

Studying the interactive effects of menthol and nicotine among youth: An examination using e-cigarettes

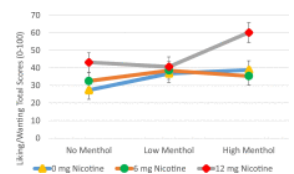
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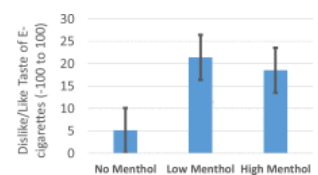
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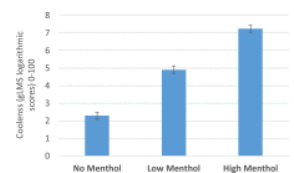
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1. Table 1



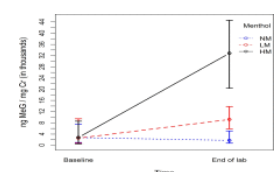
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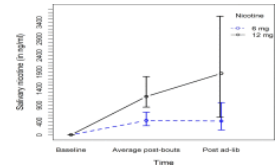


Highlights

- Tobacco products containing **menthol** appeal to youth.
- We examined if menthol alters **nicotine** reward among youth.



Menthol, even at low doses, independently enhanced liking/wanting for e-cigarettes.



Menthol enhanced positive rewarding effects of high nicotine-containing e-cigarettes.

Abstract

Background

Tobacco products containing menthol are widely used by youth. We used e-cigarettes to conduct an experimental evaluation of the independent and interactive effects of menthol and nicotine among youth.

Procedures

Pilot **chemosensory** experiments with fourteen e-cigarette users identified low (barely perceptible, 0.5%) and high (similar to commercial e-liquid, 3.5%) menthol concentrations. Sixty e-cigarette users were randomized to a nicotine concentration (0 mg/ml, 6 mg/ml, 12 mg/ml) and participated in 3 laboratory sessions. During each session, they received their assigned nicotine concentration, along with one of three menthol concentrations in random counterbalanced order across sessions (0, 0.5%, 3.5%), and participated in three fixed-dose, and an ad-lib, puffing period. Urinary menthol **glucuronide** and salivary nicotine levels validated menthol and nicotine exposure. We examined changes in e-cigarette liking/wanting and **taste**, coolness, **stimulant** effects, nicotine withdrawal and ad-lib use.

Results

Overall, the high concentration of menthol (3.5%) significantly increased e-cigarette liking/wanting relative to no menthol ($p < 0.001$); there was marginal evidence of nicotine* menthol interactions ($p = 0.06$), with an increase in liking/wanting when 3.5% menthol was combined with 12 mg/ml nicotine, but not 6 mg/ml nicotine. Importantly, both 0.5% and 3.5% menthol concentrations significantly improved taste and increased coolness. We did not observe nicotine or menthol-related changes in stimulant effects, nicotine withdrawal symptoms or ad-lib use.

Conclusions

Menthol, even at very low doses, alters the appeal of e-cigarettes among youth. Further, menthol enhances positive rewarding effects of high nicotine-containing e-cigarettes among youth.

Keywords

Youth

Menthol

Nicotine

Electronic cigarettes

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