



Smoking cessation prevalence by menthol cigarette use and select demographics among adults in the United States, TUS-CPS, 2003–2019

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ABSTRACT

People who smoke menthol cigarettes, particularly those who are non-Hispanic Black/African American, are less likely to achieve successful smoking cessation compared with people who smoke non-menthol cigarettes. This study examined the 2003–2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) harmonized data to estimate cross-sectional trends in cigarette smoking cessation among U.S. adults, stratified by menthol cigarette use, race/ethnicity, sex, and age. The analytic sample included respondents who smoked for ≥ 2 years (current users and former users who reported quitting during the past year). We tested cessation trends using orthogonal polynomial contrasts for overall, menthol, and non-menthol smoking cessation prevalence and stratified by race/ethnicity, sex, and age in logistic regression models. We also analyzed the 2018–2019 non-harmonized TUS-CPS data among recent quitters to examine differences in characteristics (e.g., demographic characteristics, smoking frequency, use of smoking cessation aids, switching to other tobacco products) by menthol cigarette use. We observed significant linear changes in prevalence trends for overall cigarette smoking cessation, menthol smoking cessation, and non-menthol smoking cessation ($p < 0.0001$ for all linear trends), and changes in menthol cessation among non-Hispanic White and non-Hispanic Other race/ethnicity categories during 2003–2019. In the 2018–2019 wave, we observed differences in menthol status for sex, race/ethnicity, age, and educational attainment. We did not observe differences for other characteristics. We observed changes in overall cigarette smoking cessation, menthol, and non-menthol smoking cessation prevalence during the study period; however, gains in cigarette smoking cessation were not experienced among non-Hispanic Black/African American adults who smoke.

1. Introduction

In 2020, approximately 17.5 million of 30.8 million United States (U.S.) adults (ages 18 + years) who smoke cigarettes used menthol cigarettes. (Substance Abuse and Mental Health Services Administration, 2020; Cornelius et al., 2022) Population simulation modeling studies estimate that menthol cigarette use is responsible for millions of life-years lost and for impeding successful smoking cessation. (Le and Mendez, 2022; Mendez and Le, 2022) Studies report disproportionately higher menthol cigarette use among racial/ethnic minority populations, female adults, and young adults who smoke. (Seaman et al., 2022; Villanti et al., 2016; Smith et al., 2017) Tobacco Use Supplement to the Current Population Survey (TUS-CPS) data indicate that menthol

cigarette use increased from 73.0 % in 2003 to 76.8 % in 2018–2019 among non-Hispanic Black/African American persons who smoke cigarettes and was the highest among this group compared to other racial/ethnic groups. (Seaman et al., 2022).

Previous research examining differences in cessation by menthol smoking status have focused on racial/ethnic disparities in menthol cigarette use. Non-Hispanic Black/African American adults who smoke cigarettes have long had the highest prevalence of menthol cigarette use. (Seaman et al., 2022; Villanti et al., 2016) Studies examining the effects of menthol smoking on cessation report that menthol cigarette use contributes to known racial/ethnic tobacco use disparities. (Tobacco Products Scientific Advisory Committee, 2011; Villanti et al., 2017; Mills et al., 2021; Delnevo et al., 2011; Trinidad et al., 2009; Smith et al.,

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2020; Leas et al., 2023) Non-Hispanic Black/African American adults who smoke menthol cigarettes are less likely to achieve successful smoking cessation compared to other racial and ethnic groups despite non-Hispanic Black/African American adults who smoke cigarettes reporting more smoking quit attempts. (Tobacco Products Scientific Advisory Committee, 2011; Villanti et al., 2017; Mills et al., 2021; Delnevo et al., 2011; Trinidad et al., 2009; Smith et al., 2020; Leas et al., 2023; National Center for Chronic Disease Prevention and Health Promotion, 1998; Babb et al., 2017) Other studies on menthol cigarette use focus on sex and age-related differences in prevalence among female and younger adults who smoke; (Seaman et al., 2022; Villanti et al., 2016; Smith et al., 2017; Giovino et al., 2015) however, it is unclear whether prevalence trends for menthol smoking cessation among female and young adults who smoke mirror overall increases in combusted cigarette cessation. (Babb et al., 2017).

The scientific literature documents common factors associated with smoking cessation in clinical practice such as sex, age at initiation, previous quit attempts, nicotine dependence, and other factors. (Caponnetto and Polosa, 2008) Differences in other behavioral factors — by menthol cigarette use — such as smoking frequency, use of smoking cessation aids, or concurrent use of other tobacco products (e.g., electronic nicotine delivery systems (ENDS)) at the population level are less understood. This information may be useful to better understand smoking cessation differences between adults who smoke menthol and those who smoke non-menthol cigarettes. Nationally representative prevalence estimates for menthol smoking cessation trends will help monitor progress in smoking cessation, particularly among populations that are more likely to use menthol cigarettes. The shifting tobacco landscape and FDA's proposed menthol product standard (Tobacco Product Standard for Menthol in Cigarettes, 2022) are reasons why continued monitoring of menthol smoking cessation prevalence is important. Furthermore, examining differences in characteristics of smoking cessation by menthol cigarette use may identify key factors associated with reduced cessation between adults who smoke menthol and those who smoke non-menthol cigarettes.

The aims of this study were 1) to analyze the 2003–2019 TUS-CPS harmonized data to examine trends in cigarette smoking cessation among U.S. adults who recently quit smoking by menthol cigarette use and further stratified by race/ethnicity, sex, and age; and 2) to assess differences in characteristics (e.g., frequency, cessation strategies) of recent cigarette quitters by menthol smoking status (among adults who recently quit smoking) using 2018–2019 TUS-CPS non-harmonized data.

2. Methods

2.1. Data source and study population

The TUS-CPS collects nationally representative data on tobacco use in the U.S. household population approximately every three to four years. This survey includes the civilian, non-institutionalized population of adults (ages 18 + years). Primary data collection was conducted by telephone interviews, but approximately 30 % of interviews were conducted in-person in the household. (National Cancer Institute, 2021) The TUS-CPS harmonized dataset combines data from all currently available TUS-CPS waves (1992–2019) into a single dataset. (National Cancer Institute, 2021) Data from the TUS-CPS are publicly available and contain no personal identifiers and were analyzed anonymously.

We analyzed data from the 2003, 2006–2007, 2010–2011, 2014–2015, and 2018–2019 TUS-CPS waves to estimate smoking cessation prevalence trends because menthol cigarette use items were added to the TUS-CPS questionnaire starting in the 2003 wave. We restricted the analytic sample to adult respondents (ages 18 + years) who smoked ≥ 100 cigarettes in their lifetime including adults who currently smoke cigarettes and adults who formerly smoked cigarettes in each TUS-CPS wave (2003 unweighted $n = 37,056$; 2006–2007

unweighted $n = 33,997$; 2010–2011 unweighted $n = 29,723$; 2014–2015 unweighted $n = 25,507$; 2018–2019 unweighted $n = 18,123$). This study relied on publicly available data from the U.S. Census Bureau and was exempt from human subjects review.

3. Measures

3.1. Smoking status

Adults who currently smoke cigarettes were those who reported smoking ≥ 100 cigarettes during their lifetime and reported smoking every day or some days at the time of the interview. Adults who formerly smoked cigarettes were those who smoked ≥ 100 cigarettes in their lifetime but did not smoke at the time of the interview.

3.2. Recent successful cigarette smoking cessation

Recent successful smoking cessation was defined using the 2020 Surgeon General's Report (SGR) definition, i.e., having smoked during the past year and stopped smoking for \geq six months at the time of the survey. (United States Public Health Service Office of the Surgeon General, 2020) The denominator included respondents who smoked for \geq two years (both adults who currently smoke cigarettes and adults who formerly smoked cigarettes that reported quitting during the past year).

3.3. Menthol cigarette use

We used the following item to define menthol cigarette use among adults who formerly smoked cigarettes and quit within the previous year to ascertain menthol smoking status for recent quitters: "Still thinking back to the year before you quit smoking. During that time, was your usual cigarette brand menthol or non-menthol?" A separate item was used to define menthol cigarette use among adults who currently smoke cigarettes (included in denominators for menthol and non-menthol cigarette use): "Do you usually smoke menthol or non-menthol cigarettes?" For both items, respondents could choose the following: non-menthol, menthol, or no usual type. We did not include respondents who chose "no usual type" in the analysis due to sample size and analytic concerns for recent quitting ($n = 434$ for the overall sample in the study).

3.4. Demographic variables

We categorized demographic variables as follows: age (18–24, 25–29, 30–39, 40–49, 50–59, and ≥ 60 years), sex (male or female), and educational attainment (<high school (0–12 years), high school diploma or general educational development (GED), some college or associate degree, or bachelor's degree or above). We categorized respondents' race/ethnicity as non-Hispanic White, non-Hispanic Black/African American, Hispanic/Latino/Latina, and Non-Hispanic Other Race (Native American, Asian and Pacific Islander, and persons of multiple races were combined into one category due to sample size and analytic concerns).

3.5. Frequency of cigarette smoking

Frequency of cigarette smoking 12 months prior to quitting was assessed among adults who formerly smoked cigarettes and quit within the past year using the following item: "Around this time 12 months ago, were you smoking cigarettes every day, some days or not at all?"

3.6. Smoking cessation strategies

Smoking cessation strategies assessed included the use of counseling (i.e., helpline, quitline, smoking cessation clinic, counseling by health professionals, internet, web-based programs), a prescription medication

(i.e., Chantix, Varenicline, Zyban, Bupropion, Wellbutrin) at the time respondents quit smoking (in the past year), and nicotine replacement therapies (NRT) (patch, gum, lozenge, nasal spray, and nicotine inhaler).

3.7. Switching to other tobacco products

Switching to ENDS (“When you quit smoking completely did you try to quit by switching to electronic or e-cigarettes?”) and other non-cigarette tobacco products excluding ENDS (“When you quit smoking completely did you try to quit by switching to chewing tobacco, snuff, snus, cigars or pipes?”) were assessed at the time respondents quit smoking (in the past year).

3.8. Current non-cigarette tobacco product use

Current use (ever use of the product and using the product on some days or every day) of the following non-cigarette tobacco products was assessed: e-cigarettes/ENDS, cigars/cigarillos/little filtered cigars, all pipe use (combined regular pipe filled with tobacco and water or hookah pipe filled with tobacco), and smokeless tobacco.

3.9. Quitting combusted cigarettes without the use of a smoking cessation strategy or switching to other tobacco products including ENDS

Respondents who did not use a smoking cessation strategy or switch to other tobacco products (including ENDS) were categorized in a separate variable (did not use a smoking cessation strategy or switch to other tobacco products vs. used a smoking cessation strategy or switched to other tobacco products).

4. Statistical analyses

All analyses were conducted in SAS-callable SUDAAN version 11.0.3. We applied the SGR’s definition of smoking cessation to estimate smoking cessation prevalence among adults who smoked menthol and non-menthol cigarettes and who smoked for more than two years, stratified by race/ethnicity, sex, and age. We used self-response and replicate weights (a way to encapsulate the effect of the sampling design on variances) to account for the sampling probabilities and complex survey design. (Kish and Frankel, 1970) For variance estimation, we used balanced repeated replication with a Fay’s adjustment value of 16 for analyses of the harmonized data and 4 for analyses of the non-harmonized data. (Liu, 2020).

We used the RLOGIST procedure to estimate logistic regression models and test the time effect over five waves on cessation by treating time/wave as a categorical variable. We estimated model adjusted smoking cessation prevalence (predicted marginals) (Bieler et al., 2010) and 95 % confidence intervals (CI) by survey wave – controlling for sex, race/ethnicity, and age – for overall smoking cessation prevalence, menthol smoking cessation prevalence, and non-menthol smoking cessation prevalence, as well as model adjusted smoking cessation prevalence stratified by race/ethnicity, sex, and age during the study period. Before testing linear and quadratic trends, we first tested whether there was an overall effect for time in the logistic regression models. If this test was not statistically significant then no additional testing was needed. If the overall effect for time was statistically significant ($p < 0.05$), then we used orthogonal polynomial contrasts to test linear and quadratic changes in model adjusted smoking cessation prevalence. We focused on quadratic changes for instances in which the linear and quadratic contrasts were statistically significant and report model adjusted smoking cessation prevalence for all trend analyses. The stratified trend analyses were performed separately for sex, race/ethnicity, and age, and logistic regression models were not adjusted for additional covariates.

We analyzed the 2018–2019 non-harmonized TUS-CPS data among

recent quitters to examine differences in characteristics (e.g., demographic characteristics, smoking frequency, use of smoking cessation aids, switching to other tobacco products) by menthol cigarette use. We analyzed the non-harmonized data because some characteristics (e.g., switching to other tobacco products) were unavailable for the harmonized data for earlier waves. We coded smoking cessation strategies, switching to other tobacco products, not using any cessation strategy (including switching to ENDS), and current use of non-cigarette tobacco products as dummy variables so that groups were not mutually exclusive. We estimated weighted frequencies of recent quitters by menthol cigarette use and used Chi-square tests to examine differences in characteristics between these groups using the CROSSTAB procedure. We used $\alpha < 0.05$ for all statistical tests.

5. Results

Overall model adjusted smoking cessation prevalence was 5.8 % in the 2003 wave and increased to 7.6 % by the 2018–2019 wave (Fig. 1). There was a statistically significant linear change in the overall cigarette smoking cessation prevalence trend during the study period ($p < 0.0001$ for the linear trend) (Table 1). There were statistically significant linear changes in overall smoking cessation among non-Hispanic White adults ($p < 0.0001$ for the linear trend) and Hispanic/Latino/Latina adults ($p = 0.0031$ for the linear trend) (Table 1). Non-Hispanic Black/African American adults had the lowest smoking cessation prevalence compared to all other racial/ethnic groups. There was a statistically significant nonlinear change in the overall smoking cessation prevalence trend among non-Hispanic Other adults ($p = 0.0047$ for the quadratic trend). The overall model adjusted smoking cessation prevalence among non-Hispanic Other adults was 7.0 % in 2003, 5.5 % in 2006–2007, 5.0 % in 2010–2011, 6.9 % in 2014–2015, and 9.5 % in 2018–2019 (highest among all racial/ethnic categories during this wave) (Fig. 2). Hispanic adults had the second highest smoking cessation prevalence in the 2018–2019 wave (9.3 %; 95 % CI: 7.5, 11.5).

There were statistically significant linear changes in the overall smoking cessation prevalence trends for male ($p < 0.0001$ for the linear trend) and female adults ($p < 0.0001$ for the linear trend) (Table 1). There were statistically significant linear changes in overall smoking cessation prevalence trends among adults ages 25–29 years ($p < 0.0001$ for the linear trend), 30–39 years ($p = 0.0002$ for the linear trend), and 40–49 years ($p < 0.0001$ for the linear trend) (Table 1). There was a statistically significant quadratic change in the overall smoking cessation prevalence trend among young adults ages 18–24 years ($p = 0.0001$ for the quadratic trend). Young adults (ages 18–24 years) had the

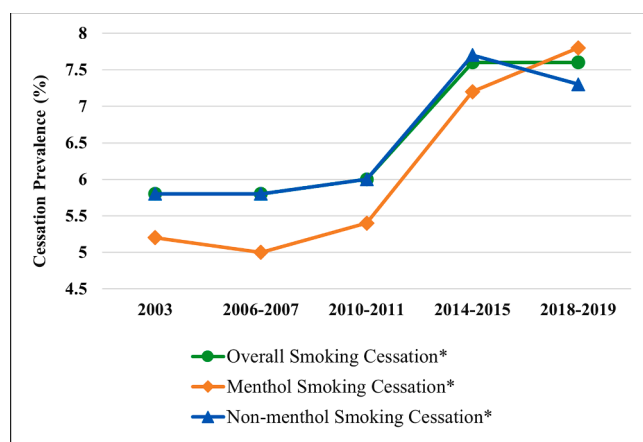


Fig. 1. Cigarette smoking cessation prevalence by overall smoking cessation, menthol smoking cessation, and non-menthol smoking cessation. Tobacco Use Supplement to the Current Population Survey, 2003–2019. Smoking cessation prevalence stratified by sex and age are presented in Tables 1 and 2.

Table 1
Model adjusted cigarette smoking cessation prevalence trends stratified by race/ethnicity, sex, and age, Tobacco Use Supplement to the Current Population Survey, United States, 2003-2019^a.

Population Size ^b	2003			2006–2007			2010–2011			2014–2015			2018–2019			p-value for linear trend ^c	p-value for quadratic trend ^c
	Weighted N = 42,695,107	Unweighted n = 37,056		Weighted N = 43,466,243	Unweighted n = 33,997		Weighted N = 39,346,505	Unweighted n = 29,723		Weighted N = 36,005,397	Unweighted n = 25,507		Weighted N = 31,038,024	Unweighted n = 18,123			
Characteristics	Unweighted n	Weighted N	Weighted % (95 % CI) ^d	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)		
Overall Smoking Cessation Prevalence^d	2,086	2,513,723	5.8 (4.9, 6.9)	1,961	2,558,359	5.8 (4.9, 7.0)	1,762	2,348,814	6.0 (5.0, 7.1)	1,858	2,725,941	7.6 (6.4, 9.1)	1,272	2,301,444	7.6 (6.4, 9.1)	<0.0001	0.1059
Race/Ethnicity																	
Non-Hispanic White	1,723	1,966,668	6.1 (5.7, 6.4)	1,588	1,977,675	6.0 (5.7, 6.4)	1,382	1,744,007	6.0 (5.6, 6.3)	1,493	2,047,555	7.9 (7.4, 8.4)	982	1,591,680	7.3 (6.8, 7.9)	<0.0001	0.4755
Non-Hispanic Black	101	153,927	3.4 (2.6, 4.5)	124	200,956	4.5 (3.7, 5.5)	141	228,599	5.2 (4.4, 6.2)	127	204,961	4.9 (4.0, 5.9)	89	200,961	5.2 (4.0, 6.7)	— ^f	— ^f
Hispanic/Latino/Latina	148	246,724	6.7 (5.5, 8.1)	146	262,743	6.6 (5.4, 8.0)	147	275,532	7.4 (6.1, 9.0)	140	324,548	8.6 (7.2, 10.4)	117	312,587	9.3 (7.5, 11.5)	0.0031	0.6183
Non-Hispanic Other ^g	114	146,404	7.0 (5.4, 8.9)	103	116,985	5.5 (4.2, 7.3)	92	100,676	5.0 (3.8, 6.6)	98	148,878	6.9 (5.2, 8.9)	84	196,215	5.5 (7.2, 12.6)	0.0535	0.0047
Sex																	
Male	970	1,269,539	5.6 (5.2, 6.0)	934	1,350,498	5.8 (5.4, 6.2)	907	1,262,967	6.0 (5.6, 6.4)	933	1,439,376	7.4 (6.9, 8.0)	642	1,239,695	7.3 (6.7, 8.0)	<0.0001	0.7089
Female	1,116	1,244,184	6.3 (5.8, 6.8)	1,027	1,207,862	6.0 (5.6, 6.4)	855	1,085,848	6.0 (5.5, 6.5)	925	1,286,565	7.8 (7.2, 8.4)	630	1,061,748	7.5 (6.8, 8.3)	<0.0001	0.1492
Age (years)																	
18–24	352	583,168	8.9 (7.8, 10.2)	253	432,512	7.0 (6.2, 7.9)	191	382,051	7.4 (6.4, 8.6)	193	464,755	10.9 (9.2, 12.9)	121	365,544	14.4 (11.9, 17.3)	<0.0001	0.0001
25–29	276	334,477	7.3 (6.4, 8.4)	301	400,541	7.9 (6.8, 9.0)	277	397,038	8.5 (7.4, 9.8)	249	401,294	10.6 (9.2, 12.1)	185	369,471	12.0 (10.2, 14.1)	<0.0001	0.3643
30–39	441	520,770	6.0 (5.3, 6.7)	418	540,769	6.4 (5.6, 7.2)	378	468,094	6.3 (5.6, 7.1)	450	618,558	8.5 (7.7, 9.5)	298	488,923	7.7 (6.6, 8.9)	0.0002	0.7333
40–49	376	412,107	3.9 (3.5, 4.4)	364	463,975	4.5 (4.0, 5.1)	315	413,758	5.1 (4.5, 5.7)	296	410,896	6.4 (5.5, 7.4)	184	357,091	6.8 (5.7, 8.0)	<0.0001	0.9327
50–59	296	325,282	4.6 (4.0, 5.3)	295	359,164	4.6 (4.0, 5.2)	287	336,875	4.2 (3.7, 4.8)	305	400,819	5.2 (4.5, 6.0)	180	291,145	4.4 (3.6, 5.2)	— ^f	— ^f
≥ 60	345	337,919	6.4 (5.7, 7.2)	330	361,397	6.6 (5.8, 7.4)	314	350,998	6.0 (5.2, 6.8)	365	429,619	6.6 (5.9, 7.4)	304	429,270	6.1 (5.3, 6.9)	— ^f	— ^f

^a Smoking cessation defined as adults who smoked ≥ 100 cigarettes in their lifetime and who reported being former smokers, completely quit smoking within the previous 12 months, and maintained smoking abstinence for at least six months. The denominator includes all persons who smoked during the past year. (i.e., current cigarette smokers who smoked for at least two years and former smokers who reported quitting during the past year).

^b Weighted denominators are presented.

^c CI = Confidence Interval.

^d Logistic regression model for trend analysis adjusted for race/ethnicity, sex, and age.

^e Bolded p-value represents statistically significant trend at p < 0.05.

^f P > 0.05 in test for overall effect of time in logistic regression model. Orthogonal polynomial contrast testing not needed as there is no time effect on smoking cessation for this group.

^g Native American and Alaskan Native, Asian and Pacific Islander, and persons of multiple races combined into one category due to sample size and analytic concerns.

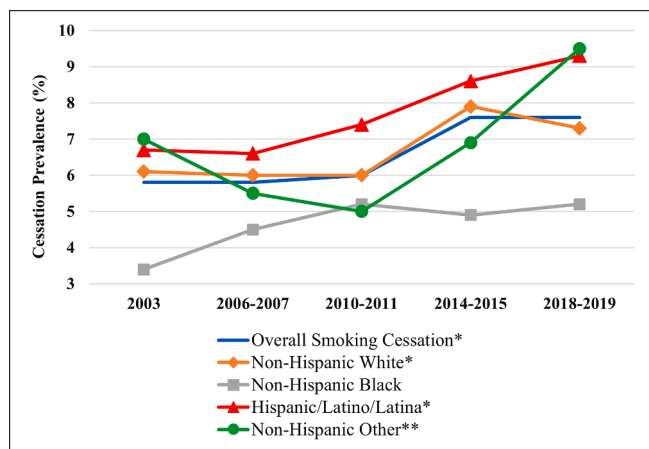


Fig. 2. Overall smoking cessation and stratified by race/ethnicity. Tobacco Use Supplement to the Current Population Survey, 2003–2019. Smoking cessation prevalence stratified by sex and age are presented in Tables 1 and 2.

highest smoking cessation prevalence in the 2018–2019 wave (14.4 %; 95 % CI: 11.9, 17.3).

Model adjusted menthol smoking cessation prevalence was 5.2 % in the 2003 wave and 7.8 % by the 2018–2019 wave (Fig. 3). There was a statistically significant linear increase in menthol smoking cessation ($p < 0.0001$ for the linear trend) (Table 2). There was a statistically significant linear change in menthol smoking cessation prevalence trend among non-Hispanic White adults ($p < 0.0001$ for the linear trend) and a statistically significant quadratic change in smoking cessation prevalence trend among non-Hispanic Other adults ($p = 0.0034$ for the quadratic trend) (Table 2) There were no statistically significant changes in the menthol smoking cessation prevalence among non-Hispanic Black/African American and Hispanic/Latino/Latina adults who smoke menthol cigarettes ($p > 0.05$ for models testing the overall effect of time). Non-Hispanic Black/African American adults had the lowest menthol smoking cessation prevalence estimates among all racial/ethnic categories during the study period.

Changes in menthol smoking cessation prevalence trends by sex and age were mostly consistent with changes in overall smoking cessation prevalence trends for these demographic groups (Table 2). There was a statistically significant linear change in the menthol smoking cessation prevalence trend among male ($p < 0.0001$ for the linear trend) and female adults ($p < 0.0001$ for the linear trend). There was a statistically significant quadratic change in the menthol smoking cessation

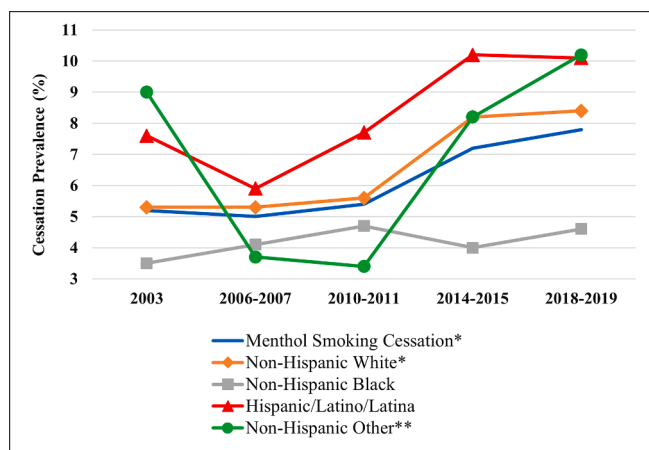


Fig. 3. Menthol smoking cessation and stratified by race/ethnicity. Tobacco Use Supplement to the Current Population Survey, 2003–2019. Smoking cessation prevalence stratified by sex and age are presented in Tables 1 and 2.

prevalence trend among young adults ages 18–24 years ($p = 0.0017$ for the quadratic trend) and significant linear changes among adults ages 25–29 years ($p < 0.0001$ for the linear trend), 30–39 years ($p = 0.0012$ for the linear trend), and 40–49 years ($p = 0.0029$ for the linear trend).

Model adjusted non-menthol smoking cessation prevalence was 5.8 % in the 2003 wave and 7.3 % by the 2018–2019 wave (Fig. 4). There was a statistically significant linear change in the non-menthol smoking cessation trend ($p < 0.0001$ for the linear trend). The non-Hispanic White category was the only race/ethnicity category with significant changes in non-menthol smoking cessation prevalence ($p = 0.0002$ for the linear trend) (Table 2). Non-Hispanic Other adults had the second highest non-menthol smoking cessation prevalence estimate in the 2018–2019 wave (8.6 %) (Table 2).

Changes in non-menthol smoking cessation prevalence trends by sex and age were consistent with changes in overall smoking cessation prevalence trends for these demographic groups (Table 2). There were statistically significant linear changes in the non-menthol smoking cessation trends among both sexes ($p < 0.0001$ for the male linear trend and $p = 0.0078$ for the female linear trend). There was a statistically significant linear change in the non-menthol smoking cessation prevalence trend among young adults ages 18–24 years ($p = 0.0007$ for the linear trend) and significant linear changes in non-menthol smoking cessation prevalence trends among adults ages 25–29 years ($p = 0.0016$ for the linear trend), 30–39 years ($p = 0.0105$ for the linear trend), and 40–49 years ($p = 0.0002$ for the linear trend).

Among recent quitters in the 2018–2019 wave, the only statistically significant differences in menthol status were for sex, race/ethnicity, age, and education attainment. Menthol recent quitters had higher proportions of adults who were female (56.9 % vs. 41.6 %; $p < 0.0001$), non-Hispanic Black/African American (17.1 % vs. 3.6 %; $p < 0.0001$), young adults ages 25–29 years (21.5 % vs. 13.5 %; $p = 0.0378$), and have some college level of education or an associate’s degree (45.5 % vs. 35.1 %; $p = 0.0009$) compared to non-menthol recent quitters (Supplementary Table). We note that approximately 26 % of all recent quitters reported switching to ENDS and approximately 31 % indicated that they did not smoke at all around 12 months prior to quitting.

6. Discussion

This study provides nationally representative prevalence estimates for cigarette smoking cessation in the U.S. by menthol cigarette use during 2003–2019, further stratified by race/ethnicity, sex, and age. Cigarette smoking cessation prevalence significantly changed for overall cigarette use, menthol cigarette use, and non-menthol cigarette use during the study period. Previous studies reported associations between menthol cigarette use and smoking cessation or focused on cigarette smoking cessation prevalence overall and trends in current menthol cigarette use. (Mills et al., 2021; Delnevo et al., 2011; Babb et al., 2017; Cook et al., 2022; Brouwer et al., 2022; Schneller et al., 2020; Mattingly et al., 2020) Non-menthol smoking cessation prevalence significantly changed among both sexes, adults ages < 50 years, and among non-Hispanic White adults. Adults in the non-Hispanic Other category had the second highest non-menthol smoking cessation prevalence estimate by the 2018–2019 wave, consistent with other research findings. (Babb et al., 2017) Menthol cigarette smoking cessation significantly changed for both sexes, among adults ages < 50 years, and for non-Hispanic White and non-Hispanic Other adults during the observation period. Although we observed changes in smoking cessation prevalence trends for menthol and non-menthol cigarette use in our study, evidence suggests ongoing disparities in cigarette smoking cessation by menthol cigarette use. (Tobacco Products Scientific Advisory Committee, 2011; Villanti et al., 2017; Mills et al., 2021; Smith et al., 2014) Declines in overall cigarette consumption are overwhelmingly attributed to declines in non-menthol cigarette consumption; the menthol cigarette market share increased from 2000 to 2018. (Delnevo et al., 2020) Future studies may need to examine menthol and non-menthol cigarette initiation

Table 2
Model adjusted cigarette smoking cessation prevalence trends by menthol cigarette use and stratified by race/ethnicity, sex, and age, Tobacco Use Supplement to the Current Population Survey, United States, 2003-2019^a.

Characteristics	2003			2006-2007			2010-2011			2014-2015			2018-2019			p-value for linear trend ^c	p-value for quadratic trend ^c
	Unweighted n	Weighted N	Weighted % (95 % CI) ^b	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)		
Menthol Smoking Cessation Prevalence^{d,e}	439	570,547	5.2 (4.4, 6.2)	422	561,695	5.0 (4.2, 5.9)	438	634,955	5.4 (4.6, 6.3)	522	837,796	7.2 (6.1, 8.4)	382	773,409	7.8 (6.5, 9.2)	<0.0001	0.0737
Race/Ethnicity																	
Non-Hispanic White	292	340,467	5.3 (4.6, 6.0)	282	357,815	5.3 (4.7, 6.0)	280	377,224	5.6 (5.0, 6.3)	347	518,406	8.2 (7.2, 9.3)	252	454,540	8.4 (7.3, 9.7)	<0.0001	0.2473
Non-Hispanic Black	69	108,613	3.5 (2.5, 4.7)	80	125,318	4.1 (3.1, 5.2)	96	154,311	4.7 (3.8, 5.9)	87	129,284	4.0 (3.1, 5.1)	58	131,995	4.6 (3.4, 6.2)	— ^f	— ^f
Hispanic/Latino/Latina	44	72,847	7.6 (5.5, 10.6)	33	60,104	5.9 (4.0, 8.6)	40	83,452	7.7 (5.4, 10.7)	54	135,867	10.2 (7.6, 13.7)	41	114,932	10.1 (7.3, 13.6)	— ^f	— ^f
Non-Hispanic Other ^g	34	48,620	9.0 (5.8, 13.9)	27	18,458	3.7 (2.2, 6.0)	22	19,967	3.4 (2.0, 5.9)	34	54,238	8.2 (5.4, 12.3)	31	71,943	10.2 (6.7, 15.2)	0.1939	0.0034
Sex																	
Male	163	226,106	4.5 (3.8, 5.3)	159	233,984	4.6 (3.9, 5.5)	184	287,378	5.5 (4.6, 6.4)	216	361,203	6.9 (5.9, 8.0)	150	333,541	7.0 (6.0, 8.3)	<0.0001	0.9454
Female	276	344,441	5.7 (4.9, 6.6)	263	327,711	5.2 (4.6, 6.0)	254	347,577	5.5 (4.8, 6.2)	306	476,593	7.6 (6.7, 8.7)	232	439,868	8.2 (7.1, 9.6)	<0.0001	0.0525
Age (years)																	
18-24	86	157,684	8.2 (6.3, 10.6)	53	89,806	4.8 (3.6, 6.4)	51	100,422	5.0 (3.7, 6.7)	77	185,779	10.7 (8.5, 13.3)	41	128,410	13.6 (9.7, 18.7)	0.0008	0.0017
25-29	49	72,522	6.2 (4.6, 8.4)	58	73,323	5.6 (4.1, 7.7)	83	136,116	8.9 (7.0, 11.2)	86	160,807	10.0 (7.9, 12.7)	72	165,999	13.2 (10.2, 16.9)	<0.0001	0.4056
30-39	74	86,239	4.3 (3.3, 5.6)	78	100,958	5.3 (4.0, 6.9)	77	97,739	4.7 (3.6, 6.1)	118	183,690	7.3 (5.9, 9.0)	98	171,902	7.1 (5.5, 9.0)	0.0012	0.8359
40-49	95	117,510	3.8 (2.9, 4.8)	90	124,676	4.4 (3.4, 5.6)	75	105,404	4.9 (3.8, 6.3)	74	105,046	6.3 (4.7, 8.3)	47	99,154	6.5 (4.8, 8.8)	0.0029	0.892
50-59	63	67,806	3.8 (2.8, 5.2)	82	100,158	4.5 (3.5, 5.9)	83	101,499	4.3 (3.3, 5.5)	75	94,632	4.1 (3.2, 5.2)	43	81,863	4.3 (3.0, 6.1)	— ^f	— ^f
≥ 60	72	68,787	6.1 (4.6, 8.1)	61	72,774	5.9 (4.4, 7.9)	69	93,776	6.4 (4.9, 8.4)	92	107,842	6.4 (4.9, 8.3)	81	126,081	6.3 (4.8, 8.2)	— ^f	— ^f
Non-Menthol Smoking Cessation Prevalence^{d,e}	1,512	1,775,057	5.8 (4.7, 7.3)	1,405	1,782,560	5.8 (4.7, 7.2)	1,212	1,568,822	6.0 (4.8, 7.5)	1,234	1,732,931	7.7 (6.2, 9.6)	800	1,364,368	7.3 (5.8, 9.0)	<0.0001	0.7647
Race/Ethnicity																	
Non-Hispanic White	1,318	1,491,273	6.1 (5.7, 6.5)	1,210	1,487,487	6.0 (5.6, 6.3)	1,021	1,263,512	5.9 (5.5, 6.3)	1,075	1,439,377	7.7 (7.2, 8.3)	663	1,032,526	6.7 (6.1, 7.3)	0.0002	0.7269
Non-Hispanic Black	27	39,163	3.6 (2.4, 5.3)	33	53,973	4.7 (3.3, 6.8)	32	55,774	6.1 (4.3, 8.6)	30	52,554	6.8 (4.6, 10.1)	26	49,280	6.3 (3.8, 10.3)	— ^f	— ^f
Hispanic/Latino/Latina	92	155,231	6.2 (4.9, 7.8)	95	157,111	6.0 (4.8, 7.6)	95	173,687	7.3 (5.9, 9.1)	73	158,334	7.3 (5.6, 9.6)	68	178,131	8.9 (6.8, 11.6)	— ^f	— ^f
Non-Hispanic Other ^g	75	89,390	6.2 (4.6, 8.3)	67	83,988	5.6 (4.0, 7.7)	64	75,849	5.8 (4.3, 7.9)	56	82,667	6.1 (4.3, 8.4)	43	104,430	8.6 (5.9, 12.3)	— ^f	— ^f
Sex																	

(continued on next page)

Table 2 (continued)

Characteristics	2003			2006–2007			2010–2011			2014–2015			2018–2019			p-value for linear trend ^c	p-value for quadratic trend ^c
	Unweighted n	Weighted N	Weighted % (95 % CI ^b)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)	Unweighted n	Weighted N	Weighted % (95 % CI)		
Male	736	951,227	5.7 (5.2, 6.3)	698	978,764	5.7 (5.2, 6.3)	665	892,790	6.0 (5.5, 6.6)	660	978,522	7.4 (6.7, 8.3)	436	796,487	7.1 (6.3, 7.9)	<0.0001	0.8979
Female	776	823,830	6.3 (5.7, 6.9)	707	803,796	6.1 (5.6, 6.6)	547	676,032	6.0 (5.4, 6.7)	574	754,409	7.7 (6.9, 8.6)	364	567,881	6.9 (6.1, 7.8)	0.0078	0.9166
Age (years)																	
18–24	240	382,158	8.9 (7.5, 10.4)	178	291,987	7.3 (6.2, 8.7)	129	261,526	9.1 (7.6, 11.0)	102	252,370	11.2 (9.0, 13.9)	68	202,329	14.2 (10.9, 18.3)	0.0007	0.0517
25–29	207	232,888	7.2 (6.1, 8.6)	221	286,099	8.1 (6.9, 9.4)	177	237,722	8.1 (6.8, 9.7)	148	210,864	10.5 (8.5, 12.8)	98	183,745	11.0 (8.8, 13.7)	0.0016	0.7229
30–39	343	409,669	6.4 (5.6, 7.4)	317	404,329	6.4 (5.7, 7.3)	276	330,630	6.5 (5.6, 7.5)	309	400,980	9.0 (7.8, 10.3)	178	272,561	7.5 (6.2, 8.9)	0.0105	0.5603
40–49	269	285,123	4.1 (3.5, 4.7)	254	310,493	4.4 (3.8, 5.2)	215	280,494	5.0 (4.3, 5.7)	207	286,579	6.3 (5.4, 7.5)	119	223,190	6.4 (5.1, 8.0)	0.0002	0.9549
50–59	212	230,197	4.6 (4.0, 5.4)	200	240,642	4.4 (3.8, 5.2)	191	220,119	4.1 (3.5, 4.7)	211	279,798	5.5 (4.7, 6.5)	128	198,238	4.4 (3.5, 5.4)	— ^f	— ^f
≥ 60	241	235,021	6.1 (5.3, 7.0)	235	249,010	6.2 (5.4, 7.2)	224	238,331	5.7 (4.9, 6.7)	257	302,341	6.5 (5.7, 7.5)	209	284,304	6.0 (5.1, 7.0)	— ^f	— ^f

^a a. Smoking cessation defined as adults who smoked ≥ 100 cigarettes in their lifetime and who reported being former smokers, completely quit smoking within the previous 12 months, and maintained smoking abstinence for at least six months. The denominator includes all persons who smoked during the past year (i.e., current cigarette smokers who smoked for at least two years and former smokers who reported quitting during the past year).

^b CI = Confidence Interval.

^c Bolded p-value represents statistically significant trend at p < 0.05.

^d Totals for menthol and non-menthol smoking cessation “weighted n” estimates may differ from overall cessation totals due to excluding recent quitters who reported “no usual type” of cigarette (2003, n = 98; 2006–2007, n = 103; 2010–2011, n = 84; 2014–2015, n = 75; 2018–2019, n = 74).

^e Logistic regression model for trend analysis adjusted for race/ethnicity, sex, and age.

^f P > 0.05 in test for overall effect of time in logistic regression model. Orthogonal polynomial contrast testing not needed as there is no time effect on smoking cessation for this group.

^g Native American and Alaskan Native, Asian and Pacific Islander, and persons of multiple races combined into one category due to sample size and analytic concerns.

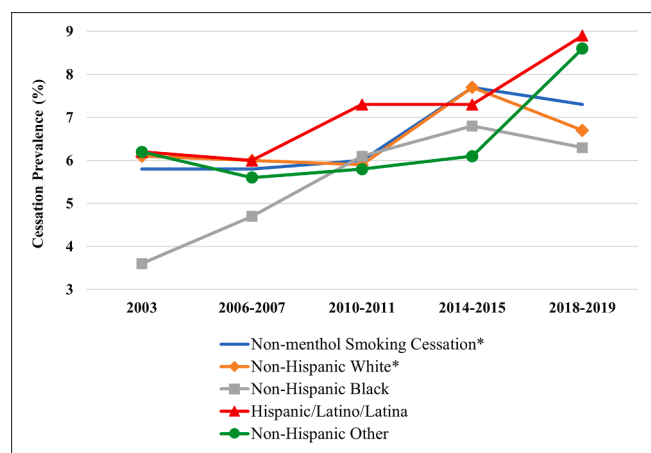


Fig. 4. Non-menthol smoking cessation and stratified by race/ethnicity. Tobacco Use Supplement to the Current Population Survey, 2003–2019. Smoking cessation prevalence stratified by sex and age are presented in Tables 1 and 2.

trends to fully characterize declines in cigarette use.

The findings indicate ongoing racial/ethnic disparities. Non-Hispanic Black/African American adults were the only race/ethnicity group to not experience any changes in overall smoking cessation prevalence, menthol smoking cessation prevalence, or non-menthol smoking cessation prevalence. Cessation prevalence estimates among non-Hispanic Black/African American adults who smoke were lower than non-Hispanic White adults who smoke overall, among adults who smoke menthol cigarettes, and among adults who smoke non-menthol cigarettes consistent with other studies. (Mills et al., 2021; Delnevo et al., 2011; Trinidad et al., 2009; Babb et al., 2017; Smith et al., 2014; Leventhal et al., 2022) Persistent racial/ethnic disparities in smoking cessation may be attributed to lower rates of health insurance coverage, lower use of smoking cessation aids among these populations, and other structural barriers such as racial discrimination. (National Center for Chronic Disease Prevention and Health Promotion, 1998; Babb et al., 2017; Sohn, 2017; Delnevo et al., 2020; Webb Hooper et al., 2020; Nguyen et al., 2012) Population simulation modeling studies estimate that banning the sale of menthol cigarettes would avert more than 237,000 smoking-attributable deaths and result in relative reductions in menthol and non-menthol cigarette use of 35.7 % in 2026 and 25.3 % in 2060 among the non-Hispanic Black/African American population. (Levy et al., 2011; Issabakhsh et al., 2022).

We observed significant changes in smoking cessation prevalence trends for male and female adults who smoke menthol cigarettes and those who smoke non-menthol cigarettes. Although female adults smoke menthol cigarettes at higher rates than male adults, (Villanti et al., 2016; Smith et al., 2017) it does not appear that female adults quit menthol cigarette use at lower rates than male adults. We observed changes in smoking cessation prevalence trends among adults ages 18–49 years who smoke menthol cigarettes and those who smoke non-menthol cigarettes. These results are consistent with previous research showing higher smoking cessation prevalence among adults ages 18–44 years. (Babb et al., 2017) Adults ages ≥ 50 years had lower smoking cessation prevalence, irrespective of menthol smoking status. This disparity could be due to lower smoking quit attempts reported by adults ages ≥ 45 years. (Babb et al., 2017) NRT is effective for smoking cessation. (Cawkwell et al., 2015) Increasing access to NRT, other safe and effective treatments, and counseling may help to increase smoking cessation prevalence among adults ages ≥ 45 years.

Recent quitters of menthol cigarettes were more likely to be non-Hispanic Black/African American, female, and young adults ages 25–29 years. The results are likely a reflection of these populations' tendency to use menthol cigarettes and the history of targeted advertising of menthol cigarettes to these populations. (Villanti et al., 2016;

Smith et al., 2017; Anderson, 2011) Furthermore, recent quitters of menthol cigarettes were more likely to have some college level of education or an associate's degree in our study. This finding may reflect that people with some post high school/college education showed the largest increase in menthol use in the 2003–2019 TUS-CPS data. (Seaman et al., 2022) Approximately 26 % of all recent quitters reported switching to ENDS in our study. Racial/ethnic minority populations are more likely to use menthol cigarettes, (Seaman et al., 2022; Villanti et al., 2016) yet these groups have lower prevalence of using e-cigarettes to quit combusted cigarettes. (Leventhal et al., 2022).

7. Strengths and limitations

We used a large nationally representative dataset to generate population estimates for smoking cessation prevalence trends by menthol smoking status. We note some limitations. The TUS-CPS is based on self-reported behaviors and is subject to recall bias; however, former users of cigarettes report smoking history characteristics consistent with current users of cigarettes. (Soulokova et al., 2012) We note that approximately 31 % of recent quitters included in the analysis of the 2018–2019 wave indicated that they did not smoke around 12 months prior to completing the survey. These recent quitters could have attempted to quit without completely abstaining from smoking during the recall period. Some adults who formerly smoke cigarettes can relapse to smoking after six months. (United States Public Health Service Office of the Surgeon General, 2020; Hughes et al., 2008) We observed changes in overall smoking cessation among Hispanic/Latino/Latina adults; however, these changes were not observed when analyzing cessation by menthol cigarette use (likely due to lower samples for analyses by menthol cigarette use). Furthermore, Native American/Alaskan Native, Asian and Pacific Islander, and persons of multiple racial-ethnic identities were grouped into one category, making it unclear whether gains in cigarette smoking prevalence were equal across these groups. We did not stratify the analysis by the specific sex, race/ethnicity group, and age groups (due to sample size limitations). Cessation trends could vary by the intersections of these variables.

8. Conclusions

We observed significant changes in overall cigarette smoking cessation prevalence, including among adults who smoke menthol cigarettes and those who smoke non-menthol cigarettes during 2003–2019. Changes in cigarette smoking cessation were not observed among non-Hispanic Black/African American adults who smoke. Changes in cigarette smoking cessation were experienced among younger adults; however, changes in cigarette smoking cessation prevalence were not observed among older adults who smoke overall, those who smoke menthol cigarettes, or those who smoke non-menthol cigarettes.

CRedit authorship contribution statement

Jamal T. Jones: Conceptualization, Formal analysis, Writing – original draft. **Kerui Xu:** Formal analysis, Writing – review & editing. **Li Deng:** Formal analysis, Writing – review & editing. **Michael D. Sawdey:** Writing – review & editing. **Carolyn M. Reyes-Guzman:** Writing – review & editing. **Cindy M. Chang:** Writing – review & editing. **Joanne T. Chang:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data used are publicly available for download at the TUS-CPS website <https://cancercontrol.cancer.gov/brp/tcrb/tus-cps>.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2023.102440>.

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