Patterns of menthol cigarette use among current smokers, overall and within demographic strata, based on data from four U.S. government surveys

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The National Health and Nutrition Examination Survey, National Survey on Drug Use and Health, National Health Interview Survey and Tobacco Use Supplement to the Current Population Survey provide estimates of the proportions of U.S. smokers who currently use menthol cigarettes, overall and within demographic strata. Among adult past-month, regular and daily smokers, menthol cigarette use ranges from 26% to 30%, with statistically higher proportions of female versus male smokers (8–11 percentage points higher) currently using menthol cigarettes. Compared to adult smokers overall, statistically higher proportions of non-Hispanic Black smokers (72–79%) and statistically lower proportions of non-Hispanic White smokers (19–22%) currently use menthol cigarettes, with no differences among smokers of other race/ethnicity groups (18–20% to 28–30%, depending on the survey). Higher proportions of younger adult past-month, regular and daily smokers (aged 18–25 years) currently use menthol cigarettes compared to older adult smokers (aged 26–29 years and/or ≥30 years); however, differences are small in magnitude, with the vast majority of adult smokers (70–75%) who currently use menthol cigarettes being aged ≥30 years. Comparisons between youth and adult smokers are provided, although data for youth smokers are less available and provide less consistent patterns of menthol cigarette use.

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1. Introduction

Previous studies have examined patterns of menthol cigarette use among nationally representative samples of U.S. adults (Alexander et al., 2010; Caraballo and Asman, 2011; Cubbin et al., 2010; Delnevo et al., 2011; Fagan et al., 2010; Fernandez et al., 2010; Lawrence et al., 2010; Mendiondo et al., 2010; Rock et al., 2010; Stahre et al., 2010; Trinidad et al., 2010). These studies provide consistent data to indicate that a majority of African-American smokers use menthol cigarettes; and, menthol cigarette use is generally higher among female compared to male smokers. In contrast, studies that provide nationally representative estimates of menthol cigarette use among youth and/or younger adult compared to older adult smokers provide less consistent data on age-related patterns (Appleyard et al., 2001; Delnevo et al., 2011; Fernandez et al., 2010; Hersey et al., 2010, 2006; Lawrence et al., 2010; Mendiondo et al., 2010; Rock et al., 2010; Thorne et al., unpublished; Wackowski and Delnevo, 2007).

When evaluating the available studies on menthol cigarette use among younger compared to older smokers, it is important to consider potential threats to internal validity, as well as the generalizability of findings to the U.S. population overall. For example, the National Youth Tobacco Survey (NYTS) differs from other government surveys with regard to both target population (i.e., restricted to youth enrolled in public and private schools, grades 6–12) and data collection methodology (i.e., group versus private setting). The potential for group versus private survey setting to affect data collection is also a possible threat to internal validity. Therefore, the objective of this report is to systematically review existing studies on patterns of menthol cigarette use among current smokers, overall and within demographic strata, based on data from four U.S. government surveys.

Abbreviations: NHANES, National Health and Nutrition Examination Survey; NHS, National Health Interview Survey; NSDUH, National Survey on Drug Use and Health; NYTS, National Youth Tobacco Survey; TUS-CPS, Tobacco Use Supplement to the Current Population Survey; YRBS, Youth Risk Behavior Surveillance System.

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quality is underscored by a comparison of youth responses to iden-
tically worded items from the school-based Youth Risk Behavior
Surveillance System (YRBSS) and household-based National Health
Interview Survey (NHIS). Kann et al. (2002) reported that 39 of the
42 identically worded items produced higher risk estimates for
YRBSS compared to NHIS; for 24 of the items, comparisons yielded
statistically significant differences, including higher estimates for
ever having tried cigarette smoking, having smoked a whole ciga-
rette prior to the age of 13 years, ever having smoked regularly,
and having smoked regularly prior to the age of 13 years. The
potential for data collection setting to influence responses related
to risky behaviors has been discussed elsewhere (e.g., Delnevo
and Bauer, 2009).

In addition to presenting original analyses of menthol cigarette
use among current smokers, overall and within demographic
strata, based on data from four U.S. government surveys, this paper
provides a review of the available studies on patterns of menthol
cigarette use among youth, younger adult and/or older adult smok-
ers. Studies on patterns of menthol cigarette use were identified by
searching the U.S. National Library of Medicine’s PubMed database,
using the terms “menthol” and “cigarette” (1990 to present). Ar-
ticles were screened for data on socio-demographic patterns of men-
thol cigarette use among U.S. smokers, and papers that provided
relevant data were further reviewed and evaluated for generaliz-
ability and methodological quality. A synthesis of the inferences
that can be drawn from these studies is provided.

Among the 10 studies identified, four examine menthol ciga-
rette use among youth smokers based on data from NYTS (Appleyard
et al., 2001; Hersey et al., 2010, 2006; Wackowski and Delnevo,
2007). Findings from one of these studies would not be generalizable
to all youth smokers, as analyses are specific to Asian Americans and
a small number of Hawaiian/Pacific Islanders (Appleyard et al., 2001).
The remaining three studies provide estimates of menthol cigarette use among youth smokers overall.

Analyses based on data from the 2000 and 2002 NYTS (Hersey
et al., 2006) suggest that menthol cigarette use among past-month
smokers, i.e., smoked part or all of a cigarette during the past
month, is statistically higher among middle school compared to
high school students who had been smoking for <1 year, but not
among students who had been smoking ≥1 year; no confidence
intervals are provided. Prevalence data provided in one of the
results tables (Hersey et al., 2006; Table 3, which includes 95% con-
fidence intervals) indicate no statistically significant differences in
the proportions of menthol compared to non-menthol cigarette
smokers who had smoked either <1 year or ≥1 year (Hersey et al.,
2006). The authors excluded observations for >20% of survey par-
ticipants due to inconsistent responses on cigarette brand and
menthol status. The high proportion of unreliable data is likely
due to the inclusion of less experienced smokers who had no usual
brand or were uncertain about the cigarette type being smoked.

Subsequent analyses based on data from the 2006 NYTS
attempted to minimize the potential for misclassification by
excluding data for youth smokers who provided inconsistent infor-
mation on brand and menthol status (Hersey et al., 2010). In con-
trast with previous findings from the less restricted sample
(Hersey et al., 2006), no statistically significant differences are indi-
cated for menthol cigarette use among middle school compared to
high school past-month and/or lifetime (i.e., smoked ≥100 cig-
rettes) smokers, overall or when stratified by gender and race.
In addition, menthol cigarette use is statistically higher among high
school compared to middle school past-month and lifetime smokers
who reported a usual cigarette brand (past-month smokers: 19.7% versus 6.3%; lifetime smokers: 10.9% versus 1.7%).

Analyses based on data from NYTS (Hersey et al., 2010, 2006)
provide no consistent evidence on whether smokers in lower grade
levels are statistically more likely to use menthol cigarettes
compared to smokers in higher grade levels. Similarly, analyses
based on data from the 2004 NYTS (Wackowski and Delnevo,
2007) indicate no consistent pattern of menthol cigarette use
among lower compared to higher grade level past-month smokers
(grades 9–12).

Separate publications provide analyses based on data from the
2003 and 2006/07 Tobacco Use Supplement to the Current Popula-
tion Survey (TUS-CPS) (Fernandez et al., 2010; Lawrence et al.,
2010). These analyses indicate that adult menthol smokers who
had used cigarettes some days or every day during the past month
are predominantly aged 25–44 years (40.6%); however, the propor-
tion of menthol cigarette smokers who are younger adults (aged
18–24 years) is statistically higher than the proportion of younger
adult non-menthol smokers (17.3% versus 14.1%). Findings from
analyses that adjust for demographic variables, age of initiation
and purchasing type indicate that smokers aged 18–24 years,
25–44 years and 45–64 years are statistically more likely to use
menthol cigarettes compared to smokers aged ≥65 years
(Fernandez et al., 2010). Similar findings are provided based on
analyses that adjust for demographic and smoking behavior vari-
ables (Lawrence et al., 2010), overall or when stratified by gender
and race/ethnicity.

While these findings (Fernandez et al., 2010; Lawrence et al.,
2010) indicate that higher proportions of smokers aged 18–
24 years use menthol cigarettes compared to smokers aged
≥65 years, this referent group comprises the smallest proportion
of menthol smokers (i.e., 5.7% of menthol smokers are aged
≥65 years); thus, the data likewise indicate that menthol smokers
are statistically more likely to be aged 25–44 years and/or
45–64 years compared to aged ≥65 years. While not provided, a
similar comparison among non-menthol smokers would likely
indicate similar, elevated distributions of non-menthol cigarette
use among younger age groups compared to smokers aged
≥65 years.

A more recent analysis of the 2003 and 2006/07 TUS-CPS data
(Delnevo et al., 2011) indicates that menthol versus non-menthol
cigarette use among lifetime smokers who reported smoking some
days or every day in the past month is not statistically different
among smokers within the age category of 18–24 years (16.6% ver-
sus 13.7%). Findings from this study likewise indicate that menthol versus non-menthol cigarette use is statistically lower among smokers aged 25–44 years (40.3% versus 44.1%), and statistically
higher among smokers aged 45–65 years (36.5% versus 33.9%).

Estimates based on data from the 2004–2008 National Survey
on Drug Use and Health (NSDUH) suggest that younger past-month
smokers are more likely to report menthol cigarette use compared
to older smokers (Rock et al., 2010); greater inclusion of less expe-
rienced smokers may have increased the potential for misclassifi-
cation. The data likewise indicate that 5.8% of all menthol
cigarette smokers are youths (aged 12–17 years), 23.0% are young
adults (aged 18–25 years) and 71.2% are older adults (aged
≥26 years); comparatively, the proportions of non-menthol smok-
ers who are youths, young adults and older adults are 3.4%, 19.2%
and 77.5%, respectively (Rock et al., 2010). Overall, the propor-
tion of past-month smokers who use menthol cigarettes is suggested to
be highest among those who are aged 12–17 years, and to decrease
in the older age groups. In contrast to analyses based on NYTS data
(Hersey et al., 2010, 2006), whereby attempts are made to correlate
menthol status with brand, no attempt was made to validate
reported cigarette type among NSDUH participants.

Findings from the two remaining U.S. government surveys that
provide data on menthol cigarette use among adult smokers indi-
cate no statistically significant differences based on age. Specifi-
cally, Mendiondo et al. (2010) provide estimates from adjusted
analyses based on 2005 NHIS data to suggest that menthol versus
non-menthol cigarette use is not associated with a younger mean
age among current or former smokers. Moreover, estimates based on data from the 2001–2006 National Health and Nutrition Examination Survey (NHANES) indicate no differences in menthol cigarette use among lifetime smokers aged 20–24 years, 25–34 years, 35–44 years, 45–64 years and ≥65 years (28.9%, 26.1%, 23.6%, 25.3%, and 23.7%, respectively) (Thorne et al., unpublished). Unlike other government surveys, menthol and non-menthol cigarette use data from adult smokers in NHANES are collected through barcode scanning of cigarette packs, which substantially reduces the opportunity for misclassification.

In summary, NHANES, NSDUH, NHIS and TUS-CPS provide nationally representative samples of the U.S. population for descriptive analyses of menthol cigarette use among current smokers, overall and within strata based on gender, race/ethnicity and current age category. There are differences in the analytic approaches and comparisons provided by the various authors (summarized above) that may contribute to the inconsistent findings on age-related patterns of menthol cigarette use. The current analyses are intended to further examine whether menthol cigarette use is associated with specific patterns of smoking; in particular, whether menthol preference is disproportionately higher among younger compared to older smokers. Data on numbers of cigarettes smoked per day based on cigarette type preference (i.e., menthol versus non-menthol) are reported elsewhere (Curtin et al., 2014).

2. Materials and methods

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 methods used for the current analyses are provided elsewhere (Supplemental Materials and Methods). Analyses were based on combined data from multiple administrations of each of these nationally representative surveys, and included the most recent administration of each survey that provided relevant data. Survey statistics were used to account for the complex sample designs to properly estimate variances and provide estimates weighted to represent the U.S. population. Public files for the four surveys were downloaded and analyzed using the appropriate SAS V9.3 survey procedures; in addition, analyses were constructed with the goal of being as comparable across survey data sets as possible. For these descriptive analyses, differences between smoker groups (within a survey) are considered statistically significant if 95% confidence intervals do not overlap in comparisons of distributions across multiple strata.

2.1. Definitions

Current smokers are defined based on smoking frequency, or number of days smoked during the past month, as follows: (1) past-month smokers, or individuals who smoked part or all of a cigarette on ≥1 day during the month prior to the survey; (2) regular smokers, or those who smoked on ≥10 days during the month prior to the survey; and, (3) daily smokers, or those who smoked daily during the month prior to the survey. All surveys except for the NSDUH and NHANES (youth only) limit smoking-related questions to those individuals who have smoked ≥100 cigarettes (i.e., lifetime smokers). Menthol and non-menthol cigarette smokers are defined on the basis of their usual or current type of cigarette used, depending on the wording of the survey question (Supplemental Materials and Methods).

The use of menthol and non-menthol cigarettes among adult smokers is assessed in NHANES, NSDUH, NHIS and TUS-CPS based on current age categories of 20–25 years, 26–29 years and ≥30 years; use of menthol and non-menthol cigarettes among youth is assessed in NHANES using age categories, 12–15 years and 16–19 years, and in the TUS-CPS for those aged 15–19 years (proxy data excluded from analyses). Race/ethnicity is categorized as non-Hispanic White, non-Hispanic Black and other race/ethnicity.

3. Results

3.1. Menthol cigarette use by gender and race/ethnicity


NHANES (1999–2010) provides data on 6,830 past-month, 6,286 regular and 5,355 daily smokers, aged ≥20 years; weighted estimates for menthol cigarette use are 25.5%, 25.8% and 25.9%, respectively (Fig. 1; Supplemental Table 1). Within strata based on gender, statistically higher proportions of female past-month, regular and daily smokers use menthol cigarettes (31.2%, 31.3% and 31.5%) compared to male smokers (20.7%, 21.0% and 20.9%). Compared to adult smokers overall, statistically higher proportions of non-Hispanic Black past-month, regular and daily smokers use menthol cigarettes (72.2%, 72.7% and 74.0%); statistically lower proportions of non-Hispanic White smokers use menthol cigarettes (19.0%, 19.0% and 19.1%); and, generally statistically lower proportions of other race/ethnicity smokers use menthol cigarettes (18.2%, 19.2% and 19.8%).

NHANES (1999–2010) likewise provides data on 1,653 past-month, 960 regular and 545 daily smokers, aged 12–19 years; weighted estimates for menthol cigarette use are 22.1%, 17.6% and 18.2%, respectively (Supplemental Table 2). The proportions of female past-month, regular and daily smokers who use menthol cigarettes (25.7%, 19.9% and 20.2%) are numerically but not statistically higher compared to male smokers (18.7%, 15.4% and 16.4%). In addition, statistically lower proportions of non-Hispanic Black past-month, regular and daily smokers use menthol cigarettes (7.9%, 4.0% and 5.3%), with no statistically significant differences in the proportions of non-Hispanic White smokers (22.7%, 18.9% and 19.9%) or other race/ethnicity smokers (25.4%, 17.4% and 14.8%) who use menthol cigarettes compared to youth smokers overall.


NSDUH (2000–2009) provides data on 106,767 past-month, 85,836 regular and 65,356 daily smokers, aged ≥20 years; weighted estimates for menthol cigarette use are 29.8%, 26.6% and 28.5%, respectively (Fig. 2; Supplemental Table 3). Statistically higher proportions of female past-month, regular and daily smokers use menthol cigarettes (33.8%, 33.7% and 32.8%) compared to male smokers (27.7%, 24.9% and 23.9%).
male smokers (26.3%, 26.0% and 24.6%). Compared to adult smokers overall, statistically higher proportions of non-Hispanic Black past-month, regular and daily smokers use menthol cigarettes (77.8%, 78.5% and 79.0%), and statistically lower proportions of non-Hispanic White smokers use menthol cigarettes (22.1%, 22.3% and 22.3%); the proportions of other race/ethnicity smokers who use menthol cigarettes (30.0%, 30.1% and 29.8%) are not statistically different from adult smokers overall.

3.1.3. National Health Interview Survey (2005 and 2010)
NHIS (2005 and 2010) provides data on 10,567 past-month, 9802 regular and 8608 daily smokers, aged ≥20 years; weighted estimates for menthol cigarette use are 29.3%, 29.2% and 28.9%, respectively (Fig. 3; Supplemental Table 4). After stratifying by gender, statistically higher proportions of female past-month, regular and daily smokers use menthol cigarettes (34.2%, 33.9% and 33.8%) compared to male smokers (25.1%, 25.1% and 24.7%). Compared to adult smokers overall, statistically higher proportions of non-Hispanic Black past-month, regular and daily smokers use menthol cigarettes (77.9%, 78.2% and 78.4%), and statistically lower proportions of non-Hispanic White smokers use menthol cigarettes (21.7%, 21.6% and 21.6%); the proportions of other race/ethnicity smokers who use menthol cigarettes (29.4%, 30.0% and 29.5%) are not statistically different compared to adult smokers overall.

TUS-CPS (2003 and 2006/07) provides data on 61,184 past-month, 58,363 regular and 51,487 daily smokers, aged ≥20 years; and, 1684 past-month, 1608 regular and 1343 daily smokers, aged 15–19 years. Weighted estimates for menthol cigarette use are 27.8%, 27.8% and 27.4%, respectively, for smokers aged ≥15 years (Fig. 4; Supplemental Table 5). Statistically higher proportions of female past-month, regular and daily smokers use menthol cigarettes (32.4%, 32.4% and 32.1%) compared to male smokers (23.6%, 23.8% and 23.1%). Compared to smokers overall, statistically higher proportions of non-Hispanic Black past-month, regular and daily smokers use menthol cigarettes (73.9%, 73.8% and 73.6%), and statistically lower proportions of non-Hispanic White smokers use menthol cigarettes (21.3%, 21.4% and 21.3%); the proportions of other race/ethnicity smokers who use menthol cigarettes (27.9%, 28.1% and 28.1%) are not statistically different compared to smokers overall.

3.1.5. Summary of data on menthol cigarette use by gender and race/ethnicity
Descriptive analyses based on adult data from NHANES, NSDUH, NHIS and TUS-CPS (for TUS-CPS, ~2.5% of smokers are aged 15–19 years) provide consistent estimates of overall menthol cigarette use among current smokers, regardless of smoking frequency (i.e., smoked on ≥1 day, ≥10 days or daily during the past month). Estimates range from 26% based on data collected through barcode scanning of participants’ cigarette packs (NHANES, 1999–2010) to 29–30% for data collected from participants who had smoked at least part or all of a cigarette during the past month (NSDUH, 2000–2009). For analyses that are restricted to youth (i.e., aged 12–19 years, NHANES only), menthol cigarette use among current smokers ranges from 18% to 22%, depending on smoking frequency. Overall youth smoker estimates may, in part, reflect the unexpectedly low levels of menthol cigarette use reported among non-Hispanic Black smokers; however, reported cigarette type preference was confirmed during data collection based on brand usually smoked.

Generally consistent patterns are likewise reported for menthol cigarette use among adult female compared to male smokers, regardless of smoking frequency (Fig. 5). Menthol cigarette use among female smokers ranges from 31–34%, compared to 21–26% for male smokers; the percentage differences within surveys (accounting for smoking frequency) range from 8% to 11%, and generally indicate statistically higher proportions of female compared to male smokers use menthol cigarettes. For analyses restricted to youth smokers (NHANES only), numerically but not statistically higher proportions of female smokers (20–26%) use menthol cigarettes compared to male smokers (15–19%).

Lastly, estimates based on adult data from all four surveys demonstrate statistically higher proportions of non-Hispanic Black smokers use menthol cigarettes compared to smokers overall,
regardless of smoking frequency (Fig. 6); estimates range from 72–74% (NHANES, TUS-CPS) to 78–79% (NSDUH, NHIS). The proportions of non-Hispanic White smokers who use menthol cigarettes [ranging from 19% (NHANES) to 21–22% (NSDUH, NHIS and TUS-CPS)] are statistically lower, while the proportions of other race/ethnicity smokers who use menthol cigarettes [ranging from 18–20% (NHANES) to 28–30% (NSDUH, NHIS and TUS-CPS)] are not statistically different compared to the proportions of menthol smokers overall. For analyses restricted to youth (NHANES only), a statistically lower proportion of non-Hispanic Black smokers report using menthol cigarettes, representing a departure from the patterns observed for the adult data. There are no statistically significant differences in the proportions of non-Hispanic White and other race/ethnicity smokers who use menthol cigarettes compared to the proportions of menthol smokers overall.

For each of the four surveys, adult menthol cigarette smokers are predominantly female and non-Hispanic White, demonstrating that these nationally representative samples are comparable despite the use of different sampling strategies.

3.2. Menthol cigarette use by current age category


Unlike the other government surveys examined as part of the current analyses, menthol and non-menthol cigarette use data among adult smokers in NHANES are collected through barcode scanning of cigarette packs, which reduces the opportunity for misclassification; youth smokers are directly queried with regard to menthol and non-menthol cigarette use, and asked to identify usual brand smoked.

NHANES (1999–2010) data, stratified by current age category, indicate no statistically significant differences in menthol cigarette use among younger adult compared to older adult smokers (Fig. 7; Supplemental Table 1). Specifically, the proportions of smokers aged 20–25 years, 26–29 years and ≥30 years who use menthol cigarettes are 30.2%, 26.1% and 24.5% among past-month smokers, 31.0%, 27.4% and 24.6% among regular smokers, and 30.5%, 28.4% and 24.8% among daily smokers. While the proportion of adult smokers who use menthol cigarettes is suggested to decrease in older age categories, menthol cigarette use among youth smokers (i.e., aged 12–19 years) ranges from 18% to 22%, depending on smoking frequency (Supplemental Table 2); these data indicate that a lower proportion of youth smokers uses menthol cigarettes compared to younger and older adult smokers.


NSDUH is unique among the government surveys examined in that it provides data from participants who had smoked at least part or all of a cigarette during the past month (i.e., have not necessarily smoked >100 cigarettes, and thus are not necessarily lifetime smokers); this survey likewise provides the largest nationally representative sample of adult smokers, aged ≥20 years (e.g., 106,767 past-month smokers, for 2000–2009). Within strata based on current age category, the proportions of past-month, regular and daily smokers aged 20–25 years who use menthol cigarettes (32.4%, 33.2% and 33.1%, respectively) are statistically higher compared to smokers aged 26–29 years (29.2%, 30.3% and 29.5%) and ≥30 years (29.3%, 28.7% and 27.6%) (Fig. 8; Supplemental Table 3); however, these differences are small in magnitude, and there are no corresponding statistically significant differences among smokers aged 26–29 compared to smokers aged ≥30 years.

3.2.3. National Health Interview Survey (2005 and 2010)

NHIS (2005 and 2010) data, stratified by current age category, indicate no statistically significant differences in menthol cigarette use among past-month, regular and daily smokers aged 20–25 years compared to aged 26–29 years (Fig. 9; Supplemental Table 4); however, statistically lower proportions of smokers aged ≥30 years report menthol cigarette use (27.1%, 26.9% and 26.8%, respectively) compared to smokers aged 20–25 years (37.2%, 37.4% and 37.8%) and 26–29 years (34.9%, 35.8% and 35.6%).
3.2.4. Tobacco Use Supplement—Current Population Survey (2003 and 2006/07)

Analyses based on data from TUS-CPS (2003 and 2006/07) include a relatively small proportion of youth smokers, aged 15–19 years (i.e., ~2.5% of the overall sample examined, regardless of smoking frequency); hence, some caution is warranted when drawing inferences regarding patterns of use for this particular age category. Stratification of youth and adult smokers based on categories of current age suggests statistically higher proportions of smokers aged 15–19 years use menthol cigarettes compared to adult smokers (e.g., 36.7% of daily smokers aged 15–19 years use menthol cigarettes compared to 31.0% for smokers aged 20–25 years) (Fig. 10; Supplemental Table 5). Statistically significant differences are generally indicated among adult age categories (aged 20–25 years, 26–29 years and ≥30 years), with smaller proportions of menthol smokers in older age categories; however, these differences are small in magnitude (e.g., 31.0%, 27.9% and 26.1% of daily smokers aged 20–25 years, 26–29 years and ≥30 years, respectively, use menthol cigarettes).

3.2.5. Summary of data on menthol cigarette use by current age category

The current analyses based on data from four nationally representative samples of U.S. adults (NHANES, NSDUH, NHIS and TUS-CPS) appear to provide somewhat inconsistent evidence on whether menthol cigarette use is more prevalent among younger compared to older smokers. Interpretation of findings from these analyses is further complicated by corresponding estimates of youth preferences, whereby menthol cigarette use among youth smokers participating in NHANES (aged 12–19 years) is estimated to be 18–22% compared to 37% among youth smokers participating in TUS-CPS (aged 15–19 years). The 2-fold difference in menthol cigarette use among these nationally representative samples of youth is noteworthy. Misclassification of menthol versus non-menthol cigarette use is likely to be higher among youth and younger adult smokers compared to older adult smokers with more established smoking habits (e.g., Giovino et al., 2004; Hersey et al., 2006, 2010). The potential for misclassification of cigarette type is lowest among NHANES participants, as discussed above.

Nevertheless, the proportions of adult smokers within each age group (i.e., aged 20–25 years, 26–29 years and ≥30 years) reporting menthol cigarette use are consistent across three of the four nationally representative samples (Fig. 11, daily smokers only). Specifically, the proportions of past-month, regular and daily smoker aged 20–25 years participating in NHANES, NSDUH and TUS-CPS who use menthol cigarettes are 30–31%, 32–33% and 30–31%, respectively; for smokers aged 26–29 years, the proportions are 26–28%, 29–30% and 27–28%; and, for smokers aged ≥30 years, the proportions are 24–25%, 28–29% and 26–27%. While these data suggest that menthol cigarette use may be numerically higher among younger adult compared to older adult smokers, statistically significant differences are inconsistent and...
numerical differences are small in magnitude. NHIS data suggest higher proportions of menthol cigarette use, in particular, among smokers aged 20–25 years and 26–29 years (i.e., 37–38% and 35–36%, respectively).

For each of the four surveys, adult menthol cigarette smokers are predominantly (i.e., >70%) aged ≥30 years, demonstrating that these nationally representative samples are, in fact, comparable despite the use of different sampling strategies.

4. Conclusions

The current analyses examine menthol cigarette preference, using three definitions for current smokers (i.e., past-month, regular and daily smokers, based on smoking frequency), based on data from four nationally representative samples of U.S. adults, and in some instances youth. Estimates of overall adult menthol cigarette use are consistent across the four government surveys, regardless of smoking frequency. Among adult smokers, overall menthol cigarette use ranges from 26% based on data collected through barcode scanning of lifetime smokers’ cigarette packs (NHANES, 1999–2010) to 29–30% based on data collected from participants who had smoked at least part or all of a cigarette in the past month (NSDUH, 2000–2009). Corresponding estimates of menthol cigarette use among youth smokers differ substantially, depending on the survey (discussed below).

When stratified based on gender, estimates of menthol cigarette use among adult smokers are likewise consistent across the four government surveys, regardless of smoking frequency. Menthol cigarette use among adult female smokers ranges from 31–34%, compared to 21–26% among male smokers; the differences within surveys (and accounting for smoking frequency) range from 8 to 11 percentage points, and generally indicate that statistically higher proportions of female compared to male smokers use menthol cigarettes. These findings are consistent with published analyses of nationally representative samples of U.S. adults that examine menthol cigarette preference based on a single definition of current smokers, i.e., combines some day and daily smokers (Alexander et al., 2010; Caraballo and Asman, 2011; Cubbin et al., 2010; Delnevo et al., 2011; Fagan et al., 2010; Fernandez et al., 2010; Lawrence et al., 2010; Mendiondo et al., 2010; Rock et al., 2010; Stahre et al., 2010; Trinidad et al., 2010). For analyses restricted to youth smokers (NHANES only), numerically but not statistically higher proportions of females (20–26%) use menthol cigarettes compared to males (15–19%).

Stratifying by race/ethnicity (i.e., non-Hispanic White, non-Hispanic Black and other race/ethnicity) indicates statistically higher proportions of non-Hispanic Black adult smokers use menthol cigarettes compared to smokers overall, regardless of smoking frequency. Estimates range from 72–74% (NHANES, TUS-CPS) to 78–79% (NSDUH, NHS); these findings are consistent with previous analyses (Alexander et al., 2010; Caraballo and Asman, 2011; Cubbin et al., 2010; Delnevo et al., 2011; Fagan et al., 2010; Fernandez et al., 2010; Lawrence et al., 2010; Mendiondo et al., 2010; Rock et al., 2010; Stahre et al., 2010; Trinidad et al., 2010). In addition, menthol cigarette use among other race/ethnicity smokers ranges from 18–20% (NHANES) to 28–30% (NSDUH, NHS and TUS-CPS); the proportions of other race/ethnicity smokers who use menthol cigarettes are not statistically different from smokers overall. For analyses restricted to youth smokers (NHANES only), a small proportion (4–8%) of non-Hispanic Black smokers report using menthol cigarettes; and, the proportions of other race/ethnicity smokers (19–23%) who use menthol cigarettes are not statistically different compared to smokers overall.

Published analyses examining cigarette type preference within strata based on current age category provide inconsistent evidence on whether higher proportions of youth and younger adult smokers use menthol cigarettes compared to older adult smokers. Studies based on youth smokers participating in NYTS (Hersey et al., 2010, 2006; Wackowski and Delnevo, 2007) provide inconsistent findings on menthol cigarette use among students in lower compared to higher grade levels; as previously discussed, these analyses have the potential for misclassification and/or biases arising from the data collection setting.

Previous analyses based on adult data from TUS-CPS (Fernander et al., 2010; Lawrence et al., 2010) have been interpreted to suggest that higher proportions of younger adult smokers use menthol cigarettes compared to older adult smokers; however, the referent for these analyses is smokers aged ≥65 years, which has the lowest preference for menthol cigarette use (5.7%) and the lowest smoking rate (7.1%) among categories of current age. More recently, Delnevo et al. (2011) presented analyses of TUS-CPS data that indicate menthol versus non-menthol cigarette use is not statistically different among smokers aged 18–24 years, is statistically lower among smokers aged 25–44 years, and is statistically higher among smokers aged 45–65 years. Data from NSDUH suggest that a statistically higher proportion of youth and younger adult smokers use menthol cigarettes compared to older adult smokers (Rock et al., 2010), while analyses based on adult data from NHIS (Mendiondo et al., 2010) and NHANES (Thorne et al., 2010) indicate no statistically significant difference in the mean age of menthol compared to non-menthol cigarette smokers and no differences in the proportions of menthol smokers in younger compared to older age categories, respectively.

Results from the current analyses provide consistent estimates for prevalence of menthol cigarette use among smokers aged 20–25 years, 26–29 years and ≥30 years across three of the four nationally representative samples (NHANES, NSDUH and TUS-CPS). Specifically, the cumulative proportions of past-month, regular and daily younger adult smokers (aged 20–25 years) who use menthol cigarettes are 30–33%, compared to 26–30% and 24–29% for older adult smokers (aged 26–29 years and ≥30 years, respectively). While these data suggest that menthol cigarette use may be numerically higher among younger adult compared to older adult smokers, statistically significant differences are inconsistent and numerical differences are small in magnitude. For analyses that include youth smokers, menthol cigarette use among smokers aged 12–19 years participating in NHANES is estimated to be 18–22%, compared to 37% among smokers aged 15–19 years participating in TUS-CPS.

These inconsistent findings for menthol cigarette use among youth smokers may be attributable, at least in part, to differences in smoking initiation age among current smokers participating in the two surveys. For example, data from NHANES indicate past-month smokers aged 16–19 years who use menthol cigarettes initiated smoking at a statistically older mean age (0.9 years older) compared to non-menthol smokers; in contrast, TUS-CPS data provide estimates to suggest past-month smokers aged 15–19 years who use menthol cigarettes initiated smoking at a statistically younger mean age (0.1 years younger) compared to non-menthol smokers (Curtin et al., submitted for publication). Younger smokers, particularly those who have just started using cigarettes, are less likely to have a usual cigarette type (i.e., menthol versus non-menthol) and/or may be more likely to misclassify their usual cigarette type compared to older smokers with more established smoking habits (e.g., Giovino et al., 2004; Hersey et al., 2006, 2010); however, the potential for misclassification is reduced for NHANES data that are collected through brand verification.

These analyses are subject to the limitations of 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 exposure (i.e., menthol or non-menthol cigarette type). The surveys examined for
the current analyses are wide-reaching, with many purposes; thus, the samples are not constructed specifically to include large numbers of smokers. The strengths of these analyses include the use of multiple data sources, and thus the ability to compare results across surveys. Moreover, 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 within strata defined by socio-demographic characteristics.

In summary, the current analyses examine menthol cigarette use, overall and within demographic strata, among four nationally representative samples of U.S. adults, and in some instances among youth. Findings from these analyses confirm that adult female smokers are more likely to use menthol cigarettes compared to male smokers, and that a majority of adult non-Hispanic Black smokers use menthol cigarettes; these patterns persist regardless of smoking frequency. Smokers in other race/ethnicity groups may be more likely to use menthol cigarettes compared to non-Hispanic White smokers, but are not more likely to use menthol cigarettes compared to smokers overall. Finally, higher proportions of younger adult smokers (aged 18–25 years) report using menthol cigarettes compared to older adult smokers (aged 26–29 years and ≥30 years), but statistically significant differences are inconsistent and numerical differences are small in magnitude; the limited data for youth smokers do not provide consistent patterns of menthol cigarette use.

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.jyrtph.2014.06.018.

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