

WNY CENTER FOR RESEARCH ON FLAVORED TOBACCO

## The association between statewide vaping prevalence and COVID-19

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Society for Research on Nicotine and Tobacco Annual Meeting

February 24-27, 2021

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**Dongmei Li**, Daniel P. Croft, Deborah J. Ossip, Zidian Xie (2020). The Association between Statewide Vaping Prevalence and COVID-19. Preventive Medicine Reports. 2020 Dec; 20:101254. doi: 10.1016/j.pmedr.2020.101254. Epub 2020 Nov 25. PMID: 33257909.



- •All authors have no potential conflict of interest to declare.
- •Research reported in this publication was supported by the National Cancer Institute of the National Institutes of Health (NIH) and the Food and Drug Administration (FDA) Center for Tobacco Products under Award Number U54CA228110.



## Outline

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- •Novel coronavirus disease 2019 (COVID-19) outbreak was declared a global pandemic by the World Health Organization (WHO) on March 11, 2020.
- •As of January 17, 2021, there were over 94 million COVID-19 cases and over two million death globally and over 24 million cases and over 0.4 million death in the US.







## Introduction



- •Electronic cigarettes (e-cigarettes) rapidly gained popularity in recent years in the US.
- •The prevalence of current e-cigarette use (vaping) in US adults was 3.2% in 2018.
- Previous studies observed associations between vaping and symptoms of wheezing and self-reported Chronic Obstructive Pulmonary Disease (COPD), along with increased inflammation in bronchial epithelial cells and alterations in the pulmonary immune response to infection.



## Introduction



- •Tobacco control researchers have raised concerns that vapers may be more susceptible to COVID-19 and could develop more severe COVID-19 symptoms.
- •There is very limited evidence on the association between vaping and COVID-19.
- •We examined the state-level association of vaping and COVID-19 cases and death using the following data:
  - Weighted proportions of current e-cigarette users (vapers) from the 2018 Behavioral Risk Factor Surveillance System (BRFSS) survey data
  - The daily number of COVID-19 cases and deaths in each state from the 1Point3Acres.com website during the time period from January 21, 2020 to April 25, 2020 in the United States





### Study Population

- From the 2018 BRFSS survey, 34 states provided information on the vaping status variable.
- The population size in each state in 2018 and land area in each state were obtained from the United States Census Bureau website.
- The COVID-19 infected cases and deaths counts were available for each state from January 21, 2020 to April 25, 2020. Reports of negative numbers of infected cases and deaths were excluded from the COVID-19 data.
- After integrating the BRFSS data and the census data with the COVID-19 cases and deaths from different dates at the state level, there were 1607 observations in the final analysis data.





## Vaping Status

- Based on the answers to the question "Do you now use e-cigarettes, every day, some days, or not at all?" in the 2018 BRFSS survey, Subjects who now use e-cigarettes every day or some days were classified as vapers and subjects who responded that they use ecigarettes "not at all" or "not applicable" were classified as non-vapers.
- Weighted frequency of vapers in each state was obtained using the proc surveyfreq procedure in SAS v9.4.
- Weighted proportion of vapers in each US state was calculated using the ratio of weighted frequency of vapers and weighted frequency of total number of subjects in each state.





## •Outcomes and covariates

- The number of COVID-19 cases and deaths in US states is the outcome.
- Covariates for COVID-19 cases include population size, population density (calculated using population size divided by land area), age, gender, race/ethnicity, education, income, mental health, physical health, obesity, respiratory disease (including asthma and COPD), heart disease, cancer, stroke, diabetes, kidney disease, and smoking (currently smoke every day or some days).
- The covariates for COVID-19 deaths included the number of daily confirmed cases in each state, state population size in log scale, proportion of people aged 35–44, proportion of White, Black, and Hispanic, proportion of people having respiratory disease, cancer, being obese, and being smokers.

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## Statistical Analysis

- Generalized estimating equation (GEE) models with negative binomial distribution assumptions and log link functions were used.
- Autoregressive 1 (AR (1)) variance-covariance structure was used to model the correlations of COVID-19 cases and deaths within the same state.
- Variance inflation factor (VIF) was used to examine the multicollinearities among the predictor variables in the GEE models.
- SAS v9.4 and R were used for data analysis.



## Results



- •The weighted proportion of vapers ranged from 2.9% to 6.4% for US states.
- •The daily number of infected COVID-19 cases ranged from 0 to 11,743 with an average of 362 daily cases and a median of 69 daily cases across all states in the US during the time period from January 21, 2020 to April 25, 2020.





## Results

#### •US map for vaping prevalence and incidence of COVID-19 per 10,000.



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#### • Estimated coefficients and their 95% confidence intervals on daily number



Adjusted Estimated Coefficient From the GEE Model

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Results



## Results



#### • Estimated coefficients and their 95% confidence intervals on daily

number of COVID-19 death.

OVID-19 death.	Estimated Coefficient					
	with 95% CI 0.0004					
Number of Confirmed Cases	(0.0003, 0.0006)			1		
Population size in log scale	(0.8561, 1,2067)					
Age 35-44	-0.6556 (-1.0500, -0.2613)		-			
Age 65 or older	-0.0447					
White	(-0.2717, 0.1824) 0.0523			-		
Black	(0.0238, 0.0808) 0.1045			-		
Diack	(0.0601, 0.1490) 0.6437					
Hispanic	(0.2515, 1.0359) 0.0888					
Respiratory Disease	(-0.0246, 0.2022)					
Cancer	-0.3332 (-0.6105, -0.0 <u>559</u> )					
Obese	-0.0760 (-0.1479, -0.0041)					
Smoker	-0.0582					
Vaper	(-0.1539, 0.0375) 0.3730					
·	(0.0815, 0.6646)		1		1	
		-1	-0.5	0	0.5	1

1 Adjusted Estimated Coefficient From the GEE Model

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## Discussion

- •A significant positive association of vaping prevalence with COVID-19 cases and deaths at the state level.
- •This finding further supports the need for future research into the potential susceptibility of vapers to COVID-19.
- •No significant association between smoking and COVID-19 cases and deaths at the state level.
- •A positive association between a low education level and COVID-19 cases at the state level.
- •A positive association of non-Hispanic Blacks and Hispanics with COVID-19 deaths at the state level.



## Discussion



- •Although we cannot determine causality between vaping and COVID-19 cases and deaths from our study, prior research supports the biological plausibility of a relationship between vaping and an increased susceptibility to respiratory infection.
- Multiple mouse models have observed an increased severity in respiratory infection associated with vaping exposure related to dysregulation of lung epithelial cells and an impaired immune response to both viral and bacterial infection.
- A human cell-based model of exposure to nicotine-free flavored e-liquid observed immunosuppressive effects and impaired respiratory innate immune cell function.
- Flavorings could also trigger inflammatory responses in human monocytes.16

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## Discussion

- Social behaviors associated with vaping could also enhance the risk of infection.
- •Vapers who were not wearing a mask inside confined areas or even outside in a non-distanced group would be at an increased risk for contracting COVID-19.
- •Vapers who share vaping devices are also at an increased risk for contracting COVID-19.
- •Health concerns have been raised regarding vaping, such as whether vapers have higher risk for COVID-19 and could develop more severe symptoms once contracted COVID-19.





## Discussion

- •The association of smoking with COVID-19 cases and death is still unclear with many inconsistent results.
- •A prior meta-analysis found an increased risk of current smokers for influenza infection compared to non-smokers.
- •A recent study based on 1,099 COVID-19 patients found smoking history was associated with COVID-19 severity.
- •A recent meta-analysis based on Chinese patients suggests that active smoking is not associated with severity of COVID-19.
- •Our study did not find a significant association between the weighted proportion of smokers and the number of COVID-19 infections and deaths at state level.



## Discussion



- •We found positive association between the weighted proportion of less than high school education with the number of COVID-19 cases.
- •Researchers from the University of Southern California found that Americans who had less than high school education had a lower perceived risk of exposure to COVID-19 and a higher perceived risk of deaths than those who have college or higher degrees.
- •We found states that had a larger proportion of non-Hispanic Blacks and Hispanics had a larger number of COVID-19 deaths.
- •This could be related to the higher proportion of chronic conditions such as hypertension, heart disease and diabetes, as well as lower availability and access to care and the level of care in non-Hispanic Blacks and Hispanics.



## **Limitations**



- •The weighted proportions of vapers, smokers, and other demographic and chronic diseases are from the 2018 BRFSS data, which might differ from the 2020 estimates.
- •The outbreak of e-cigarette, or vaping product use-associated lung injury (EVALI) occurred in September 2019 might change the vaping pattern on state levels as CDC issued guidance against the use of e-cigarettes.
- •The reported COVID-19 cases and deaths obtained from 1Point3Acres.com website could be subject to some reporting errors as we noticed some negative numbers of COVID-19 cases and deaths, which we excluded from further analysis.



## **Limitations**



- •We don't know the individual status of vaping and COVID-19 cases or deaths, thus estimated coefficients of association could be different from epidemiological or clinical studies on individual subjects.
- •This ecological study at a group-level is also subject to limitations such as ecological bias, confounding, and misclassifications.
- •The group-level data did not include information on whether vapers were strictly following social/physical distancing guidelines to reduce their risks for COVID-19.



## Limitations



- •The study period did not cover the whole duration in the US as the pandemic is still ongoing. The analysis of the first period of the pandemic could be biased as the spread of the virus was unequally across states in the US during the first three months.
- •Our ecological study was not able to account for outbreak dynamics (size of outbreak, public health guidelines).
- •The number of reported cases could be impacted by testing strategies and reporting system that might be different from one state to another.



## Conclusions



- •There are positive associations between the weighted proportion of vapers and the daily number of COVID-19 cases and deaths at the US state level.
- •These positive associations suggest vapers may have an increased susceptibility to COVID-19 cases and deaths.
- •Systematic assessment of vaping among patients, along with additional studies on the associations of vaping with COVID-19 infections and deaths at individual level are needed to further explore this positive association between vaping and COVID-19 cases and deaths.





- •Statewide vaping prevalence was significantly associated with COVID-19 cases at a state level.
- •Statewide vaping prevalence was significantly associated with COVID-19 death at a state level.
- •This study emphasizes the importance of studying the susceptibility of current vapers to COVID-19 cases and death.





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