Nicotine and Tobacco Product Sales after E-cigarette Flavor Restrictions

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Agenda

• Background
• Research Questions
• Data
• Methods
• Findings
• Discussion, Limitations, & Implications

Vocabulary: ENDS = “Electronic Nicotine Delivery Systems”
Percent of State Residents Covered by Flavored ENDS Sales Restrictions

Flavored ENDS Sales Restrictions on 1/1/2023

- 100%
- 75% - 99.9%
- 50% - 74.9%
- 25% - 49.9%
- 5.0% - 24.9%
- 0.01% - 4.99%
- 0%

Map showing states color-coded by percentage of residents covered by flavored ENDS sales restrictions.
US Tobacco Product Flavor Policies

Percent of State Residents Covered by Restrictions on:
Flavored Cigar Sales
Menthol Cigarette Sales

Flavored Cigar Sales Restrictions on 1/1/2023
- 100%
- 75% - 99.9%
- 50% - 74.9%
- 25% - 49.9%
- 5.0% - 24.9%
- 0.01% - 4.99%
- 0%

Menthol Cigarette Sales Restrictions on 1/1/2023
- 100%
- 75% - 99.9%
- 50% - 74.9%
- 25% - 49.9%
- 5.0% - 24.9%
- 0.01% - 4.99%
- 0%
# GRADE Evaluation of Evidence on ENDS Flavor Policies’ Effects

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Quality of Evidence</th>
<th>Supporting Evidence</th>
</tr>
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<tbody>
<tr>
<td><strong>Sale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced sales of ENDS</td>
<td>Moderate</td>
<td>Ali (2022), Gammon (2021), Katchmar (2021), Liber (2021) [28–31]</td>
</tr>
<tr>
<td>Increased sales of combustible cigarettes</td>
<td>Low</td>
<td>Gammon (2021), Katchmar (2021), Liber (2021), Xu (2022) [28–30, 33]</td>
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<tr>
<td><strong>Behaviour</strong></td>
<td></td>
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<tr>
<td>Reduced consumption of any tobacco use</td>
<td>Low</td>
<td>Kingsley (2019, 2021), Olsen (2022), Yang (2022) [38–41]</td>
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<tr>
<td>Reduced ENDS consumption</td>
<td>Low</td>
<td>Hawkins (2021), Kingsley (2019), Liu (2022), Yang (2020) [35, 38, 39, 42]</td>
</tr>
<tr>
<td>Increased combustible cigarette consumption</td>
<td>Very Low</td>
<td>Friedman (2021), Hawkins (2021), Kingsley (2019), Liu (2022), Yang (2022) [34, 35, 38, 39, 42]</td>
</tr>
</tbody>
</table>
Concern 1: Substitution towards more Lethal Products

• Myriad evidence links policies making ENDS more expensive or less accessible to increases in cigarette smoking
  • Adults: Saffer et al. 2020; Pesko, Courtemanche, & Maclean, 2020
  • Pregnant women: Abouk et al, 2019
  • Young adults: Friedman & Pesko 2022
  • Youth: Abouk et al 2022, Pesko & Warman, 2021, Friedman 2015; Pesko, Hughes, & Faisal, 2016; Dave, Feng, & Pesko, 2019

• Economic theory: consumption effects from reducing a product’s appeal should be in the same direction as policies increasing its price, all else equal
Concern 2: Current Results’ Generalizability

• Most prior studies:
  • Assess flavor restrictions’ effects in a single jurisdiction or state, or multiple temporary policies;
  • Omit tests required for causal interpretation of quasi-experimental evidence
  • Consider short follow up periods
  • Ignore policy heterogeneity

ENDS Flavor Prohibition

ENDS Flavor Limitations
Research Question

What are ENDS flavor restrictions’ effects on ENDS and cigarette sales?
Data

**Data:** IRI retail sales data for 44 US states (Jan. 2018–March 2023) + newly compiled data on state & local tobacco flavor policies

**Outcomes:** ENDS sales/capita; Cigarette sales/capita

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![Graph showing data trends over time]
**Data & Methods**

**Exposure:** Proportion of state residents covered by ENDS flavor policies

Two-way fixed effects

\[ Y_{st} = \beta_0 + \beta_1 Flv_{st} + \lambda \overline{X}_{st} + \gamma_s + \delta_t \]  \hspace{1cm} (1)

\[ Y_{st} = \beta_0 + \beta_1 Flv_{st} + \beta_2 Flv_{s,t-13} + \lambda \overline{X}_{st} + \gamma_s + \delta_t \]  \hspace{1cm} (2)

\( \overline{X}_{st} \): Proportion covered by flavored cigar & menthol cigarette sales restrictions, flavor policy interim periods (between passage & effective dates for each flavor policy), other tobacco control policies (tax rates, T21, etc.), beer taxes, medical & recreational cannabis legalization, & environmental controls
Results: Continuous Flavor Policy Variable

**ENDS Volume Sales/Capita**
- Basic Covariate Specification
  - + Tobacco Control Covariates
  - + All Policy Covariates
  - + Environmental Covariates
- Short Run Effect Estimate All Covariates
  - -0.353**
- Long Run Effect Estimate All Covariates
  - -0.174*

**Cigarette Pack Sales/Capita**
- Basic Covariate Specification
  - + Tobacco Control Covariates
  - + All Policy Covariates
  - + Environmental Covariates
- Short Run Effect Estimate All Covariates
  - 0.157*
- Long Run Effect Estimate All Covariates
  - 0.368**
Results: Binary Flavor Policy Variable

**ENDS Volume Sales/Capita**
- Basic Covariate Specification
- + Tobacco Control Covariates
- + All Policy Covariates
- + Environmental Covariates
- Short Run Effect Estimate All Covariates
- Long Run Effect Estimate All Covariates

**Cigarette Pack Sales/Capita**
- Basic Covariate Specification
- + Tobacco Control Covariates
- + All Policy Covariates
- + Environmental Covariates
- Short Run Effect Estimate All Covariates
- Long Run Effect Estimate All Covariates

State ENDS Flavor Restriction Coefficients & 95% Confidence Intervals
Results: Binary Exposure, de Chaisemartin & d’Haultfoeuille (DCDH, 2022)

**ENDS Volume Sales/Capita**
- Basic Covariate Specification: $-0.346^{**}$
- + Tobacco Control Covariates: $-0.317^{**}$
- + All Policy Covariates: $-0.316^{**}$
- + Environmental Covariates: $-0.304^{**}$

**Cigarette Pack Sales/Capita**
- Basic Covariate Specification: $1.00$
- + Tobacco Control Covariates: $0.75$
- + All Policy Covariates: $0.50$
- + Environmental Covariates: $0.25$

State ENDS Flavor Restriction ATEs & 95% Confidence Intervals
ENDS Sales/Capita analysis using DCDH (2022)

ATE = -0.304, 95%CI: (-0.406, 0.202), p<0.001

4-Week Periods Since State Flavor Policy Went into Effect
Cigarette Sales/Capita analysis using DCDH (2022)

ATE = 0.227, 95% CI: (0.136, 0.319), p<0.001
Results

**ENDS Sales/Capita**
- **Flavored ENDS (Except Menthol)**
  - Short Run Effect Estimate: 0.102
  - Long Run Effect Estimate: -0.265*
- **Menthol Flavored ENDS**
  - Short Run Effect Estimate: -0.128*
  - Long Run Effect Estimate: -0.315**
- **Tobacco/Unflavored ENDS**
  - Short Run Effect Estimate: 0.061
  - Long Run Effect Estimate: 0.060

**Cigarette Sales/Capita**
- **Menthol Flavored Cigarettes**
  - Short Run Effect Estimate: 0.020
  - Long Run Effect Estimate: 0.108**
- **Tobacco Flavored Cigarettes**
  - Short Run Effect Estimate: 0.072
  - Long Run Effect Estimate: 0.259**

ENDS Flavor Restriction Coefficients & 95% Confidence Intervals
ENDS Sales/Capita by Flavor, DCDH (2022)

Flavored ENDS

Tobacco or Unflavored ENDS

ATE = -0.372, 95%CI: -0.521, -0.223, p<0.001

ATE = 0.070, 95%CI: -0.010, 0.150, p=0.086
Results

**ENDS Sales/Capita**
- Flavored ENDS (Except Menthol)
  - Short Run Effect Estimate: \(-0.102\)
  - Long Run Effect Estimate: \(-0.265^*\)
- Menthol Flavored ENDS
  - Short Run Effect Estimate: \(-0.128^*\)
  - Long Run Effect Estimate: \(-0.315^{**}\)
- Tobacco/Unflavored ENDS
  - Short Run Effect Estimate: \(0.061\)
  - Long Run Effect Estimate: \(0.060\)

**Cigarette Sales/Capita**
- Menthol Flavored Cigarettes
  - Short Run Effect Estimate: \(0.020\)
  - Long Run Effect Estimate: \(0.108^{**}\)
- Tobacco Flavored Cigarettes
  - Short Run Effect Estimate: \(0.072\)
  - Long Run Effect Estimate: \(0.259^{**}\)
Results by Consumer Base

Total Cigarette Sales/Capita
- ENDS Flavor Policies Short Run: 0.092
- ENDS Flavor Policies Long Run: 0.368**

Youth-Disproportionate Cigarette Sales/Capita
- ENDS Flavor Policies Short Run: 0.030
- ENDS Flavor Policies Long Run: 0.147**

Age-Proportionate Cigarette Sales/Capita
- ENDS Flavor Policies Short Run: 0.047
- ENDS Flavor Policies Long Run: 0.146**

Adult-Disproportionate Cigarette Sales/Capita
- ENDS Flavor Policies Short Run: 0.016
- ENDS Flavor Policies Long Run: 0.074*
Results: Prohibitions vs Limitations, Omitting MA & RI

- Total ENDS Sales/Capita
  - Flavored ENDS Prohibitions, Short Run
  - Flavored ENDS Prohibitions, Long Run
  - Flavored ENDS Limitations, Short Run
  - Flavored ENDS Limitations: Long Run

- Total Cigarette Sales/Capita
  - Flavored ENDS Prohibitions, Short Run
  - Flavored ENDS Prohibitions, Long Run
  - Flavored ENDS Limitations, Short Run
  - Flavored ENDS Limitations: Long Run

- Youth-Disproportionate Cigarette Sales/Capita
  - Flavored ENDS Prohibitions, Short Run
  - Flavored ENDS Prohibitions, Long Run
  - Flavored ENDS Limitations, Short Run
  - Flavored ENDS Limitations: Long Run

- Age-Proportionate Cigarette Sales/Capita
  - Flavored ENDS Prohibitions, Short Run
  - Flavored ENDS Prohibitions, Long Run
  - Flavored ENDS Limitations, Short Run
  - Flavored ENDS Limitations: Long Run

- Adult-Disproportionate Cigarette Sales/Capita
  - Flavored ENDS Prohibitions, Short Run
  - Flavored ENDS Prohibitions, Long Run
  - Flavored ENDS Limitations, Short Run
  - Flavored ENDS Limitations: Long Run

ENDS Flavor Policies’ Relationships to Per Capita Sales: Sales Limitations vs. Prohibitions
Findings

- ENDS flavor policies ➔ ENDS & ↑ Cigarette sales
  - + 15 cigarettes purchased for every 1 less 0.7mL ENDS pod sold
  - 70% of the long-run effect on cigarette sales stems from non-menthol cigarettes
  - ≈ 40% of the long-run effect on cigarette sales stems from youth-disproportionate brands

- Flavor Prohibitions vs. Limitations
  - Evidence does not suggest that ENDS flavor prohibitions are more effective at reducing ENDS sales than limitations
  - Only flavor prohibitions ➔ statistically significant increases in sales of adult-disproportionate cigarette brands
Implications

Any public health benefit of reducing ENDS use by limiting or prohibiting flavors could lead to offsetting public health damage by increasing cigarette sales.
Limitations

• **Sales ≠ Consumption.** If flavor restrictions lead people to buy ENDS in unrestricted jurisdictions, flavor restrictions’ effects on ENDS use will be smaller than estimated by sales data.

• **Blind Spots in Retail Scanner Data:** omits online sales, specialty shops, illicit markets. ➔ sales changes may reflect shifts in sourcing, e.g., from convenience stores to vape shops

  IRI’s data cover vast majority of cigarette sales ➔
  These issues should not impact cigarette results.
Policy Concerns & Options

1. FDA PMTA review has not authorized a single flavored or menthol ENDS product ➔ de facto flavor prohibition?
   • Could evaluating whether each product independently is “appropriate for the protection of public health” yield a mix of products that make this market inappropriate for public health?

   Alternative: Concrete Product Standards + Manufacturer Penalties for Youth Use + Point of Sale Retailer Regulation
Policy Concerns & Options

2. Misdirection: Is the focus on less lethal tobacco products impeding efforts to reduce combustible product use, the primary driver of tobacco-related disease?

• Critical Challenges:
  – Substantial equivalence allows introduction of new cigarettes that are quite different from predicate products sold pre-February 15, 2007
  – No manufacturer-specific penalties for disproportionate youth consumption
  – No ENDS user fees in FD&C Act ➔ FDA is under-resourced
Questions/Comments?

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