

## **Emerging Disparities in e-Cigarette Use**

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## **Emerging Disparities in e-Cigarette Use**

### **Abstract:**

E-cigarette use among adolescents is a key issue for public health, but little is known about the social determinants of its use. We identify social patterns in e-cigarette use, focusing on differences across grades earned in school for both e-cigarette and cigarette use. We employ the 2017 Youth Risk Behavior Survey (YRBS), which represents U.S. students in grades 9-12 and use logistic regression analysis. Our results indicate that there are important social differences in e-cigarette use among U.S. high school students. Strong differences across grades earned in school suggest the emergence of educational disparities for this new health behavior. For example, students reporting they receive “F’s” in school display odds of vaping more than six times greater than their peers receiving “A’s.” These differences appear slightly less strong compared to cigarette smoking, but provide evidence that educational disparities will be a key component of this emergent public health problem.

# Emerging Disparities in e-Cigarette Use

## EXTENDED ABSTRACT

### Introduction

Although the use of e-cigarettes, also called vaping, is a relatively new phenomenon, adolescent use is a burgeoning public health problem. Estimates from the 2017 Monitoring the Future study demonstrate that more than one-quarter of high school seniors and nearly that many sophomores used an e-cigarette in the past year in the United States (NIDA 2017). Researchers attribute the rise in youth e-cigarette use to the appealing flavors and the ability to hide the device that is the size of (and looks like) a USB flash drive (Bold et al. 2016). Just this month, the FDA coordinated a massive effort in addressing youth e-cigarette use, warning retailers and manufacturers to take action to reduce adolescent use (FDA 2018). The CDC identifies health risks of e-cigarettes for youth, including the effects of nicotine on the brain and memory of adolescents, as well as the consumption of e-cigarette aerosol as potentially harmful (CDC 2018), with experts asserting that health effects are generally unknown (Dinakar and O'Connor 2016).

Because e-cigarettes are relatively new and patterns are changing, we do not have a good understanding of who is vaping and why. Further, much of the research has focused on the associations between e-cigarettes and traditional (or combustible) cigarettes or other substances. Much of the research has focused on the role of e-cigarettes in adolescent initiation of smoking and adult cessation of smoking. Starting with e-cigarettes opens potential pathways for adolescents to transition to traditional smoking, as nicotine concentrations in e-cigarette cartridges increases the likelihood for dependence (Leventhal et al. 2015; Goldenson et al. 2017). For adults, there is not strong evidence that e-cigarettes improve cessation efforts, despite the promotion and marketing of the devices as cessation tools (Kalkhoran and Glantz 2016; Malas et al. 2016). In addition to understanding the relationships between e-cigarettes and other substances, documenting the social determinants of e-cigarettes among U.S. adolescents can help us identify upstream causes that lead to these behaviors. The goal of this study is to therefore to examine today's social determinants of e-cigarette use, focusing on measures of education.

Further, we can better understand educational differences in e-cigarette use if we compare the patterns to those of cigarette smoking. While smoking was widespread in the 1950's, over the decades, we have seen vast differences in smoking across educational levels emerge and grow stronger over time. Furthermore, today, smoking is much less common among the highly educated and contributes to widening mortality by educational level (Lawrence 2017; Ho and Fenelon 2015; Jamal et al. 2016; Sasson 2016). Smoking therefore can provide a point of reference to identify whether the social determinants, and educational differences specifically, are similar for smoking and vaping. Additionally, we focus on adolescence since this is the life course stage when health risk behaviors become relevant and can establish lifelong patterns, particularly for smoking (Maralani 2014).

### Methods

#### *Data*

We use the Youth Risk Behavior Survey (YRBS) from 2017, a survey conducted by the Centers for Disease Control and Prevention (CDC) that is representative of U.S. students in grades 9-12

attending public or private schools (CDC 2017). The YRBS is conducted every two years, surveying around 15,000 students each cycle. All analyses adjust for complex sampling design to ensure representative estimates. More information can be found on the website: <https://www.cdc.gov/healthyyouth/data/yrbs/data.htm>.

Before the meetings in the spring, we plan to incorporate data from young adults in the 2017 National Health Interview Survey (NHIS), a nationally representative survey conducted by the National Center for Health Statistics each year. In NHIS, questions on e-cigarettes were only asked of sample adults, so the two datasets together will allow us to present a fuller picture of educational disparities across the transition to adulthood.

### *Measures*

We have four dependent variables representing smoking and vaping. These dichotomous variables include whether the student reported ever trying an e-cigarette, ever smoking a cigarette, using an e-cigarette in the last 30 days, and smoking a cigarette in the last 30 days.

Our independent variable of interest is the grades the student reported receiving in school. Since students are in school, their educational attainment is unknown, and we use this variable as a proxy for how well they are performing. We categorize this variable as “A’s” (referent), “B’s,” “C’s,” “D’s,” “F’s,” and “not sure or other.” We also control for age, gender, race/ethnicity, and sexual identity.

### *Analytic Approach*

We use logistic regression for our four outcomes, sequentially adding in sexual identity and grades received in school to the base model that controls for age, sex, and race/ethnicity. Prior to the meetings, we plan to further examine vaping and smoking, using negative binomial regression to evaluate differences in frequency of use. We also plan to evaluate combinations of cigarette and e-cigarette use. We will conduct similar analyses using the NHIS data. We also plan to test all of the relationships for differences by race/ethnicity and gender.

## **Results**

Table 1 displays descriptive statistics for our sample. More students (42%) reported ever trying an e-cigarette compared to a combustible cigarette (29%). The results demonstrate social patterns in both e-cigarette and cigarette use. More males smoke or vape compared to females, and more students identifying as bisexual have smoked or vaped. We see particularly marked differences in both smoking and vaping across grades in school: those with higher grades are disproportionately likely to not vape or smoke.

Table 2 presents odds ratios and 95% confidence intervals from models examining whether students have ever tried vaping (Panel A) or smoking (Panel B). For both vaping and smoking, age is associated with increased use and this association remains similar with the inclusion of sexual identity and grades in school. Females are less likely to smoke or vape, although these differences are no longer statistically significant once grades in school has been considered. Race/ethnicity is complex and patterns differ for smoking and vaping. Non-Hispanic Black and Hispanic youth are far less likely to vape or smoke, and these differences are mostly similar in magnitude for vaping and smoking, and remain robust to the covariates. In contrast, multiracial individuals have greater odds for vaping, though these differences do not persist. But, in the full model, multiracial Hispanic and non-Hispanic multiracial youth are less likely to

smoke cigarettes. For sexual identity, bisexual adolescents have greater odds of vaping and smoking compared to their peers reporting they are heterosexual. Students identifying as gay or lesbian do not demonstrate different odds of vaping, but are more likely to smoke cigarettes.

Turning to grades in school, we see a general gradient such that each grade lower is associated with more smoking or vaping. Interestingly, “D” students appear to be engaging in more smoking and vaping than “F” students. The magnitudes appear larger for smoking compared to vaping (and in further analyses, we will conduct statistical tests of this). Nonetheless, differences are quite strong. Getting “D’s” or “F’s” results in odds of vaping more than three times those for “A” students.

Table 3 provides results similar for Table 2, but examining use in the last 30 days rather than “ever use.” These results demonstrate similar, but generally stronger patterns compared to Table 2. The one key difference is that race/ethnicity appears more straightforward, as almost all groups demonstrate reduced odds of vaping or smoking compared to non-Hispanic White youths.

## Discussion

The results of this study demonstrate important social patterns in e-cigarette use, in many ways similar to cigarette smoking. The strong differences in vaping across grades earned in school suggest that there will be future consequential educational disparities. We will explore why and how these disparities emerge in the coming months, and discuss their implications for research and policy.

## References

- Bold, Krysten W., Grace Kong, Dana A. Cavallo, Deepa R. Camenga and Suchitra Krishnan-Sarin. 2016. "Reasons for Trying E-Cigarettes and Risk of Continued Use." *Pediatrics* 138(3):e20160895.
- Centers for Disease Control and Prevention (CDC). 2017. Youth Risk Behavior Survey Data. Available at: [www.cdc.gov/yrbs](http://www.cdc.gov/yrbs). Accessed on August 5, 2018.
- Centers for Disease Control and Prevention (CDC). 2018. "Electronic cigarettes." Accessed September 15, 2018 at [https://www.cdc.gov/tobacco/basic\\_information/e-cigarettes/index.htm](https://www.cdc.gov/tobacco/basic_information/e-cigarettes/index.htm).
- Dinakar, C., & O'Connor, G. T. (2016). The health effects of electronic cigarettes. *New England Journal of Medicine*, 375(14), 1372-1381.
- FDA. 2018. "FDA takes new steps to address epidemic of youth e-cigarette use, including a historic action against more than 1,300 retailers and 5 major manufacturers for their roles perpetuating youth access." Accessed September 17, 2018 at <https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm620184.htm>
- Goldenson, Nicholas I., Adam M. Leventhal, Matthew D. Stone, Rob S. McConnell and Jessica L. Barrington-Trimis. 2017. "Associations of Electronic Cigarette Nicotine Concentration with Subsequent Cigarette Smoking and Vaping Levels in Adolescents." *JAMA Pediatrics* 171(12):1192-1199.
- Ho, J. Y., & Fenelon, A. (2015). The contribution of smoking to educational gradients in US life expectancy. *Journal of health and social behavior*, 56(3), 307-322.
- Jamal A, King BA, Neff LJ, Whitmill J, Babb SD, Graffunder CM. Current Cigarette Smoking Among Adults — United States, 2005–2015. (2016). *MMWR Morb Mortal Wkly Rep*, 65, 1205–1211. DOI: <http://dx.doi.org/10.15585/mmwr.mm6544a2>

- Kalkhoran, S., & Glantz, S. A. (2016). E-cigarettes and smoking cessation in real-world and clinical settings: a systematic review and meta-analysis. *The Lancet Respiratory Medicine*, 4(2), 116-128.
- Lawrence, E. M. (2017). Why Do College Graduates Behave More Healthfully Than Those Who Are Less Educated?. *Journal of health and social behavior*, 58(3), 291-306.
- Leventhal, Adam M., David R. Strong, Matthew G. Kirkpatrick, Jennifer B. Unger, Steve Sussman, Nathaniel R. Riggs, Matthew D. Stone, Rubin Khoddam, Jonathan M. Samet and Janet Audrain-McGovern. 2015. "Association of Electronic Cigarette use with Initiation of Combustible Tobacco Product Smoking in Early Adolescence." *Jama* 314(7):700-707.
- Malas, M., van der Tempel, J., Schwartz, R., Minichiello, A., Lightfoot, C., Noormohamed, A., ... & Ferrence, R. (2016). Electronic cigarettes for smoking cessation: a systematic review. *Nicotine & Tobacco Research*, 18(10), 1926-1936.
- Maralani, V. (2014). Understanding the links between education and smoking. *Social science research*, 48, 20-34.
- NIDA. 2017. "Monitoring the Future 2017 Survey Results." Accessed September 17, 2018 at <https://www.drugabuse.gov/related-topics/trends-statistics/infographics/monitoring-future-2017-survey-results>.
- Sasson, I. (2016). Diverging trends in cause-specific mortality and life years lost by educational attainment: evidence from United States vital statistics data, 1990-2010. *PloS one*, 11(10), e0163412.

Table 1. *Weighted means for independent variables for population sample, and across Vaping and Cigarette Smoking Usage, United States adolescents 2017*

	All	E-cigarette use		Smoked a cigarette	
		Never (58%)	Ever (42%)	Never (71%)	Ever (29%)
<u>Age</u>	16.01	15.87	16.20	15.90	16.32
<u>Gender</u>					
Female	0.51	0.53	0.48	0.52	0.48
Male	0.49	0.47	0.52	0.48	0.52
<u>Race/Ethnicity</u>					
Asian	.01	.01	.02	.01	.01
Black	.03	.05	.02	.04	.02
Hispanic/Latino	.13	.15	.11	.13	.09
NH White	.54	.55	.54	.53	.58
Multiple Hispanic	.10	.09	.11	.10	.10
Multiple Non-Hispanic	.13	.11	.15	.13	.14
Other	.06	.05	.06	.05	.06
<u>Sexual identity</u>					
Heterosexual	.85	.87	.85	.87	.82
Gay or Lesbian	.02	.02	.02	.02	.03
Bisexual	.08	.07	.10	.07	.11
Not Sure	.04	.05	.04	.04	.03
<u>Grades in School</u>					
"A" Students	.38	.45	.28	.43	.26
"B" Students	.37	.36	.39	.37	.38
"C" Students	.17	.13	.22	.14	.23
"D" Students	.03	.02	.05	.02	.07
"F" Students	.01	.01	.02	.01	.02
None of these grades/not sure	.04	.04	.04	.03	.05

Source: 2017 Youth Risk Behavior Survey (YRBS). N=14,684.

Notes: Analyses adjust for complex sampling design.

Table 2. Odds ratios and 95% confidence intervals from logistic regression models for ever using an e-cigarette (Panel A) or ever smoking a cigarette (Panel B), United States adolescents

	Panel A: e-cigarette						Panel B: cigarette smoking					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Age	<b>1.25</b>	<b>1.20,1.31</b>	<b>1.24</b>	<b>1.19,1.31</b>	<b>1.25</b>	<b>1.19,1.32</b>	<b>1.32</b>	<b>1.25,1.39</b>	<b>1.32</b>	<b>1.25,1.40</b>	<b>1.33</b>	<b>1.26,1.41</b>
Gender (male)												
Female	<b>0.83</b>	<b>0.71,0.97</b>	<b>0.84</b>	<b>0.77,0.93</b>	0.94	0.84,1.06	0.87	0.75,1.01	<b>0.83</b>	<b>0.75,0.92</b>	0.96	0.85,1.08
Race/Ethnicity (NH White)												
Asian	<b>1.53</b>	<b>1.01,2.29</b>	1.31	0.87,1.98	1.13	0.72,1.75	1.08	0.73,1.60	0.99	0.66,1.48	0.88	0.59,1.31
Black	<b>0.35</b>	<b>0.26,0.47</b>	<b>0.33</b>	<b>0.25,0.44</b>	<b>0.37</b>	<b>0.28,0.49</b>	<b>0.37</b>	<b>0.26,0.52</b>	<b>0.36</b>	<b>0.26,0.49</b>	<b>0.39</b>	<b>0.27,0.55</b>
Hispanic/Latino	<b>0.79</b>	<b>0.64,0.99</b>	<b>0.73</b>	<b>0.62,0.86</b>	<b>0.61</b>	<b>0.52,0.73</b>	<b>0.59</b>	<b>0.48,0.73</b>	<b>0.54</b>	<b>0.45,0.65</b>	<b>0.41</b>	<b>0.34,0.50</b>
Multi,Hispanic	<b>1.34</b>	<b>1.02,1.76</b>	1.24	0.98,1.56	0.98	0.76,1.27	0.94	0.68,1.30	0.89	0.65,1.21	<b>0.69</b>	<b>0.50,0.97</b>
Multi, Non-Hispanic	<b>1.33</b>	<b>1.10,1.61</b>	<b>1.23</b>	<b>1.06,1.43</b>	1.05	0.90,1.22	0.96	0.77,1.21	0.89	0.71,1.10	<b>0.72</b>	<b>0.58,0.90</b>
Other	1.25	0.95,1.64	1.13	0.88,1.46	1.09	0.84,1.43	1.04	0.73,1.47	0.95	0.68,1.34	0.89	0.64,1.25
Sexual Identity (heterosexual)												
Gay or Lesbian			1.11	0.79,1.54	1.06	0.74,1.51			<b>1.84</b>	<b>1.30,2.58</b>	<b>2.03</b>	<b>1.41,2.93</b>
Bisexual			<b>1.60</b>	<b>1.33,1.93</b>	<b>1.43</b>	<b>1.19,1.74</b>			<b>2.05</b>	<b>1.63,2.59</b>	<b>1.83</b>	<b>1.46,2.30</b>
Not Sure			0.83	0.66,1.05	0.79	0.61,1.01			0.99	0.75,1.29	0.95	0.72,1.27
Grades in School (A's)												
"B" Students					<b>1.71</b>	<b>1.51,1.94</b>					<b>1.81</b>	<b>1.54,2.12</b>
"C" Students					<b>2.56</b>	<b>2.27,2.90</b>					<b>2.80</b>	<b>2.27,3.45</b>
"D" Students					<b>3.56</b>	<b>2.83,4.47</b>					<b>6.01</b>	<b>4.09,8.84</b>
"F" Students					<b>3.43</b>	<b>2.32,5.08</b>					<b>4.98</b>	<b>3.21,7.72</b>
None of these grades/not sure					<b>1.83</b>	<b>1.47,2.28</b>					<b>2.69</b>	<b>2.04,3.54</b>
Constant	<b>0.02</b>	<b>0.01,0.05</b>	<b>0.02</b>	<b>0.01,0.05</b>	<b>0.01</b>	<b>0.01,0.03</b>	0.01	0.00,0.01	0.01	0.00,0.01	0.00	0.00,0.01

Source: 2017 Youth Risk Behavior Survey (YRBS)

Notes: Analyses adjust for complex sampling design. Significant results are in bold.



Table 3. Odds ratios and 95% confidence intervals from logistic regression models for an e-cigarette (Panel A) or smoking a cigarette (Panel B) in the last 30 days, United States adolescents, 2017

	Panel A: e-cigarette						Panel B: cigarette smoking					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Age	<b>1.29</b>	<b>1.20,1.38</b>	<b>1.29</b>	<b>1.19,1.39</b>	<b>1.33</b>	<b>1.22,1.45</b>	<b>1.33</b>	<b>1.25,1.42</b>	<b>1.34</b>	<b>1.26,1.43</b>	<b>1.37</b>	<b>1.29,1.46</b>
Gender (male)												
Female	<b>0.65</b>	<b>0.53,0.79</b>	<b>0.62</b>	<b>0.53,0.73</b>	<b>0.71</b>	<b>0.59,0.86</b>	<b>0.8</b>	<b>0.67,0.97</b>	<b>0.73</b>	<b>0.62,0.86</b>	0.88	0.74,1.05
Race/Ethnicity (NH White)												
Asian	1.07	0.53,2.18	1.04	0.50,2.16	0.91	0.44,1.85	0.86	0.41,1.82	<b>0.91</b>	<b>0.42,1.96</b>	<b>0.78</b>	<b>0.36,1.69</b>
Black	<b>0.20</b>	<b>0.13,0.31</b>	<b>0.20</b>	<b>0.13,0.30</b>	<b>0.20</b>	<b>0.13,0.31</b>	<b>0.17</b>	<b>0.08,0.36</b>	<b>0.17</b>	<b>0.08,0.37</b>	<b>0.17</b>	<b>0.07,0.41</b>
Hispanic/Latino	<b>0.50</b>	<b>0.34,0.73</b>	<b>0.47</b>	<b>0.33,0.68</b>	<b>0.39</b>	<b>0.26,0.57</b>	<b>0.36</b>	<b>0.25,0.52</b>	<b>0.33</b>	<b>0.23,0.46</b>	<b>0.23</b>	<b>0.15,0.35</b>
Multi,Hispanic	<b>0.63</b>	<b>0.41,0.97</b>	<b>0.59</b>	<b>0.39,0.91</b>	<b>0.45</b>	<b>0.30,0.68</b>	<b>0.56</b>	<b>0.40,0.79</b>	<b>0.53</b>	<b>0.38,0.75</b>	<b>0.39</b>	<b>0.27,0.56</b>
Multi, Non-Hispanic	<b>0.74</b>	<b>0.56,0.96</b>	<b>0.69</b>	<b>0.53,0.90</b>	<b>0.56</b>	<b>0.40,0.78</b>	<b>0.64</b>	<b>0.48,0.87</b>	<b>0.60</b>	<b>0.45,0.80</b>	<b>0.48</b>	<b>0.35,0.66</b>
Other	0.81	0.53,1.24	0.77	0.51,1.17	0.75	0.48,1.16	<b>0.65</b>	<b>0.46,0.93</b>	<b>0.61</b>	<b>0.43,0.86</b>	<b>0.58</b>	<b>0.40,0.84</b>
Sexual Identity(heterosexual)												
Gay or Lesbian			1.18	0.78,1.79	1.06	0.70,1.60			<b>2.26</b>	<b>1.53,3.35</b>	<b>2.09</b>	<b>1.35,3.24</b>
Bisexual			<b>1.80</b>	<b>1.42,2.28</b>	<b>1.56</b>	<b>1.22,2.01</b>			<b>2.55</b>	<b>1.95,3.33</b>	<b>2.10</b>	<b>1.56,2.83</b>
Not Sure			0.80	0.49,1.28	0.7	0.41,1.18			1.21	0.78,1.88	1.11	0.66,1.85
Grades in School (A's)												
"B" Students					<b>1.95</b>	<b>1.55,2.43</b>					<b>1.84</b>	<b>1.37,2.46</b>
"C" Students					<b>2.88</b>	<b>2.22,3.75</b>					<b>3.27</b>	<b>2.39,4.46</b>
"D" Students					<b>4.40</b>	<b>3.17,6.10</b>					<b>5.76</b>	<b>3.78,8.76</b>
"F" Students					<b>6.55</b>	<b>3.49,12.30</b>					<b>8.88</b>	<b>4.49,17.56</b>
None of these grades/not sure					<b>2.91</b>	<b>2.14,3.94</b>					<b>4.32</b>	<b>2.81,6.64</b>
Constant	0	0.00,0.01	0	0.00,0.01	0	0.00,0.01	0	0.00,0.00	0	0.00,0.00	0	0.00,0.00

Source: 2017 Youth Risk Behavior Survey (YRBS)

Notes: Analyses adjust for complex sampling design. Significant results are in bold.