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Original Investigation

The Relationship Between Menthol Cigarette Use, Smoking Cessation, and Relapse: Findings From Waves 1 to 4 of the Population Assessment of Tobacco and Health Study

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Abstract

Introduction: Some, but not all, studies suggest that menthol cigarette smokers have more difficulty quitting than non-menthol cigarette smokers. Inconsistent findings may be a result of differences in smoker characteristics (eg, daily vs. non-daily smokers) across studies. This study examines the relationship between menthol cigarette use, cessation, and relapse in a longitudinal, nationally representative study of tobacco use in the United States.

Aims and Methods: Data come from four waves of the Population Assessment of Tobacco and Health Study. Waves 1–4 were conducted approximately annually from September 2013 to January 2018. Generalized estimating equation models were used to prospectively examine the relationship between menthol cigarette use, cessation, and relapse in non-daily and daily adult (18+) smokers. Cessation was defined as smokers who had not used cigarettes within the past 30 days at their subsequent assessment. Relapse was defined as cessation followed by past 30-day smoking in the next assessment.

Results: Among daily smokers (*n* = 13 710), 4.0% and 5.3% of menthol and non-menthol smokers quit after 1 year, respectively. In an adjusted model, menthol smokers were less likely to quit compared with non-menthol smokers (odds ratio [OR] = 0.76 [0.63, 0.91]). When the sample was stratified by race/ethnicity, African American (OR = 0.47 [0.24, 0.91]) and White (OR = 0.78 [0.63, 0.97]) daily menthol users were less likely to have quit. Among non-daily smokers (*n* = 3608), there were no significant differences in quit rates. Among daily and non-daily former smokers, there were also no differences in relapse rates between menthol and non-menthol smokers.

Conclusions: Menthol cigarette use is associated with lower odds of cessation.

Implications: Findings from this study suggest that menthol cigarette use is associated with lower odds of cessation, but not relapse. Removing menthol cigarettes from the market may improve cessation rates.

Introduction

Although limited data are available on the prevalence of menthol cigarette use globally, research suggests that prevalence rates vary widely.[1] A 2016 study of eight European countries finds that 7.4% of respondents overall smoke menthol cigarettes.[1] Prevalence rates range from 0.4% in Spain to 12.4% in England.[1] Data from Kenya in 2012 and Zambia in 2014 indicate that 21% and 43% of adults use menthol cigarettes, respectively. Rates of menthol cigarette use are also high in the United States. Prevalence estimates from 2018 indicate that more than one-third (39%) of US smokers use menthol cigarettes.[2] Although consumption of non-menthol cigarettes is declining in the United States, consumption of menthol cigarettes is steady over the past decade.[3]

In the United States, menthol cigarette use is highest among youth, lower-income, and racial/ethnic minority smokers, and those who report serious psychological distress.[2,4,5] Sociodemographic disparities in menthol cigarette use have been attributed to targeted marketing by the tobacco industry that has occurred for decades and continues today.[6,7] Studies conducted in the United States find that retail advertising for menthol cigarettes is more common in neighborhoods with more youth, racial/ethnic minorities, especially African Americans, and lower-income populations.[5,8] For example, in a national sample of tobacco retailers in 2015, retail advertising and price promotions for Newport menthol cigarettes, the most popular menthol cigarette brand, were more common in neighborhoods with the highest percentage of African American residents.[8] Disparities in menthol cigarette use according to sociodemographic characteristics are a concern because some studies suggest that menthol cigarette smokers have more difficulty quitting than non-menthol cigarette smokers, even despite research showing menthol cigarette smokers use fewer cigarettes per day.[9,10]

Menthol is an organic compound that, when added to cigarettes, masks the harshness of cigarette smoke and provides anesthetic and cooling effects that permit deeper inhalation of the nicotine in cigarettes.[6,9] Research from preclinical studies indicates that menthol in cigarettes changes the expression and function of nicotine and alters nicotine metabolism, increasing its bioavailability.[11] Greater nicotine exposure is hypothesized to cause greater nicotine dependence and more difficulty quitting and maintaining abstinence.[6] A review found that menthol cigarette smokers are more dependent on nicotine, according to several different indictors, than non-menthol cigarette smokers.[10] The anesthetic and cooling effects are also expected to conceal the pain or burning in the throat caused by cigarettes that would otherwise motivate smokers to quit.[12]

Several studies have used nationally representative, cross-sectional data to examine differences in cessation rates between menthol and non-menthol cigarette smokers in the United States. Some studies find lower quit rates among menthol smokers as compared with non-menthol smokers,[13–15] but not all research is consistent.[16–18] For example, Levy et al.[13] found that past-year quit rates were 4% and 12% lower among menthol as compared with non-menthol smokers using data from the 2003 and 2006/2007 waves of the Tobacco Use Supplement to the Current Population Survey (TUS), respectively. However, using data from the 2006/2007 and 2010/2011 waves of the TUS, Keeler et al.[16] found there was no significant difference in quit rates between menthol and non-menthol smokers.[16]

Most longitudinal research is from clinical trials or is conducted among smokers attending cessation clinics. In comparative effectiveness trials of cessation treatments, some studies find that menthol cigarette smokers are less likely to successfully quit as compared with smokers who used non-menthol cigarettes.[19–21] Other studies, however, find no significant differences in cessation rates,[22,23] or find significant differences in cessation rates only among certain racial/ethnic groups.[24] Menthol cigarette use may be associated with cessation only among certain racial/ethnic groups because of targeted marketing of menthol cigarettes according to the racial/ethnic makeup of communities.[25] Greater exposure to marketing for menthol cigarettes in certain communities may result in more difficulty quitting among residents of those communities. Studies show that tobacco retail marketing acts as an effective cue to smoke for current and former smokers.[26]

Longitudinal research using national US samples is limited. Using data from Waves 1 and 2 of the Population Assessment of Tobacco and Health (PATH) Study, Schneller et al.[27] compared cessation rates 1 year after baseline assessment among smokers using non-menthol cigarettes and smokers using menthol cigarettes with different menthol delivery methods. In adjusted models, there were no significant differences in cessation rates between smokers who used menthol and non-menthol cigarettes, regardless of menthol delivery method. A recent meta-analysis of studies examining the relationship between menthol cigarette use and cessation in the United States found no significant association when all studies were combined.[28] Race/ethnicity, however, accounted for 47% of the heterogeneity in effect sizes across studies.[28] The authors[28] stated that research to date has been inconsistent because of heterogeneity in study samples and varied operationalization of cessation and study design. The meta-analysis highlights the importance of examining the relationship between menthol cigarette use and cessation separately by race/ethnicity and considering other populations for which the relationship between menthol cigarette use and cessation may differ. Differences in the relationship between menthol use and cessation across non-daily and daily smokers may also be, in part, responsible for inconsistent findings in past studies. The relationship between menthol use and cessation may not be the same among non-daily menthol and daily menthol smokers because non-daily smokers use the product less frequently, which may play a role in the likelihood of quitting successfully. Due to potentially higher levels of nicotine dependence among daily smokers, as well as other unique experiences dependent on smoking frequency (eg, more interaction with the tobacco retail environment among daily smokers), determinants of cessation may be substantively different across non-daily and daily smokers. Combining non-daily and daily menthol smokers may obscure the effect of menthol on cessation.

Fewer studies have examined the relationship between menthol cigarette use and relapse. This may be due to a lack of consensus on how to define cessation and relapse.[29] Successful cessation typically refers to the point at which a person no longer smokes.[29] Cessation has been defined using a range of methods from 7-day point prevalence abstinence to sustained abstinence for 12 months or longer. Relapse, on the other hand, occurs when a person has attained abstinence and subsequently resumes smoking.[29] In a sample (*n* = 597) of smokers followed for 15 years in the Coronary Artery Risk Development in Young Adults (CARDIA) Study, menthol cigarette smokers were almost two times as likely to relapse as compared with non-menthol cigarette smokers.[30]

The present study uses data from four waves of the PATH Study to prospectively examine the relationship between menthol cigarette use, cessation, and relapse in a nationally representative sample of smokers in the United States. To date, longitudinal studies have largely been limited to comparative effectiveness trials of cessation

treatments with high cessation rates or are conducted among smokers attending cessation clinics in single states. Clarity on the relationship between menthol cigarette use, cessation, and relapse is important because localities, states, and countries have implemented or are considering restrictions on the sale of menthol cigarettes. The Food and Drug Administration (FDA) in the United States has regulatory authority over the sale of tobacco products, including menthol cigarettes, and is considering a ban on the product.[31] Despite federal inaction on menthol cigarettes, as of February 2020, one state (Massachusetts) and at least 90 US localities ban or restrict the sale of menthol cigarettes.[32] Outside the United States, several countries restrict the sale of menthol cigarettes including Canada, Brazil, Ethiopia, and Turkey, as well as the European Union.[33] Better understanding the relationships between menthol cigarette use, cessation, and relapse may provide valuable information for policy makers considering menthol cigarette bans or policy makers intent on keeping restrictions in place. Increasing rates of successful cessation and reducing rates of relapse are critical to reducing smoking prevalence and tobacco-related disease.

Methods

Data for the present study come from the PATH Study. The PATH Study is a longitudinal, nationally representative cohort study of tobacco use behavior and beliefs and tobacco-related health outcomes among youth and adults in the United States.[34] The PATH Study is conducted through a collaboration between the National Institute on Drug Abuse, the National Institutes of Health, and the FDA's Center for Tobacco Products. Questionnaires were administered through computer-assisted interviews. PATH uses a four-stage, stratified probability sample design to obtain a nationally representative sample.[34] Adults were oversampled for young adults (18–24 years), African Americans, and tobacco users. Data for the present study come from adult (18+ years) interviews in Waves 1, 2, 3, and 4 of the study. Surveys for Waves 1 through 4 were administered from September 2013 to December 2014, October 2014 to October 2015, October 2015 to October 2016, and December 2016 to January 2018, respectively. For a detailed description of the PATH Study, see Hyland et al.[34]

Measures

Smoker Status and Menthol Cigarette Use
Smokers were defined as respondents who smoked at least 100 cigarettes in their lifetime and, at the time of interview, smoked every day or some days, and were not current users of e-cigarettes or cigars. Smokers were further divided into daily (ie, every day) and non-daily (ie, some day) smokers; and menthol and non-menthol cigarette users. Smokers were considered menthol cigarette users if they responded yes to the question, "Is/was your regular brand/the last brand you smoke/smoked flavored to taste like menthol or mint?"

Cessation
Smokers were considered to have quit if they had not smoked cigarettes within the past 30 days at their subsequent assessment (ie, Wave X + 1).

Relapse
Smokers were considered to have relapsed if they quit smoking at the subsequent wave (ie, Wave X + 1) and at the following wave (ie, Wave X + 2) had smoked within the past 30 days.

Nicotine Dependence
Nicotine dependence was assessed by the self-reported length of time to first cigarette after waking. Nicotine dependence was categorized into two categories: less than 30 minutes and greater than or equal to 30 minutes, which reflect higher and lower levels of dependence, respectively.

Past Quit Attempts
Past quit attempts were assessed by the question: "In the past 12 months have you tried to quit smoking completely?" Smokers were considered to have made a quit attempt in the past 12 months if they responded yes to the question.

Demographic Characteristics
The following variables and categories were employed: age (18–24, 25–34, 35–54, 55+), sex (male, female), education (less than high school or GED, high school graduate, some college or associate's degree, bachelor's or advanced degree), and race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic Other, and Hispanic).

Data Analysis
For the cessation analysis, the sample was limited to participants who had PATH data in two adjacent waves (ie, Waves 1 and 2; Waves 2 and 3; Waves 3 and 4) and were smokers in the first wave. For the relapse analysis, the sample was limited to participants who had data in three adjacent waves (ie, Waves 1, 2, and 3; Waves 2, 3, and 4) and were smokers in the first wave and quit smoking in the second wave. For each participant, every possible transition was examined. First, descriptive statistics for participants in the cessation and relapse analyses were examined in the total sample and separately among non-daily and daily smokers. Descriptive statistics are presented for all person-observations.

Next, for the cessation analyses, generalized estimating equations (GEEs) were estimated to prospectively examine the relationship between menthol cigarette use and cessation, controlling for age, sex, race/ethnicity, education, nicotine dependence, and past quit attempts. GEE models were also estimated separately for each racial/ethnic group. For the relapse analysis, GEE models were estimated to prospectively examine the relationship between menthol cigarette use and relapse, controlling for age, sex, race/ethnicity, education, nicotine dependence, and past quit attempts. Due to smaller sample sizes when examining relapse, models were not stratified by race/ethnicity. All analyses were conducted for non-daily and daily smokers separately. GEE was used to statistically control for correlations among participants who contribute multiple observations in a single analysis. In a sensitivity analysis, GEE models were estimated with and without year indicator variables because the likelihood of quitting may vary across year during the study period. Year, however, was not significant in the models and there were no differences in findings when year was included, so it was removed.

To statistically test for differences in the effect of menthol use across daily and non-daily smokers, fully interacted GEE models (ie, interactions between smoking frequency and each variable in the model) were examined for the cessation and relapse outcomes. For the cessation outcome, fully interacted GEE models (ie, interactions between race/ethnicity and each variable in the model) were also examined to statistically test for differences in the effect of menthol use across racial/ethnic groups. Results from the fully interacted models are presented in Tables 3 and 4.

Descriptive statistics and GEE models were conducted using the PATH Study sampling weights in SAS version 9.4 to account for the complex survey design. To obtain nationally representative estimates, the "Wave 1 Cohort Wave 4 All-Waves Weights" were used. The full-sample and 100 replicate weights were used for the descriptive statistics and GEE models. The balance repeated replication method with Fay's adjustment set to 0.3 was used to compute variances.[35,36]

Results

Descriptive Statistics

See Table 1 for sociodemographic characteristics of the study samples. In the cessation analysis (non-daily smokers: *n* = 3608; daily smokers: *n* = 13 710), 45.1% and 48.8% of non-daily and daily smokers were women, respectively. The majority of non-daily and daily smokers were 35 years or older. A greater percentage of non-daily smokers were 18–24 years old (17.1%) as compared with daily smokers (10.3%). Fewer daily smokers (8.7%) had a bachelors or advanced degree as compared with non-daily smokers (23.3%). The majority of non-daily (56.9%) and daily (71.2%) smokers were non-Hispanic White. However, a greater percentage of non-daily smokers (21.5%) were Hispanic as compared with daily smokers (10.0%). Thirty-nine percent and 36.9% of non-daily and daily smokers used menthol cigarettes, respectively. Patterns in demographic characteristics across non-daily and daily smokers were similar for the sample used for the relapse analysis (non-daily smokers: *n* = 445; daily smokers: *n* = 416).

Cessation

In the total sample, 17.9% and 19.7% of non-daily menthol and non-menthol smokers quit, respectively (Table 2 and Supplementary Figure 1). In unadjusted models, there were no significant differences in quit rates between menthol and non-menthol non-daily smokers in the total sample (*p* = .26) or when the sample was stratified by race/ethnicity (White: menthol: 21.7%, non-menthol: 18.3%, *p* = .13; Black: menthol: 10.2%, non-menthol: 13.7%, *p* = .37; Other: menthol: 26.7%, non-menthol: 28.5%, *p* = .84; Hispanic: menthol: 18.6%, non-menthol: 23.2%, *p* = .28). Among daily smokers, there were significant differences in quit rates between menthol (4.0%) and non-menthol smokers (5.3%) in the total sample (*p* < .01). When the sample was stratified by race/ethnicity, there were significant differences in quit rates between menthol and non-menthol daily smokers among African Americans (menthol: 3.0%, non-menthol: 6.2%, *p* = .01) and among Whites (menthol: 4.3%, non-menthol: 5.4%, *p* = .04), but not among Other (menthol: 3.4%, non-menthol: 5.0%, *p* = .52) or Hispanic (menthol: 5.6%, non-menthol: 5.2%, *p* = .79) racial/ethnic groups.

In adjusted models, controlling for age, sex, race/ethnicity, education, nicotine dependence, and past quit attempts, there was no significant (*p* > .05) relationship between menthol use and cessation for non-daily smokers in the total sample (odds ratio [OR] = 1.04 [0.81, 1.33]) or in models stratified by race/ethnicity (White: OR = 1.20 [0.92, 1.67]; Black: OR = 0.97 [0.38, 2.51]; Other: OR = 0.59 [0.17, 2.08]; Hispanic: OR = 0.81 [0.45, 1.46]; Table 3). However, among daily smokers, menthol use was significantly associated with cessation. Menthol cigarette smokers had a 24% lower odds of quitting as compared with non-menthol smokers (OR = 0.76 [0.63, 0.91]). When examining the relationship between menthol cigarette use and cessation in each racial/ethnic group, menthol cigarette use was significantly associated with cessation among African American (OR = 0.47 [0.24, 0.91]) and White (OR = 0.78 [0.63, 0.97]) daily smokers. There was no significant relationship between menthol cigarette use and cessation among daily smokers who identified as Other (OR = 0.49 [0.10, 2.46]) or Hispanic (OR = 1.22 [0.63, 2.35]; Table 3).

Relapse

In unadjusted models of non-daily smokers, 40.1% of menthol and 30.3% of non-menthol smokers relapsed. Among daily smokers, 37.5% and 35.3% of menthol and non-menthol smokers relapsed, respectively. For non-daily and daily smokers, there were no significant (*p* > .05) differences in relapse rates between menthol and non-menthol smokers (see Table 2). In adjusted models, controlling for age, sex, race/ethnicity, education, nicotine dependence, and past quit attempts, there were no significant relationships between menthol use and relapse among non-daily [OR = 1.51 [0.79, 2.89] or daily [OR = 0.76 [0.41, 1.41] smokers (Table 4).

Discussion

Findings from the present study indicate that menthol cigarette use is associated with a decreased likelihood of cessation among daily smokers. Among African American and White daily smokers, those who used menthol cigarettes were less likely to quit smoking as compared with those who used non-menthol cigarettes. These findings are consistent with past studies that have found a significant, negative relationship between menthol cigarette use and cessation.[28] Menthol cigarette use was significantly associated with cessation among daily smokers, even after controlling for nicotine dependence, suggesting an independent relationship with cessation.

This study provides insight into prior inconsistent findings. In the present study, there were no significant relationships between menthol cigarette use and cessation among non-daily smokers in the total sample or in models where non-daily smokers were stratified by race/ethnicity. Studies examining factors associated with successful quitting among non-daily smokers have found several correlates including age, gender, education, marital status, perceived addiction, partner smoking status, and past quit attempts.[37,38] Findings from the present study suggest that menthol cigarette use does not play an important role in cessation among non-daily smokers. In the present study, there were no significant relationships between menthol use and cessation among daily smokers who identified as Other or Hispanic. This may be a result of the small sample size of smokers who identified as Other and Hispanic. Future studies should examine the relationship between menthol use and cessation in these groups with larger sample sizes.

Disproportionate marketing of menthol cigarettes in communities with a greater percentage of racial/ethnic minorities and lower-income residents has been considered a social justice issue.[6] Greater exposure to tobacco retail marketing has been associated with greater difficulty quitting among current smokers and former smokers.[26] Therefore, marketing menthol cigarettes, which this study suggests are more difficult to quit than non-menthol cigarettes, to racial/ethnic minority and lower-income communities may cause disproportionate harm to individuals living in those communities.

There were no significant relationships between menthol cigarette use and relapse in non-daily or daily smokers. Compared

Table 1. Sample Characteristics for Cessation and Relapse Analyses, PATH Study Waves 1–4

	Cessation						Relapse					
	Non-daily smokers N = 3608		Daily smokers N = 13 710		Total N = 17 318		Non-daily smokers N = 445		Daily smokers N = 416		Total N = 861	
Characteristics	Freq	Weighted percent (%)	Freq	Weighted percent (%)	Freq	Weighted percent (%)	Freq	Weighted percent (%)	Freq	Weighted percent (%)	Freq	Weighted percent (%)
Age												
18–24	887	17.1 (15.5, 18.6)	2082	10.3 (9.7, 10.9)	2969	11.8 (11.1, 12.4)	117	17.8 (13.9, 21.7)	86	14.3 (11.1, 17.5)	203	16.2 (13.4, 18.9)
25–34	980	28.8 (26.3, 31.3)	3021	22.1 (20.8, 23.5)	4001	23.6 (22.4, 24.9)	129	33.5 (27.3, 39.7)	94	22.8 (18.0, 27.7)	223	28.6 (24.3, 32.8)
35–54	1174	35.8 (33.1, 38.6)	5345	40.8 (39.3, 42.3)	6519	39.7 (38.3, 41.1)	132	30.0 (24.4, 35.7)	133	32.4 (27.1, 37.7)	265	31.1 (27.1, 35.1)
55+	565	18.3 (16.3, 20.3)	3262	26.8 (25.2, 28.3)	3827	24.9 (23.6, 26.2)	67	18.7 (13.4, 24)	103	30.4 (24.3, 36.5)	170	24.1 (20.0, 28.1)
Sex												
Male	1870	54.9 (52.5, 57.3)	6209	51.2 (49.9, 52.5)	8079	52.0 (50.8, 53.3)	219	55.5 (49.4, 61.6)	210	57.3 (52.0, 62.7)	429	56.3 (52.1, 60.6)
Female	1738	45.1 (42.7, 47.5)	7496	48.8 (47.5, 50.1)	9234	48.0 (46.7, 49.2)	226	44.5 (38.4, 50.6)	206	42.7 (37.3, 48.0)	432	43.7 (39.4, 47.9)
Education												
Less than high school or GED	769	19.0 (17.0, 21.0)	4282	29.6 (28.4, 30.8)	5051	27.3 (26.2, 28.3)	63	13.3 (9.0, 17.7)	112	26.2 (20.8, 31.7)	175	19.3 (15.9, 22.7)
High school graduate	794	22.9 (20.7, 25.0)	3507	28.8 (27.5, 30.1)	4301	27.5 (26.3, 28.7)	97	25.2 (19.0, 31.5)	101	25.2 (20.9, 29.5)	198	25.2 (21.3, 29.1)
Some college or Associates degree	1286	34.9 (32.0, 37.7)	4710	32.9 (31.5, 34.3)	5996	33.4 (32.0, 34.7)	159	33.6 (28.7, 38.4)	166	39.0 (33.3, 44.8)	325	36.1 (32.4, 39.8)
Bachelor's or Advanced degree	746	23.3 (20.9, 25.7)	1157	8.7 (8.0, 9.4)	1903	11.9 (11.0, 12.8)	121	27.9 (23.1, 32.7)	34	9.5 (6.5, 12.6)	155	19.4 (16.7, 22.1)
Race/ethnicity												
White	1869	56.9 (54.2, 59.7)	9014	71.2 (69.7, 72.8)	10883	68.1 (66.7, 69.4)	235	54.7 (47.8, 61.6)	294	74.5 (70.2, 78.8)	529	63.8 (59.4, 68.1)
Black	547	13.8 (12.2, 15.5)	2058	13.9 (12.8, 15.0)	2605	13.9 (12.9, 14.8)	41	8.5 (5.0, 11.9)	46	10.1 (7.4, 12.8)	87	9.2 (6.8, 11.6)
Other	274	7.7 (5.8, 9.6)	849	4.8 (4.3, 5.4)	1123	5.5 (4.9, 6.1)	44	11.8 (7.1, 16.6)	20	4.7 (1.9, 7.5)	64	8.5 (5.7, 11.4)
Hispanic	868	21.5 (19.4, 23.7)	1549	10.0 (9.1, 11.0)	2417	12.6 (11.8, 13.4)	123	25.0 (19.2, 30.8)	52	10.7 (7.5, 14.0)	175	18.4 (14.8, 22.1)
Menthol												
No	2060	60.7 (58.3, 63.0)	8256	63.1 (61.3, 64.9)	10316	62.6 (61.1, 64.0)	265	62.8 (56.6, 69.1)	277	70.7 (65.7, 75.7)	542	66.5 (62.4, 70.5)
Yes	1548	39.3 (37.0, 41.7)	5454	36.9 (35.1, 38.7)	7002	37.4 (36.0, 38.9)	180	37.2 (30.9, 43.4)	139	29.3 (24.3, 34.3)	319	33.5 (29.5, 37.6)
Nicotine												
≥30 minutes	3044	87.5 (86.1, 88.9)	6345	46.5 (45.1, 47.9)	9389	55.4 (54.0, 56.7)	381	91.2 (88.1, 94.3)	277	70.7 (65.7, 75.7)	632	77.6 (74.4, 80.7)
<30 minutes	479	12.5 (11.1, 13.9)	7324	53.5 (52.1, 54.9)	7803	44.6 (43.3, 46.0)	41	8.8 (5.7, 11.9)	139	29.3 (24.3, 34.3)	198	22.4 (19.3, 25.6)
Quit												
Not tried to quit	528	19.5 (17.3, 21.7)	3477	35.1 (34.0, 36.2)	4005	31.5 (30.4, 32.5)	118	29.5 (22.5, 36.5)	134	32.6 (27.6, 37.5)	252	30.9 (26.5, 35.2)
Tried to quit	2373	80.5 (78.3, 82.7)	6716	64.9 (63.8, 66.0)	9089	68.5 (67.5, 69.6)	324	70.5 (63.5, 77.5)	276	67.4 (62.5, 72.4)	600	69.1 (64.8, 73.5)

Freq = frequencies; PATH = Population Assessment of Tobacco and Health. Frequencies presented are unweighted. All racial/ethnic groups are non-Hispanic except for the Hispanic group.

Table 2. Cessation and Relapse Rates in Menthol and Non-menthol Cigarette Users

Sample characteristics		Cessation rates						Relapse rates					
		Non-daily smoker N = 3608		Daily smoker N = 13 710		Total N = 17 318		Non-daily smoker N = 445		Daily smoker N = 416		Total N = 861	
		Weighted percent (%)	p	Weighted percent (%)	p	Weighted percent (%)	p	Weighted percent (%)	p	Weighted percent (%)	p	Weighted percent (%)	p
Total sample	Menthol	17.9 (15.6, 20.2)	.26	4.0 (3.5, 4.5)	<.01	7.2 (6.5, 7.9)	.02	40.1 (29.1, 51.1)	.15	37.5 (27.9, 47.1)	.72	39.1 (31.4, 46.7)	.19
	Non-menthol	19.7 (17.3, 22.2)		5.3 (4.7, 5.9)		8.4 (7.6, 9.2)		30.3 (23.8, 36.8)		35.3 (28.1, 42.5)		32.7 (27.8, 37.7)	
White	Menthol	21.7 (17.6, 25.8)	.13	4.3 (3.6, 5.1)	.04	7.6 (6.6, 8.5)	.77						
	Non-menthol	18.3 (15.3, 21.3)		5.4 (4.7, 6.0)		7.7 (6.9, 8.6)							
Black	Menthol	10.2 (6.5, 13.9)	.34	3.0 (2.1, 3.9)	.01	4.5 (3.5, 5.6)	.01						
	Non-menthol	13.7 (6.1, 21.4)		6.2 (3.7, 8.7)		8.1 (5.2, 11.1)							
Other	Menthol	26.7 (14.3, 39.2)	.84	3.4 (0.9, 6.0)	.52	10.9 (6.6, 15.2)	.67						
	Non-menthol	28.5 (17.0, 39.9)		5.0 (1.9, 8.0)		12.2 (8.0, 16.3)							
Hispanic	Menthol	18.6 (12.7, 24.5)	.28	5.6 (3.6, 7.6)	.79	10.6 (8.0, 13.2)	.49						
	Non-menthol	23.2 (17.3, 29.1)		5.2 (3.6, 6.9)		11.9 (9.3, 14.6)							

All racial/ethnic groups are non-Hispanic except for the Hispanic group. Bold font indicates *p* < .05. Relapse rates were not examined by race/ethnicity because of the small sample size.

Table 3. Relationships Between Sociodemographic Characteristics and Cessation

Characteristics	Total sample			Non-daily smokers					Daily smokers				
	Non-daily N=3608	Daily N=13 710	p	White N=1869	Black N=547	Other N=274	Hispanic N=868	p	White N=9014	Black N=2048	Other N=849	Hispanic N=1549	p
	OR 95% CI	OR 95% CI		OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI		OR 95% CI	OR 95% CI	OR 95% CI	OR 95% CI	
Menthol			.07					.37					.23
No	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
Yes	1.0 (0.8, 1.3)	0.8 (0.6, 0.9)		1.2 (0.9, 1.7)	1.0 (0.4, 2.5)	0.6 (0.2, 2.1)	0.8 (0.5, 1.5)		0.8 (0.6, 1.0)	0.5 (0.3, 0.9)	0.5 (0.1, 2.5)	1.2 (0.6, 2.4)	
Age			.45					.39					.83
18–24	0.8 (0.5, 1.3)	1.2 (0.9, 1.7)		0.8 (0.5, 1.4)	0.9 (0.3, 2.6)	1.9 (0.3, 14.0)	0.7 (0.3, 2.1)		1.1 (0.7, 1.6)	2.7 (0.9, 8.1)	1.0 (0.1, 8.2)	2.1 (0.5, 8.9)	
25–34	0.9 (0.6, 1.4)	1.0 (0.8, 1.4)		0.9 (0.5, 1.6)	1.2 (0.5, 2.8)	5.4 (0.8, 37.4)	0.5 (0.2, 1.4)		0.9 (0.6, 1.2)	1.7 (0.7, 4.3)	1.3 (0.1, 15.2)	2.2 (0.5, 9.7)	
35–54	0.6 (0.4, 1.0)	0.7 (0.5, 1.0)		0.6 (0.4, 1.0)	0.9 (0.3, 2.9)	2.7 (0.5, 13.6)	0.5 (0.2, 1.2)		0.7 (0.5, 0.9)	1.1 (0.5, 2.8)	0.9 (0.1, 6.5)	1.3 (0.3, 5.7)	
55+	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
Sex			.10					.30					.35
Male	0.9 (0.7, 1.2)	1.2 (1.0, 1.6)		1.0 (0.8, 1.4)	0.6 (0.3, 1.1)	0.7 (0.2, 1.8)	1.0 (0.6, 1.8)		1.4 (1.1, 1.7)	0.8 (0.5, 1.4)	1.1 (0.3, 3.7)	1.0 (0.5, 2.1)	
Female	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
Education			.80					.41					.01
Less than high school or GED	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
High school graduate	1.4 (0.8, 2.3)	1.1 (0.8, 1.5)		1.0 (0.5, 2.1)	3.4 (1.1, 9.8)	4.8 (0.7, 34.1)	1.2 (0.5, 3.2)		1.0 (0.7, 1.4)	0.9 (0.4, 2.0)	6.0 (1.3, 28.1)	1.3 (0.6, 2.8)	
Some college or Associates degree	1.3 (0.9, 1.9)	1.2 (0.9, 1.8)		1.3 (0.7, 2.4)	1.7 (0.6, 4.7)	2.2 (0.4, 12.1)	1.0 (0.5, 1.9)		1.2 (0.8, 1.7)	0.9 (0.4, 2.1)	1.0 (0.2, 6.5)	3.3 (1.6, 6.9)	
Bachelor's or Advanced degree	1.6 (1.0, 2.4)	1.4 (0.9, 2.2)		1.5 (0.8, 3.0)	4.4 (0.7, 27.9)	1.8 (0.2, 13.3)	1.4 (0.6, 3.1)		1.3 (0.8, 2.0)	1.6 (0.3, 7.6)	5.1 (0.8, 31.6)	0.6 (0.0, 8.3)	
Nicotine			.56					.48					.24
≥30 minutes	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
<30 minutes	0.7 (0.5, 1.1)	0.6 (0.5, 0.8)		0.7 (0.4, 1.2)	0.5 (0.2, 1.5)	0.5 (0.1, 3.2)	1.3 (0.6, 3.0)		0.7 (0.5, 0.9)	0.6 (0.3, 1.2)	0.1 (0.0, 0.6)	0.6 (0.3, 1.3)	
Quit			<.01					.99					.51
Not tried to quit	Ref	Ref		Ref	Ref	Ref	Ref		Ref	Ref	Ref	Ref	
Tried to quit	0.7 (0.4, 1.0)	1.4 (1.1, 1.8)		0.6 (0.4, 1.0)	0.7 (0.3, 1.7)	0.7 (0.1, 4.5)	0.7 (0.3, 1.5)		1.5 (1.1, 2.0)	1.4 (0.8, 2.6)	2.6 (0.6, 11.8)	0.9 (0.5, 1.8)	

Table 3. Continued

Characteristics	Total sample — Non-daily (N = 3608) OR (95% CI)	Total sample — Daily (N = 13 710) OR (95% CI)	p	Non-daily — White (N = 1869) OR (95% CI)	Non-daily — Black (N = 547) OR (95% CI)	Non-daily — Other (N = 274) OR (95% CI)	Non-daily — Hispanic (N = 868) OR (95% CI)	p	Daily — White (N = 9014) OR (95% CI)	Daily — Black (N = 2048) OR (95% CI)	Daily — Other (N = 849) OR (95% CI)	Daily — Hispanic (N = 1549) OR (95% CI)	p
Race/ethnicity			.13										
White	Ref	Ref											
Black	0.6 (0.4, 1.0)	0.9 (0.6, 1.1)											
Other	1.4 (0.8, 2.4)	0.9 (0.5, 1.7)											
Hispanic	1.3 (0.9, 2.0)	0.9 (0.6, 1.3)											

CI = confidence interval; GEE = generalized estimating equation; OR = odds ratio. Bold font indicates p < .05. All racial/ethnic groups are non-Hispanic except for the Hispanic group. The p values reflect the significance level of the interaction terms in the fully interacted GEE models. For example, among non-daily smokers, the p value of .37 indicates that there is no significant difference in the relationship between menthol cigarette use and cessation across racial/ethnic groups.

Table 4. Relationships Between Sociodemographic Characteristics and Relapse

Characteristics	Non-daily smokers N = 445 OR 95% CI	Daily smokers N = 416 OR 95% CI	p
Menthol			.12
No	Ref	Ref	
Yes	1.5 (0.8, 2.9)	0.8 (0.4, 1.4)	
Age			.98
18–24	**3.9 (1.8, 8.3)**	**3.3 (1.5, 7.6)**	
25–34	**2.8 (1.1, 7.1)**	**2.6 (1.1, 6.0)**	
35–54	2.0 (0.8, 4.9)	**2.1 (1.0, 4.3)**	
55+	Ref	Ref	
Sex			.55
Male	1.0 (0.5, 1.8)	0.8 (0.5, 1.2)	
Female	Ref	Ref	
Education			.77
Less than high school or GED	Ref	Ref	
High school graduate	0.6 (0.2, 1.6)	0.9 (0.4, 1.8)	
Some college or Associates degree	0.7 (0.3, 1.6)	1.0 (0.5, 1.9)	
Bachelor's or Advanced degree	0.6 (0.2, 1.7)	1.3 (0.6, 3.2)	
Nicotine			.62
≥30 minutes	Ref	Ref	
<30 minutes	0.8 (0.3, 2.1)	1.1 (0.6, 1.9)	
Quit			.39
Not tried to quit	Ref	Ref	
Tried to quit	0.9 (0.5, 1.8)	1.3 (0.7, 2.5)	
Race/ethnicity			.34
White	Ref	Ref	
Black	0.9 (0.3, 2.6)	1.1 (0.5, 2.3)	
Other	0.4 (0.1, 1.2)	1.3 (0.4, 4.2)	
Hispanic	0.7 (0.3, 1.5)	1.4 (0.6, 3.1)	

CI = confidence interval; GEE = generalized estimating equation; OR = odds ratio. Bold font indicates p < .05. All racial/ethnic groups are non-Hispanic except for the Hispanic group. The p values reflect the significance level of the interaction terms in the fully interacted GEE models. For example, the p value of .12 indicates that there is no significant difference in the relationship between menthol cigarette use and relapse across non-daily and daily smokers.

with cessation, fewer studies have examined the relationship between menthol cigarette use and relapse. Two studies using data from the CARDIA Study suggest that menthol cigarette smokers are more likely to relapse than non-menthol cigarette smokers.[30,39] Findings from the present study may be inconsistent with prior research because of differences in the demographic composition of study samples and differences

in how relapse was operationalized. The CARDIA studies included African American and White men and women, while the PATH Study is a nationally representative sample.[30,39] The larger percentage of African Americans in the CARDIA Study may account for the inconsistent results with the present study. Similar to cessation, the effect of menthol on relapse may be strongest among African American smokers. The sample size of the present study precluded examination of the impact of menthol cigarette use on relapse stratified by race/ethnicity. Future studies should examine the relationship between menthol cigarette use and relapse across racial/ethnic groups. In addition, one of the CARDIA studies defined relapse as smokers who quit at any subsequent examination and were smoking at their final examination 15 years after the baseline assessment.[30] The other study assessed for relapse over a 25-year study period.[39] The present study limited the assessment of relapse to a more brief period of 1 year after successfully quitting.

Findings from the present study suggest that a national menthol cigarette ban may improve cessation rates, especially among smoker groups where menthol cigarette use is common, such as among African American, lower-income, and youth smokers, and those with serious mental illness.[5,40,41] Improving cessation rates is critical for further reducing tobacco use in the United States. In addition, despite being a priority for tobacco control, disparities in tobacco use and related disease according to race/ethnicity, income, and serious psychological distress persist.[42] Tobacco control policies that are likely to have a pro-equity impact (or reduce smoking among populations disproportionately burdened by tobacco use), such as a menthol cigarette ban, are needed.

This study has limitations. The PATH Study is conducted annually. The present study was limited to examining likelihood of cessation or relapse 1 year after the prior assessment. An assessment of smoking at more frequent intervals would provide information about the impact of menthol cigarette use on short-term cessation and relapse. In addition, due to the limited sample size, the present study was unable to examine the relationship between menthol cigarette use and relapse across racial/ethnic groups. Like cessation, the relationship between menthol cigarette use and relapse may vary by race/ethnicity. Also, the present study defines a smoker as a menthol or non-menthol cigarette user based on the smoker's last brand used or regular brand type. Smokers, however, may not always use their regular cigarette brand.

In summary, menthol cigarette use is associated with decreased likelihood of cessation among daily smokers. Menthol cigarette use is not significantly associated with relapse. Findings from the present study suggest that that removing menthol cigarettes from the market may improve cessation rates in the United States.

Supplementary Material

A Contributorship Form detailing each author's specific involvement with this content, as well as any supplementary data, are available online at https://academic.oup.com/ntr.

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Declaration of Interests

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