

# What the research says...

## CAsToR Briefing

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The Center for the Assessment of Tobacco Regulations (CAsToR) aims to provide evidence-based and expert-informed modeling of the behavioral and public health impacts of FDA tobacco rules or other regulatory actions, focusing on Impact Analysis, Behavior and Health Effects as Scientific Domains.

### Flavors in e-cigarettes: a summary of the evidence

This brief summarizes findings from “The impacts of e-cigarette flavours: An overview of systematic reviews” by Livingstone-Banks et al (2025) and “An update of a systematic review and meta-analyses exploring flavours in intervention studies of e-cigarettes for smoking cessation” by Lindson et al (2024).

#### Key takeaways.

- Non-tobacco flavorings increase e-cigarette appeal, which may vary by flavor and apply across different population groups.
- Among adolescents, experimenting with different flavors can increase e-cigarette appeal.
- Certain flavor constituents (e.g. cinnamon, menthol, sweet/fruity flavors) may lead to increased harms, although evidence was very limited.
- There is very limited evidence and no comparative studies on differences between adults and younger populations on the impacts of e-cigarette flavors.
- Impacts of e-cigarette flavors on e-cigarette and cigarette use are inconclusive.
- There is a need for more high-quality evidence on this topic.
- Current and future studies should report outcomes categorized by flavors used.

#### What is the current state of evidence on the impacts of e-cigarette flavors?

Although there is strong evidence that nicotine e-cigarettes help people stop smoking, young people who don't smoke also use e-cigarettes. Vaping nicotine is considerably less harmful than

smoking tobacco, but vaping may introduce some health risks to those who vape but don't smoke.

Policymakers are interested in how to discourage those who do not smoke from vaping while simultaneously encouraging people who smoke to switch to vaping.

This brief is based on two reviews, Livingstone-Banks et al (2025) and Lindson et al (2024).

**Livingstone-Banks et al (2025)** summarizes 32 peer reviewed and published systematic reviews that covered 326 unique primary studies on e-cigarette flavor impacts. Searches were run in February 2024 on 6 databases (MEDLINE, Embase, PsycINFO, Cochrane Database of Systematic Reviews, PROSPERO, and Epistemonikos). These reviews reported impacts of e-cigarette flavors on appeal/perceptions of vaping (13 reviews); harms (12); smoking (7); and vaping (13) behaviors.

**Lindson et al (2024)** investigates whether the use of e-cigarettes to stop smoking varies based on e-cigarette flavors. The review updates secondary data analyses from an earlier version (2023) and includes 25 studies, published from January 2004 to February 2024.

Both Livingstone-Banks et al (2025) and Lindson et al (2024) find a need for more evidence on e-cigarette flavor impacts. The impacts of e-cigarette flavors on cessation, smoking initiation, and vaping initiation are inconclusive.

# CAsToR Briefing

*A summary of evidence on the impacts of e-cigarette flavors.*

## **Impacts of e-cigarette flavors on appeal, perception, use, and harms of vaping.**

### **1. On appeal and perceptions of vaping and motivation to use e-cigarettes.**

Non-tobacco flavorings increase e-cigarette appeal, which may vary by flavor and apply across different population groups.

Flavorings decreased harm perceptions among young people with and without a history of combustible tobacco use and young people who vape but don't have a history of smoking tobacco.

Most studies considered "non-tobacco flavors" as a category, rather than delving into specific flavors.

### **2. On harms from vaping.**

Certain flavor constituents may lead to increased harms, although evidence was very limited.

Evidence was from in vitro experiments of cell damage from exposure to flavored e-cigarette liquid and chemical analyses of potentially toxic components. Some studies drew on reports of adverse events such as throat irritation.

No reviews reported evidence of serious harms from e-cigarette flavorings in human participants.

### **3. On vaping behaviors.**

Flavor preferences vary based on a range of factors including age, combustible tobacco use history, country, and even device used.

Fruit and sweet flavors were consistently popular. Tobacco and menthol flavors were sometimes more popular among current, former, and older combustible tobacco users.

Overall, there is currently mixed or inconclusive evidence on the effect of e-cigarette flavors on uptake of vaping.

## **Impacts of e-cigarette flavors on smoking.**

### **4. On smoking.**

Some people who smoke and use e-cigarettes to quit switch between e-cigarette flavors during a quit attempt.

Those who smoke may prefer sweet/fruit flavors over tobacco and menthol, but this may differ based on age, combustible tobacco use history, country, and even device used.

Subgroup meta-analyses showed no clear associations between e-liquid flavors provided and smoking cessation or study product use, possibly due to lack of data.

Overall, the evidence is currently inconclusive on the effect of e-cigarette flavors on smoking.

## **Strengths and weaknesses of existing evidence on e-cigarette flavors.**

Of the 32 reviews in Livingstone-Banks et al (2025), 11 were deemed higher quality and 21 lower quality. Those deemed lower quality did not list excluded studies and reasons for exclusion. These studies did not cite a pre-registered protocol and did not conduct or report quality appraisal of the included studies. There was no clear difference in findings between higher and lower quality reviews.

Lindson et al (2024) draws from 25 studies, of which 15 were deemed to be at high risk of bias, 3 at unclear risk, and 7 at low risk.

## **Impacts of e-cigarette flavors on adults vs. younger populations.**

There is very limited evidence and no existing reviews that directly compare adults with younger populations on the impacts of e-cigarette flavors.

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