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Multiple tobacco product use among cigarette smokers: a longitudinal examination of menthol and non-menthol smokers during young adulthood

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Abstract

Background—Multiple tobacco product (MTP) use is common among young adults. Most MTP users are combustible cigarette smokers that use one or more other tobacco products. This study aims to explore menthol as a risk factor for MTP use among a cohort of young adult cigarette smokers.

Methods—Participants were 18–29 years cigarette smokers at 24 Texas colleges in a 6-wave study. Participants (n=4700 observations) were classified as: single product users (ie, exclusive cigarette smoking); dual product users and poly product users. A multilevel, ordered logistic regression model was used to examine the association between menthol cigarette smoking and MTP use. Two longitudinal, multilevel, multinomial logistic regressions were used to examine the relationship between menthol cigarette smoking and number of tobacco products used.

Results—Overall, 40.7% of the sample were single product users, 33.7% were dual product users and 25.6% were poly product users. Menthol was associated with 1.28 greater odds of MTP use. Further, menthol was associated with 1.19 greater risk of dual and 1.40 greater risk of poly product use, relative to single product use. Lastly, menthol cigarette smoking was associated with 1.18 greater risk of poly product use, relative to dual product use.

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Conclusions—There was a gradient relationship between menthol cigarette smoking and number of tobacco products used among young adult cigarette smokers. Findings provide for greater regulatory and programmatic efforts to reduce the use of menthol cigarettes.

INTRODUCTION

In 2017, approximately 28.4% of young adult tobacco users (ie, 18–25 years) used multiple products.[1] Most multiple tobacco product (MTP) users are cigarette smokers who use additional tobacco products.[2–6] MTP use among young adults presents several health concerns including greater risk for nicotine dependence, long-term use[7 8] and tobacco-related disease,[9] given increased exposure to toxicants and carcinogens.[9–11] Understanding determinants of MTP use among young adults is critical to improving public health.

Menthol cigarette smoking may be a risk factor for MTP use due to the growing preference for flavoured tobacco products.[12–15] From 2008 to 2016, menthol increased from 27% of all cigarettes sold to 35%.[12] Over this time, flavours accounted for more than half of all smokeless tobacco and cigar products sold in the USA.[13–15] Young adults cite flavours as a reason for initiation and sustained tobacco use.[16–18] A longitudinal study found young adults who initiated tobacco use via flavoured products had increased risk for continued tobacco use.[19] Thus, it is plausible that young adult menthol cigarette smokers have a greater propensity to use other flavoured products.

Research has yet to examine the relationship between menthol and MTP use among young adults. Studies indicate adolescents who use flavoured products are more than twice as likely to be dual users and nearly 5.5 times more likely to be poly users.[20–22] However, the lack of product-specific (eg, menthol cigarettes) research leaves a substantial gap in the literature given regulatory differences in products and characterising flavours, globally.[23–26] Research is needed to explore the relationship between menthol and MTP use among young adults.

We aim to examine the relationship between menthol cigarette smoking and MTP use among a cohort of young adult cigarette smokers. We hypothesise that[1]: menthol is associated with greater odds of MTP use, relative to use of non-menthol cigarettes[2]; menthol, compared with non-menthol, is associated with greater odds of dual (ie, cigarettes+1 other product) and poly (ie, cigarettes+2 or more other products) use, relative to exclusive cigarette smoking and[3] menthol, compared with non-menthol, is associated with greater odds of poly use, relative to dual use.

METHODS

Study design

This research analyses panel data collected from the Marketing and Promotions across Colleges in Texas study; a longitudinal, multiwave, rapid response surveillance study of young adults in Texas.[8 27] This cohort study analysed six waves of data collected biannually from November 2014 to May of 2017.

Participants were young adult college students attending twenty-four 2-year and 4-year institutions in the four largest metropolitan-areas of Texas: Austin, Dallas/Fort Worth,

Houston and San Antonio. Eligibility criteria included being[1]: a degree/certificate seeking student enrolled full or part time; and[2] 18–29 years old. Individuals aged 26–29 were required be ever tobacco users to be eligible given the limited rate of tobacco initiation after the age of 25.[28]

Overall, 5482 eligible individuals provided informed consent and completed the wave 1 survey. Participants received a US$10 e-gift card at the completion of wave 1 and Wave 2 and a US$20 e-gift card at the completion of wave 3–wave 6. Study design and procures are described further elsewhere.[8 27]

Participants

This study examined 30-day cigarette smokers who completed at least two surveys and had complete data on all variables. These criteria resulted in a total sample of n=1543 participants that provided 4472 total observations across all six waves.

Measures

Cigarette type—Participants were asked ‘Are the cigarettes you currently smoke flavored to taste like menthol or mint?’ Participants reporting ‘no’ were considered non-menthol cigarette smokers (referent) and those reporting ‘yes’ were considered menthol cigarette smokers (exposure group). Cigarette type was a time-varying exposure, meaning participants could be menthol cigarette smokers at first observation and non-menthol cigarette smokers at second observation (or vice versa). Changes in cigarette type (ie, within-individual variability) was accounted for in the statistical analyses.

MTP use—The number of tobacco products used in the past 30 days was the outcome variable for this study. Participants were asked to self-report past 30-day use of four non-cigarette tobacco products: electronic cigarettes (e-cigarettes), cigars, smokeless tobacco and hookah. Participants reporting using one or more days were considered past 30-day users. Based on these responses, participants were classified as past 30 day single product users (ie, exclusive cigarette smokers), dual users (ie, cigarettes+1 additional product), and poly users (ie, cigarettes+2 or more additional products), at each wave.

Covariates—Sociodemographic covariates were assessed at baseline and analysed as time-invariant covariates. Age ranged from 18 to 29 years old. Sex was a binary variable; males served as the referent group. Race/ethnicity was categorised as: non-Hispanic white (referent); Hispanic/Latino; African American; Asian and American Indian/Alaska Native, Native Hawaiian/Pacific Islander, or any other race/ethnicity. Institution type was categorised as attending a 2-year institution (referent group) or a 4-year institution. Each sociodemographic variable is a correlate of MTP use in adults.[1]

This study also controlled for two Hooked-on Nicotine Checklist symptoms of nicotine dependence.[29 30] Participants reported experiencing[1] craving or[2] needing a cigarette. Participants craving and/or needing a cigarette were considered to have symptoms of nicotine dependence. This covariate was included as these affective symptoms may increase the propensity to use other tobacco products in areas that cigarettes are not allowed due to

legal restriction (eg, public areas) or social norms (eg, in a home or vehicle), as a method of relieving these symptoms.[31–34]

Statistical analysis

A multilevel, ordered logistic regression model examined the association between menthol cigarette smoking and MTP use; using the proportional odds model.[35] Then, two iterations of a multilevel, multinomial logistic regression were conducted to examine the relationship between menthol cigarette smoking and the number of tobacco products used in the past 30 days. For the first iteration, exclusive cigarette smokers (ie, single product users) were the referent group. For the second iteration, dual users were the referent group, relative to poly users. Post hoc tests were conducted for all models, examining the interaction between menthol cigarette smoking and survey wave to determine if the relationship between cigarette type and MTP use varied over time.

The exposure and outcome variables for this study were time-varying, meaning cigarette type and MTP use can vary from one survey wave to the next for each participant (ie, within-individual variability). Surveys/observations were collected in 6-month intervals. Responses are assumed to not be independent as they are nested within each participant. This study accounted for the nesting of responses and within-individual variability by including survey wave as a random-effect (ie, multilevel model). Multilevel models allow for regression analyses to estimate the association between the exposure and outcome variable (ie, main effect) for the study sample (ie, between-individual variable), while controlling for individual-level variability over the course of the study. Analyses controlled for time-invariant and time-varying covariates and accounted for the nesting of participants within their baseline college. Analyses were conducted using STATA V.14.2.

RESULTS

Descriptive statistics

Mean age of participants (n=1543) over the course of the study was 22.1 years (SD=2.87). The sample was predominately non-white and slightly more female than male. Descriptive statistics by product type and MTP use for all observations across the six waves are available in tables 1 and 2.

Study hypotheses

As seen in table 3, menthol cigarette smokers, relative to non-menthol cigarette smokers, were 1.25 times more likely to be MTP users, adjusting for covariates. As seen in table 4, menthol cigarette smokers, compared with non-menthol cigarette smokers, had 1.16 greater relative risk of being a dual product user and 1.37 greater relative risk of being a poly product user (relative to an exclusive cigarette smoker) and 1.18 greater relative risk of a being a poly product user, relative to being a dual tobacco product user, adjusting for covariates. Thus, menthol cigarette smokers had greater relative risk for each categorical increase in number of tobacco products use, signifying a gradient relationship between menthol and number of tobacco products used. Post hoc tests (tables 3 and 4) revealed no

statistical interaction between cigarette type and survey wave, indicating these relationships were consistent over time.

DISCUSSION

Young adult menthol cigarette smokers were significantly more likely to use MTPs, relative to those who smoked non-menthol cigarettes. Further, young adult menthol cigarette smokers, relative to non-menthol cigarette smokers, were more likely to be dual and poly users than exclusive cigarette smokers and more likely to be poly users than dual users, suggesting a gradient relationship between menthol cigarette smoking and cumulative number of tobacco products. Findings provide empirical support for greater efforts to reduce menthol cigarette smoking among young people.

Study findings reflects population data that both menthol cigarette smoking[36–38] and MTP use[1] are common among young adults. Similarly, findings mirror those of cross-sectional research on adolescent tobacco users, which find an association between flavours and MTP use.[20–22] To our knowledge, this is the first study to showcase the association between menthol cigarette smoking and MTP use among young adults.

This study suggests exemption for menthol cigarettes contribute to MTP use among young adults, particularly in the USA.[1] WHO recommended restricting the sale of menthol cigarettes[39] and, as of May 2020, the European Union (EU) officially enacted a ban on the sale of menthol cigarettes. In both the USA[40] and Canada,[25] menthol cigarettes remain exempt from federal-level restrictions on characterising flavours for combustible cigarettes. However, in the USA, local restrictions of menthol flavours for combustible cigarettes currently exist in approximately 80 municipalities across 6 states.[41] In Canada, five providences have expanded restricted the sale of menthol cigarettes.[39 42] Federal restrictions on the sale of menthol cigarettes should be considered as a method of curbing MTP use among young adults. Local policies should be considered in the absence of federal action, though the lack of comprehensive reach for these restrictions will inhibit the overall public health impact.

This study has limitations. Data were self-reported, thus subject to recall and response bias. Further, this study examined a cohort of young adult college students in urban Texas and may not be representative of other demographics. Additionally, this study was unable to explore ‘blended’ cigarette smokers who use both menthol and non-menthol cigarettes. It is plausible MTP use differs among exclusive menthol cigarette smokers and ‘blended’ cigarette smokers. Finally, this study provides estimates of concurrent menthol cigarette smoking and MTP use, not baseline use of menthol cigarettes predicting MTP use at follow-up. As such, this study does not determine if menthol cigarette use predated MTP use.

Despite these limitations, findings are relevant to tobacco control in the USA,[24] Canada[25] and the EU.[26] Findings provide insights to the growing preference for flavoured products among younger tobacco users. Research is needed to monitor long-term behavioural and health ramifications of menthol cigarette smoking.

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What this paper adds

What is already known on this subject

- Menthol cigarettes promote cigarette smoking initiation as well as inhibit cigarette smoking cessation.
- Menthol cigarettes are disproportionately popular among young people, relative to older adults.

What important gaps in knowledge exist on this topic

- Research has not yet examined the role of menthol in elevating risk for multiple tobacco product use among young adults.

What this paper adds

- This study found that young adults who smoked menthol cigarettes were at increased risk for multiple tobacco product use, relative to those who smoked non-menthol cigarettes.
- This study expands the understanding of risks associated with menthol cigarette smoking.
- Findings provide empirical support for restricting the sale of menthol cigarettes in the European Union, other nations and specific regions of Canada and the USA.

Table 1

Descriptive statistics among all cigarette smokers and stratified by cigarette type for all observations

	Full sample (n=4472 observations), %	Menthol cigarette smoker[¶] (n=1788 observations), %	Non-menthol cigarette smoker[††] (n=2684 observations), %
Per cent of sample	100	40.0	60.0
Product use[*]			
Single product user	40.9	38.2	42.6
Dual product user	33.5	32.8	34.1
Poly product user	25.6	29.0	23.3
Age			
Mean (SD)	22.1 (2.87)	22.1 (2.89)	22.1 (2.85)
Sex			
Males	46.4	42.0	49.3
Females	53.6	58.0	50.7
Race/ethnicity			
White	41.5	31.3	48.3
Hispanic/Latino	33.5	40.4	28.8
African American	4.7	6.5	3.4
Asian	12.1	14.8	10.3
Other[†]	8.3	6.9	9.2
Institution type[‡]			
2 years	8.0	8.7	7.6
4 years	92.0	91.3	92.4
Nicotine dependence[§]			
No	25.9	23.9	27.3
Yes	74.1	76.1	72.7

[*] Corresponds to the number of non-cigarette tobacco products used in the past 30 days.

[†] Individuals who identify as American Indian/Alaska Native, Native Hawaiian/Pacific Islander, or any other race/ethnicity.

[‡] Indicates if individuals attended a 2-year vocational/technical programme or 4-year college/university.

[§] Self-reported needing or craving a cigarette.

[¶] Self-reported that cigarettes smoked in the past 30 days were flavoured to taste like menthol or mint.

[**] Self-reported that cigarettes smoked in the past 30 days were not flavoured to taste like menthol or mint.

[††] Self-reported that cigarettes smoked in the past 30 days were NOT flavoured to taste like menthol or mint

Table 2

Descriptive statistics by product use for all observations (n=4472)

	Tobacco product use behaviours*		
	Single product user (n=1827 observations)	**Dual product user (n=1500 observations)**	**Poly product user (n=1145 observations)**
Percent of sample	40.9%	33.5%	25.6%
Cigarette type†			
Non-menthol	62.6%	60.9%	54.7%
Menthol	37.4%	39.1%	45.3%
Age			
Mean (SD)	22.6 (3.06)	22.0 (2.82)	21.4 (2.42)
Sex			
Males	36.8%	49.5%	57.6%
Females	63.2%	50.5%	42.4%
Race/ethnicity			
White	43.4%	46.0%	32.9%
Hispanic/Latino	35.1%	30.3%	34.9%
African American	4.5%	4.4%	5.2%
Asian	10.2%	10.5%	17.3%
Other‡	6.8%	8.9%	10.0%
Institution type§			
2 years	9.5%	7.5%	6.3%
4 years	90.5%	92.5%	93.7%
Nicotine dependence¶			
No	27.3%	25.7%	24.1%
Yes	72.7%	74.3%	75.9%

*Corresponds to the number of non-cigarette tobacco products used in the past 30 days.

†Self-reported type (ie, menthol/mint; non-menthol/mint) of cigarette smoked in the past 30 days.

‡Individuals who identify as American Indian/Alaska Native, Native Hawaiian/Pacific Islander or any other race/ethnicity.

§Indicates if individuals attended a 2-year vocational/technical programme or 4-year college/university.

¶Self-reported needing or craving a cigarette.

Table 3

Multilevel, random-effects ordered logistic regression models (n=4472)

	No of products used*
	OR 95% CI
Cigarette type†	
Non-menthol cigarettes	1.00 (Ref)
Menthol cigarette	**1.25*** (1.11 to 1.41)**
Sex	
Males	1.00 (Ref)
Females	**0.51*** (0.46 to 0.58)**
Age	**0.91*** (0.89 to 0.93)**
Race/ethnicity	
White	1.00 (Ref)
Hispanic/Latino	1.05 (0.92 to 1.19)
African American	**1.47*** (1.11 to 1.94)**
Asian	**1.52*** (1.26 to 1.83)**
Other‡	**1.55*** (1.26 to 1.90)**
Institution type§	
2 years	1.00 (Ref)
4 years	1.15 (0.88 to 1.50)
Nicotine dependence¶	
No	1.00 (Ref)
Yes	**1.36*** (1.20 to 1.55)**
Post hoc test	
Interaction term for cigarette type and survey wave	
Survey wave * cigarette type	
Menthol * wave 1	1.00 (Ref)
Menthol * wave 2	0.98 (0.68 to 1.41)
Menthol * wave 3	1.02 (0.71 to 1.46)
Menthol * wave 4	1.06 (0.74 to 1.52)
Menthol * wave 5	1.17 (0.80 to 1.71)
Menthol * wave 6	0.95 (0.64 to 1.40)

Proportional odds model was used.

Bold indicates statistical significance; *p<0.05, **p<0.01, ***p<0.001.

*Corresponds to the number of non-cigarette tobacco products used in the past 30 days.

†Self-reported type (ie, menthol/mint; non-menthol/mint) of cigarette smoked in the past 30 days.

‡Individuals who identify as American Indian/Alaska Native, Native Hawaiian/Pacific Islander or any other race/ethnicity.

§Indicates if individuals attended a 2-year vocational/technical programme or 4-year college/university.

¶Self-reported needing or craving a cigarette.

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Table 4

Multilevel, random-effects multinomial logistic models

	Dual product use* Relative to single product use	**Poly product user† Relative to single product use**	**Poly product user* Relative to dual product use**
	Relative risk ratio 95% CI	**Relative risk ratio 95% CI**	**Relative risk ratio 95% CI**
Cigarette type‡			
Non-menthol cigarettes	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Menthol cigarette	**1.16* (1.01 to 1.34)**	**1.37*** (1.17 to 1.61)**	**1.18* (1.01 to 1.39)**
Sex			
Males	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Females	**0.57*** (0.49 to 0.66)**	**0.41*** (0.35 to 0.48)**	**0.72*** (0.62 to 0.85)**
Age	**0.95*** (0.93 to 0.97)**	**0.87*** (0.85 to 0.90)**	**0.92*** (0.89 to 0.95)**
Race/ethnicity			
White	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Hispanic/Latino	**0.77** (0.66 to 0.91)**	1.19 (0.99 to 1.44)	**1.55*** (1.28 to 1.87)**
Black	1.04 (0.73 to 1.47)	**1.87** (1.28 to 2.72)**	**1.80*** (1.23 to 2.64)**
Asian	0.87 (0.68 to 1.11)	**1.94*** (1.51 to 2.48)**	**2.23*** (1.73 to 2.86)**
Other§	1.23 (0.94 to 1.561)	**1.98*** (1.48 to 2.65)**	**1.61*** (1.21 to 2.13)**
Institution type¶			
2 years	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
4 years	1.21 (0.94 to 1.57)	1.33 (0.98 to 1.79)	1.09 (0.80 to 1.50)
Nicotine dependence**			
No	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Yes	**1.21** (1.03 to 1.43)**	**1.56*** (1.30 to 1.88)**	**1.29** (1.07 to 1.55)**
Post hoc test: interaction term for cigarette type and survey wave			
Survey wave * cigarette type			
Menthol * wave 1	1.00 (Ref)	1.00 (Ref)	1.00 (Ref)
Menthol * wave 2	1.16 (0.71 to 1.89)	0.86 (0.51 to 1.45)	0.74 (0.45 to 1.22)
Menthol * wave 3	1.43 (0.89 to 2.30)	0.90 (0.38 to 1.52)	0.63 (0.38 to 1.04)
Menthol * wave 4	1.14 (0.71 to 1.83)	0.99 (0.59 to 1.69)	0.87 (0.52 to 1.47)
Menthol * wave 5	1.32 (0.81 to 2.14)	1.09 (0.63 to 1.89)	0.82 (0.47 to 1.44)

	Dual product use* Relative to single product use	**Poly product user† Relative to single product use**	**Poly product user* Relative to dual product use**
	Relative risk ratio 95% CI	**Relative risk ratio 95% CI**	**Relative risk ratio 95% CI**
Menthol * wave 6	1.05 (0.64 to 1.73)	0.90 (0.52 to 1.58)	0.86 (0.49 to 1.51)

Bold indicates statistical significance; *p<0.05, **p<0.01, ***p<0.001.

*Self-reported use of combustible cigarettes and one additional tobacco product in the past 30 days.

†Self-reported use of combustible cigarettes and two or more additional tobacco product in the past 30 days.

‡Self-reported type (ie, menthol/mint; non-menthol/mint) of cigarette smoked in the past 30 days.

§Identify as American Indian/Alaska Native, Native Hawaiian/Pacific Islander or another race/ethnicity.

¶Indicates if individuals attended a 2-year vocational/technical programme or 4-year college/university.