by Nonnemaker et al. (2010), which suggested that youth who used menthol compared to non-menthol cigarettes were more likely to progress to daily smoking. A revised, peer-reviewed set of analyses (Nonnemaker et al., 2013) suggested that menthol compared to non-menthol smokers were more likely to progress from non-established to established smoking (*i.e.*, had smoked on $\geqslant$20 days during the past month). However, findings from this single study were based on a small, non-representative sample of middle and high school students participating in an educational intervention study, and would not be generalizable to the U.S. youth population overall.

Descriptive, cross-sectional analyses of youth who had initiated smoking within two years prior to participating in TUS-CPS suggest no differences in the prevalence of menthol cigarette use when smokers are categorized based on number of cigarettes smoked per day and/or number of days smoked during the past month. These findings serve to corroborate data from NYTS indicating that the prevalence of menthol cigarette use is not different among youth smokers at different stages or trajectories of smoking progression (Caraballo and Asman, 2011), and are consistent with similar studies examining menthol cigarette prevalence among smokers categorized by number of cigarettes smoked per day and/or number of days smoked during the past month (Hersey et al., 2006; Fernander et al., 2010; Giovino et al., 2013).

Apart from the inferential limitations imposed by the use of cross-sectional data, the regression analyses reported here were constructed to control for covariates that have been the subject of discussion in the literature and in the regulatory context; analyses did not assess or control for all conceivable covariates, *e.g.*, indicators of individual and neighborhood socio-economic status. The current analyses are based on measures that may inform on smoking initiation and progression, where no prospective data are available. Analyses are likewise subject to other limitations imposed by the data sources, *i.e.*, data are self-reported and are based on current smoking habits, with little validation of amount, duration or type of cigarettes smoked. The surveys examined for this paper are wide-reaching, with many purposes; thus, the samples are not constructed specifically to include large numbers of smokers. In spite of combining data from multiple survey administrations, there are some issues with sparse data that preclude detailed analyses.

The strengths of these analyses include the use of multiple data sources, and thus the ability to compare results across surveys. Additionally, analyses are based on different samples, all intended to represent the U.S. population overall, and employ slightly different survey methods and questions that cover different years. Thus, the differences in methods used by the different surveys would supply evidence of consistency, if consistency exists. The use of data from multiple administrations of each survey increases the precision of statistical estimates, and at least in some cases, allows examination of the association between prevalence of menthol cigarette use and the examined measures of initiation and progression to increased smoking within strata defined by demographic characteristics or adjusted for demographics using regression methods.

In the absence of appropriate longitudinal data but facing the need to make a policy determination, attention has focused on measures presumed to inform on the dynamics of smoking initiation (*e.g.*, FDA, 2013). As discussed above, these measures are limited in their inferential value, but nonetheless have been evaluated in the literature. This report provides a review of the literature, and presents additional analyses of available national survey data sets. Results from the analyses provided herein indicate that menthol cigarette use is not associated with an earlier age of initiating smoking or a greater likelihood of being a daily versus non-daily smoker; and, that menthol cigarette preference is not greater among new, less-experienced compared to more-established youth smokers. While there are limitations regarding the inferences that can be drawn on whether menthol cigarette use is positively or negatively associated with smoking initiation and/or progression to regular smoking, these data indicate that menthol in cigarettes does not adversely affect those measures that are readily examined using cross-sectional data.

## Conflict of interest

Financial support for this work was provided through a contract between RAI Services Company (Winston-Salem, NC, USA) and ENVIRON International Corporation (Amherst, MA, USA). Sandra I. Sulsky and Cynthia Van Landingham are employees of ENVIRON International Corporation; Kristin M. Marano, Monica J. Graves, Michael W. Ogden, James E. Swauger and Geoffrey M. Curtin are employees of RAI Services Company.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.yrtph.2014.08.001.

## References

Caraballo, R.S., Asman, K., 2011. Epidemiology of menthol cigarette use in the United States. Tob. Induc. Dis. 9 (Suppl. 1), S1.

Cubbin, C., Soobader, M.J., LeClere, F.B., 2010. The intersection of gender and race/ethnicity in smoking behaviors among menthol and non-menthol smokers in the United States. Addiction 105 (Suppl. 1), 32–38.

Davis, K.C., Farrelly, M.C., Messeri, P., Duke, J., 2009. The impact of national smoking prevention campaigns on tobacco-related beliefs, intentions to smoke and smoking initiation: results from a longitudinal survey of youth in the United States. Int. J. Environ. Res. Public Health 6, 722–740.

Delnevo, C.D., Gundersen, D.A., Hrywna, M., Echeverria, S.E., Steinberg, M.B., 2011. Smoking-cessation prevalence among U.S. smokers of menthol versus non-menthol cigarettes. Am. J. Prev. Med. 41, 357–365.

Fagan, P., Moolchan, E.T., Hart, A., Rose, A., Lawrence, D., Shavers, V.L., Gibson, J.T., 2010. Nicotine dependence and quitting behaviors among menthol and non-menthol smokers with similar consumption patterns. Addiction 105 (Suppl. 1), 55–74.

Fernander, A., Rayens, M.K., Zhang, M., Adkins, S., 2010. Are age of smoking initiation and purchasing patterns associated with menthol smoking? Addiction 105 (Suppl. 1), 39–45.

Food and Drug Administration, 2013. Preliminary Scientific Evaluation of the Possible Public Health Effects of Menthol versus Nonmenthol Cigarettes. <http://www.fda.gov/downloads/ ScienceResearch/SpecialTopics/PeerReviewofScientificInformationandAssessments/UCM361598.pdf> (accessed November 14, 2013).

Giovino, G.A., Villanti, A.C., Mowery, P.D., Sevilimedu, V., Niaura, R.S., Vallone, D.M., Abrams, D.B., 2013. Differential trends in cigarette smoking in the USA: is menthol slowing progress. Tob. Control. http://dx.doi.org/10.1136/tobaccocontrol-2013-051159, e-pub.

Hersey, J.C., Ng, S.W., Nonnemaker, J.M., Mowery, P., Thomas, K.Y., Vilsaint, M.C., Allen, J.A., Haviland, M.L., 2006. Are menthol cigarettes a starter product for youth? Nicotine Tob. Res. 8 (3), 403–413.

Lawrence, D., Rose, A., Fagan, P., Moolchan, E.T., Gibson, J.T., Backinger, C.L., 2010. National patterns and correlates of mentholated cigarette use in the United States. Addiction 105 (Suppl. 1), 13–31.

Nonnemaker, J., Hersey, J., Homsi, G., Busey, A., Allen, J., Vallone, D., 2013. Initiation with menthol cigarettes and youth smoking uptake. Addiction 108 (1), 171–178.

Nonnemaker, J., Hersey, J., Homsi, G., Busey, A., unpublished. Menthol cigarettes and youth smoking uptake: final report. *Submission to the U.S. Food and Drug Administration Tobacco Products Scientific Advisory Committee*, November 2010. <http://www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/TobaccoProductsScientificAdvisoryCommittee/UCM237551.pdf> (last accessed on November 16, 2013).

Stahre, M., Okuyemi, K.S., Joseph, A.M., Fu, S.S., 2010. Racial/ethnic differences in menthol cigarette smoking, population quit ratios and utilization of evidence based tobacco cessation treatments. Addiction 105 (Suppl. 1), 75–83.