

# Association of flavored electronic nicotine delivery system (ENDS) use with self-reported chronic obstructive pulmonary disease (COPD): results from the PATH study, Wave 4

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## Background

- Many smokers believed that vaping can help them quit smoking, and they tended to use E-cigarettes more frequently than FDA-proved cessation aids to reduce cigarette consumption.
- Growing body of evidence showed the detrimental acute effects of ENDS flavors on respiratory health.
- A lack of evidence of the long-term health effects of ENDS use, such as COPD
- This study aims to identify the association of ENDS flavor categories with self-reported COPD by analyzing the Population Assessment of Tobacco and Health (PATH) Study Wave 4 data.

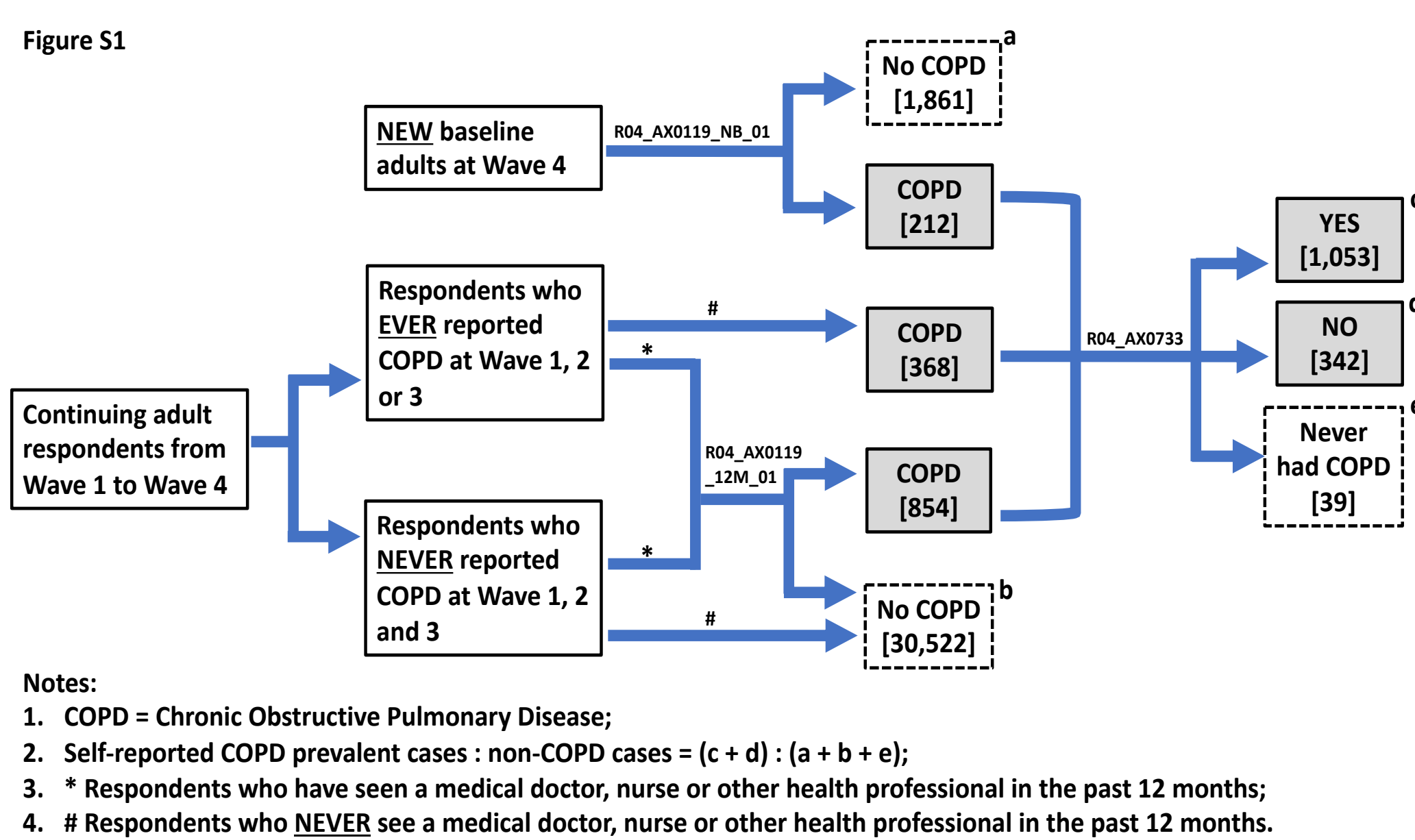
## Methods

Data for 4,909 ever established ENDS adult users from the PATH Study Wave 4, collected from 2016 to 2017, were analyzed.

### Variables:

The prevalent cases of self-reported COPD in Wave 4 consist of three components:

- Continuing adult respondents who reported being diagnosed with COPD, chronic bronchitis or emphysema at Wave 1 to 3;
- Continuing adult respondents who did not have COPD as of their last interview, but have been told they had COPD, chronic bronchitis or emphysema in the past 12 months;
- Newly enrolled respondents who have ever been told they had COPD, chronic bronchitis or emphysema



Because there is an option "I have never had COPD" to the question AX0733, we used this question to identify the respondents who ever falsely self-reported COPD

Table S1. Pearson correlation coefficients matrix of five flavor categories

	Tobacco	Menthol/mint	Fruit	Candy/dessert/sweets	Others
Tobacco	1.00				
Menthol/mint	0.11	1.00			
Fruit	0.34	0.21	1.00		
Candy/desserts/sweets	0.21	0.16	0.02	1.00	
Others	0.08	0.04	0.03	-0.11	1.00

- Flavor categories: tobacco-flavored, menthol/mint, fruit, and candy/desserts/other sweets, other flavors
- Due to the small Pearson correlations ( $|r| < 0.34$ ), we considered flavor categories as independent variables.
- Other independent variables: cigarette smoking status, Marijuana use in ENDS, age, sex, race/ethnicity, history of asthma, and household income

### Statistical analysis:

Five separate multivariable weighted logistic regression models:

- Model 1 – stratified by ENDS use status + smoking status
- Model 2 – stratified by ENDS use status and controlled for smoking status.
- Model 3 – Model 2 + age, sex, race/ethnicity, marijuana use in ENDS, history of asthma, and household income.
- Model 4 – Model 3 stratified by asthma (examine the potential modification effect)
- Model 5 – Model 3 stratified by sex (examine the potential modification effect)

## Results (description)

- There is an **association** between **tobacco flavor** use in ENDS and **self-reported COPD**.
- Among **current smokers**, individuals who were **ever ENDS users** had significantly **higher** odds of **self-reported COPD** if they regularly used **tobacco flavor** in ENDS.
- Among individuals who currently use ENDS every day or some days, the regular use of **tobacco flavor** was associated with a significantly **higher** odds of **self-reported COPD**, regardless of whether they were non-smokers, former smokers or current smokers.

## Results (Tables)

**Table 1. (Model 1) Adjusted ORs\* (with 95% CI) of self-reported COPD associated with ENDS flavors among ever established ENDS users stratified by smoking status**

	Ever established ENDS users		
	Non-smoker	Former-smoker	Current-smoker
Tobacco	<b>12.36 (2.10, 73.16)</b>	2.24 (0.74, 6.76)	<b>2.43 (1.56, 3.86)</b>
Menthol or mint	0.85 (0.13, 5.66)	1.09 (0.34, 3.50)	1.05 (0.68, 1.61)
Fruit	2.39 (0.39, 14.59)	0.50 (0.14, 1.80)	<b>0.63 (0.43, 0.93)</b>
Candy, desserts, or sweets	1.90 (0.21, 16.92)	0.59 (0.24, 1.49)	0.48 (0.33, 0.72)
Others	0.19 (0.01, 5.68)	0.96 (0.39, 2.37)	<b>1.89 (1.04, 3.44)</b>

\* Odds of self-reported COPD among users of a specific flavor vs odds of self-reported COPD among non-users of this specific flavor as reference. The adjusted ORs were controlled for the effects of all flavors other than the interested specific flavor.

**Table 2. Adjusted ORs\* (with 95% CI) of self-reported COPD associated with ENDS flavors stratified by ENDS use status**

	Tobacco	Menthol or mint	Fruit	Candy, desserts or sweets	Others
<b>Model 2</b>					
Ever ENDS users	<b>2.64 (1.75, 3.98)</b>	1.09 (0.72, 1.64)	0.66 (0.43, 1.00)	0.58 (0.41, 0.82)	1.53 (0.95, 2.47)
Former ENDS users	1.90 (0.95, 3.80)	0.84 (0.37, 1.89)	0.67 (0.29, 1.51)	0.49 (0.24, 1.02)	0.80 (0.36, 1.77)
Current ENDS users	<b>3.23 (2.02, 5.17)</b>	1.30 (0.78, 2.17)	0.66 (0.40, 1.07)	0.63 (0.38, 1.04)	<b>2.10 (1.08, 4.11)</b>
<b>Model 3</b>					
Ever ENDS users	1.50 (0.93, 2.42)	1.00 (0.56, 1.81)	0.81 (0.49, 1.35)	0.77 (0.53, 1.14)	1.10 (0.71, 1.72)
Former ENDS users	0.99 (0.40, 2.51)	0.67 (0.20, 2.29)	0.81 (0.24, 2.75)	0.54 (0.15, 2.00)	0.66 (0.23, 1.90)
Current ENDS users	<b>2.05 (1.20, 3.53)</b>	1.30 (0.67, 2.52)	0.88 (0.50, 1.55)	0.98 (0.58, 1.65)	1.56 (0.79, 3.08)

The adjusted ORs in model 2 were controlled for the effects of all other flavors, and smoking status;

The adjusted ORs in model 3 were controlled for the effects of all other flavors, smoking status, history of asthma, sex, age, race/ethnicity, income level, and marijuana use in ENDS.

## Conclusions

- Our study demonstrated that use of tobacco flavored ENDS is significantly associated with self-reported COPD.
- Future studies are necessary to confirm the biological and epidemiological association.
- Our results provide important evidence for future flavor regulations for ENDS extending beyond flavors.

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