

REVIEW ARTICLE

Menthol Flavored in Smoking Tobacco and Tobacco Commencement, Addiction, and Cessation: A Literature Review

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ABSTRACT

Menthol is the most widely used tobacco additive. Furthermore, menthol is one of the most preferred flavors of electronic cigarettes. Although there has been a steady decrease in cigarette smoking, the use of electronic cigarettes is increasing at an alarming rate with the use. The purpose of the review was to estimate the menthol flavored in smoking tobacco regarding tobacco commencement, addiction, and cessation. The review undertook with search of the peer-reviewed literature using a databases as PubMed was obtained. The prevalence of menthol cigarette use is higher in youth than the adults. The youth initiates are significantly more likely to use menthol cigarettes than youth who have smoked longer than a year. The young smokers are likely to remain with their starter type of cigarette over time. The tobacco industry has long understood the appeal of menthol cigarettes as starter products for youth. The adult menthol smokers report a shorter time to first cigarette than non-menthol smokers. Despite the limitations of this review, we concluded that the removal of menthol from cigarettes is likely to reduce youth smoking initiation, improve smoking cessation outcomes in adult smokers, and in turn, benefit public health.

Keywords: Adverse effects, Cessation, Cigarette Smoking, Dependence, Menthol, Public health, Tobacco use.

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BACKGROUND

Menthol is the most widely used tobacco additive.^[1] Menthol has been added to tobacco products as a characterizing flavor since at least the 1920s, but many of the current menthol brands were introduced in the mid-1950s.^[2] Smokers who prefer menthol cigarettes are more likely to be female, young, and less educated,^[3] compared with Caucasian smokers, and significantly more African-American smokers prefer menthol cigarettes.^[4] In addition, menthol is one of the most preferred flavors of electronic cigarettes.^[5] Although there has been a steady decrease in cigarette smoking, the use of electronic cigarettes is increasing at an alarming rate with the use. Therefore, understanding the interaction between the sensory properties of menthol and the reinforcing effect of nicotine is urgently required.^[6]

Menthol elicits complex multimodal sensory stimulation, including a strong cooling sensation mediated by the transient receptor potential M8 channel, a slightly bitter taste detected mainly in the circumvallate region of the tongue, and a strong minty odor.^[7,8] In addition, menthol has an analgesic effect that is mediated by the transient receptor potential A1 channel.^[9] Tobacco Product Scientific Advisory Committee in the United States undertook a review of the science and issued a comprehensive report, concluding that it would be in the interest of public health to remove menthol cigarettes from the market.^[10] Further, the Food and Drug Administration conducted an independent review of the science in 2013, and this report concluded that it is likely that menthol cigarettes pose a public health risk above that seen with non-menthol cigarettes.^[11] The purpose of the current review was to estimate the menthol flavored in smoking tobacco regarding tobacco commencement, addiction, and cessation with respect to two of the three key elements of the public health standard as whether there is an increased or decreased likelihood that those who do not currently use tobacco products, mostly youth, will start to use tobacco products and whether there is an increased or decreased likelihood that existing users of tobacco products will stop using such products.

METHODS

This review undertook with a search of the peer-reviewed literature using a database as PubMed was obtained. The keywords used such as "Menthol," "Tobacco use," "Addiction," and "Cessation". were relevant. Furthermore, this keywords were put into Medical Subject Headings or MeSH-controlled vocabulary. The terms such as public health, cigarette smoking, health policy, adverse effects, and review were combined with the MeSH terms by the Boolean "AND" or "OR" and then entered into all above databases and search engines. Collected literature materials consist of different original articles, reviews, etc., were documented in the reference file. Furthermore, some of literature was gathered by cross-checking the reference lists of the articles obtained. For reading and understanding purpose, only the literature materials that were published in other than English language were excluded from the study.

ROLE OF MENTHOL IN THE BEGINNING OF SMOKING TOBACCO

The role of menthol in the beginning of smoking tobacco in the form of cigarettes, especially in youth population, is noted in many research studies. A study conducted on differential trends in cigarette smoking in the American youth smokers by Giovino *et al.* found that more than half of youth smoker participants (12–17 years old) were smoked menthol cigarettes,^[12] and this compared with one-fourth of overall menthol cigarette prevalence among youth and adults, which represented around 1.2 million menthol smoking youth. Furthermore, a follow-up study showed that some of 4% increase in the percentage of menthol cigarette smokers, with youth smokers aged 12-17 years with the highest prevalence of menthol cigarette use.^[13] Furthermore, the prevalence of mentholated cigarette use remained higher in youth compared to adults. Similarly, compared to 37% of adults, more than half of youth used mentholated cigarettes among the cigarette smokers. Even regardless of age, the black smokers report a high prevalence of menthol cigarette use.^[12,14,15] A cross-sectional study of adult daily smokers by Soulakova *et al.* found that around 80% of black smokers smoked menthol cigarettes which was the highest prevalence across racial or ethnic groups.^[16] However, controlling for gender, race or ethnicity, household income, and days smoked in the past month, the odds of smoking mentholated cigarettes was >3 times higher in the youngest age groups as 12–15 and 16–17 years of smokers compared to smokers aged 35 and older.^[12,13] Hence, the prevalence of menthol cigarette use is higher in youth than the adults.

Studies of youth and adults published highlight that the highest prevalence of menthol cigarette use occurred

among youth smokers, followed by young adult smokers, and that both are significantly higher than menthol cigarette use among older adult smokers. Also, one study result stated that around 50% of middle-school smokers reported smoking menthol cigarettes compared to 45% of high-school smokers.^[14,15] Furthermore, a survey conducted by Vilsaint *et al.* to school students confirmed a statistically significantly higher prevalence of menthol cigarette use among middle-school students compared to high-school students.^[17] In addition, approximately half of the middle-school smokers reported that their usual brand was menthol compared to 43% of high-school smokers.^[18] Other studies examining adults only consistently stated that young adult smokers (18–25 years old) were significantly more likely to use menthol cigarettes than older adult smokers (25 and more years old), even after controlling for other potential confounders including socioeconomic status, sexual orientation, and psychological distress.^[19,20] Therefore, there is a persistent age gradient in menthol cigarette use among the youngest smokers. A study showed that the prevalence of smoking menthol cigarettes remained constant among youth aged 12–17 years old, and at the same time, the prevalence of non-menthol cigarette use decreased significantly in this age group.^[12] Menthol cigarette use significantly increased over this time period in young adults aged 18–25 years old, while the prevalence of non-menthol cigarette use decreased significantly and the findings were consistent with some of the studies.^[13] Hence, menthol cigarette use among youth has not decreased in the past decade, despite decreases in non-menthol cigarette use. The study on youth smoking reported a higher prevalence of menthol cigarette use among youth who have been smoking <1 year compared to those who have smoked >1 year. In the study, middle-school students who had been smoking for <1 year were significantly more likely to smoke menthol cigarettes compared with middle school students who had been smoking for >1 year.^[21] Therefore, the youth initiates are significantly more likely to use menthol cigarettes than youth who have smoked longer than a year.

The cross-sectional study assessed the impact of menthol initiation on smoking behavior and showed that middle and high school students, who smoke at lower rates, greatly accelerate their cigarette consumption when their brand of choice contains menthol.^[22] A longitudinal study conducted by Nonnemaker *et al.*^[23] documented that adolescents who initiated smoking with menthol cigarettes during the course of a cohort study were more likely to progress to establish smoking by the end of the 3-year study compared to those who initiated with non-menthol cigarettes. The another

longitudinal study published by Dauphinee *et al.*^[24] showed that recognition of a leading menthol brand was associated with smoking experimentation in a large sample of adolescent never-smokers at 12-month follow-up. Hence, these longitudinal studies demonstrate that commencement with menthol cigarettes facilitates progression to established use in young smokers. In the study published by Nonnemaker *et al.*, the majority of 63% adolescent smokers who initiated with menthol cigarettes remained menthol smokers at follow-up; this was similar to the proportion of adolescent smokers who initiated with non-menthol cigarettes and remained with 62% non-menthol smokers at follow-up.^[23] The majority of young adult smokers, aged 18–34, remain with their initial type of cigarette over time. Furthermore, the young adult's smokers who initiated with menthol cigarettes were >8 times more likely to remain menthol cigarette smokers than those who initiated with non-menthol cigarettes.^[25] Therefore, the young smokers are likely to remain with their starter type of cigarette over time.

Misclassification of menthol cigarette use has been identified in youth studies, and tobacco control researchers have also raised the notion that menthol cigarette use may be associated with economic pressure to use fewer cigarettes; thus, menthol use may be due to lower socioeconomic status.^[21,26] These show that the age gradient in use is not an artifact of misclassification of menthol use and also highlights that the use of menthol cigarettes is not explained by socioeconomic status, assessed as household income. Giovino *et al.* addressed potential misclassification of menthol brand among youth and adults, showing a persistent age gradient in menthol cigarette use across gender, race or ethnicity, household income, and number of days smoked per month.^[12] Hence, the findings regarding an age gradient in menthol cigarette use, increased levels of menthol smoking in the youngest age groups, are not attributable to menthol brand misclassification or socioeconomic status.

Menthol cigarette smoking has been associated with other tobacco use in young adults as small cigars, flavored tobacco products, alcohol, and marijuana use in youth.^[27] In a community-based sample of adolescents in the United States, past 30-day menthol cigarette smokers reported higher lifetime marijuana use but not marijuana use in the past 30 days compared to non-menthol smokers. In a sample of adolescent daily smokers seeking cessation treatment, menthol cigarette use was correlated with past 30-day marijuana use.^[28] Therefore, the tobacco industry has long understood the appeal of menthol cigarettes as starter products for youth.

ROLE OF MENTHOL IN THE ADDICTION OF SMOKING TOBACCO

In most of the studies assessing nicotine addiction among youth stated significantly higher increased of addiction symptoms among menthol smokers compared to non-menthol smokers.^[18,23,21,29-32] Young menthol cigarette users had a significantly shorter 1st time to cigarette after waking, which is a mark of nicotine addiction.^[18,30,33] These studies also showed greater endorsement of withdrawal symptoms among youth menthol smokers, particularly, craving, and feeling irritable or restless after not smoking for a few hours.^[18,30] A cross-sectional study of adolescents by Collins and Moolchan stated a greater proportion of adolescent menthol smokers' smoking within 5 min of waking compared to non-menthol smokers.^[29] The studies showed no differences in adolescent nicotine addiction in menthol versus non-menthol smokers using the "Hooked on Nicotine Checklist."^[31,34] The study which used data from four samples of youth and adults found that menthol smokers do not report a higher "heaviness of smoking index," compared to non-menthol smokers.^[32] Hence, the youth menthol smokers report greater levels of nicotine Addiction than youth non-menthol smokers. Some studies in adults also focus on nicotine addiction among menthol compared to non-menthol smokers by assessing time to first cigarette.^[35,36] Female menthol smokers had a significantly shorter time to the first cigarette than non-menthol smokers.^[37] Some studies in adult current smokers found no significant difference in time to first cigarette between menthol and non-menthol cigarette smokers.^[35,36] Therefore, the adult menthol smokers report a shorter time to first cigarette than non-menthol smokers.

ROLE OF MENTHOL IN THE CESSATION OF SMOKING TOBACCO

Menthol users were less successful in quitting than non-menthol users despite increased quit attempts or intentions to quit.^[38,39] Moreover, the past-year quit attempts were significantly increased in menthol compared to non-menthol smokers, but short-term that is >3 months and <1 year and longer-term that is >3 months and <5 years quit rates were significantly lower among those who smoke menthol cigarettes as compared to non-menthol cigarettes.^[38] Furthermore, menthol smokers were less likely to have quit smoking in the past 5 years compared to their non-menthol smoking counterparts.^[39] Menthol smokers reported a more recent quit attempt compared to non-menthol smokers, but there was no difference in the most recent or longest ever duration of abstinence,^[40] and some studies were

reported significantly lower quit rates among menthol smokers compared to non-menthol smokers at follow-up.^[41,42] Some randomized controlled trials in populations motivated to quit smoking discovered the impact of menthol cigarette use on cessation.^[43] A study among stimulant-dependent adults found no significant association between cigarette type and smoking cessation.^[44] However, some studies testing the effect of pharmacotherapies and behavioral therapies on smoking cessation reported significantly reduced cessation among menthol smokers compared to non-menthol smokers.^[43,45] Menthol smoking was associated with reduced likelihood of smoking cessation success compared to non-menthol smoking.^[45] One individual-level intervention did not show a difference in cessation by menthol use but that may be attributed to its unique population and the effect of smoking on the participant's other substance use. The studies focusing on individual-level interventions are more relevant to the question of menthol influence on smoking cessation, as they capture 7–8-week window of evidence-based treatment for smoking cessation rather than a single provider visit.^[46]

DISCUSSION

There were augments in the published literature regarding the deleterious relationship between menthol cigarette use, youth smoking commencement, and nicotine addiction. The strength and consistency of the associations in published literature confirm the conclusions of previous studies and provide additional support for the further research proposed conclusion. There are some limitations of this review as the restriction of the search to articles published in PubMed. Furthermore, the menthol brand names were not included in the search strategy, which may have resulted in not capturing all relevant studies.

Studies of the cigarette marketplace confirm menthol's growing market share. The analysis of the study highlighted that among past 30-day smokers, the proportion of menthol cigarette users was 35% in 2008–2010 and increased significantly to 39% in 2012–2014 [Reference 13]. These increases were observed in young adults aged 18–25, as well as adults aged 26–34 and 35–49 and over this time period, youth smokers aged 12–17 remained the group with the highest prevalence of menthol cigarette use (54%). Therefore, the findings of literature review, in concert with evidence on the increasing presence of menthol in the cigarette market, underscores the urgent need for policy action to ban the sale, marketing, or presence of menthol as a characterizing flavor in cigarettes at the national, state, and local levels.

CONCLUSIONS

Despite the limitations of this review, we concluded that there is sufficient research literature evidence to establish the affirmative relationship between menthol cigarettes as well as the increased youth smoking commencement, increased nicotine addiction, and decreased cessation. The removal of menthol from cigarettes would decrease the likelihood that those who do not use tobacco products will start using such products as well as increase the likelihood that existing users of tobacco products will stop using such products.

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