



## Short Communication

## School socioeconomic disparities in e-cigarette susceptibility and use among central Texas middle school students

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## ABSTRACT

Social-ecological theory posits that health-related behavior is shaped by the environments and settings that surround us. We examined e-cigarette susceptibility and ever use prevalence among central Texas middle school students by the level of economic disadvantage (ED) of their school. As a secondary aim, we explored gender and ethnic differences (Hispanic vs. White) in e-cigarette susceptibility across school ED levels. A cross-sectional analysis was conducted of baseline data collected in 2017 as part of the *CATCH My Breath* study. Participants ( $n = 5278$ ) were 6th grade students from 23 central Texas public middle schools. E-cigarette susceptibility/use and demographics were self-reported; school ED was determined by Texas Education Agency. Analyses included chi-square tests and multi-level logistic regression. E-cigarette susceptibility and use varied by school ED for total sample ( $p < .0001$ ) and by ethnicity ( $p \leq .003$ ). While e-cigarette susceptibility was higher in boys ( $p < .001$ ), no gender differences were found for e-cigarette use. Students in the highest school ED quartile (Q4) (lowest SES) had significantly higher odds of e-cigarette susceptibility (AOR = 2.01; 95% CI: 1.49–2.71) and use (AOR = 8.12, 95% CI: 2.58–26.30) compared with Q1 students. Significant gender differences in e-cigarette susceptibility persisted within school ED quartiles 1–3 ( $p \leq .001$ ); no gender differences were found for Q4 ( $p = .537$ ). Despite overall higher e-cigarette susceptibility for Hispanic students, they had similar prevalence as White students within three school ED quartiles. Findings underscore a higher risk for e-cigarette susceptibility/use among central Texas sixth graders attending high ED schools and provide foundation for further exploration of the school socioeconomic context in adolescent e-cigarette use.

## 1. Introduction

Findings from the most recent National Youth Tobacco Survey indicate that electronic cigarette use begins as early as middle school for many adolescents in the United States, with an estimated 500,000 U.S. middle school students (4.3%) reporting past 30-day use (Jamal et al., 2017). The initiation of tobacco use at this early age is of public health concern given that the majority of tobacco users begin tobacco use during adolescence (USDHHS, 2012), and e-cigarette use by non-smoking adolescents has been found to lead to conventional tobacco smoking (NASEM, 2018). In guiding prevention efforts, research is needed to identify the subgroups of adolescents most at risk for e-cigarette use as well as the social-environmental factors that may shape e-cigarette use initiation.

Although the association between socio-economic status (SES) and

conventional tobacco smoking among young people has been well established (USDHHS, 2012), the role of SES in adolescent e-cigarette use is less clear. Research on SES and e-cigarette use in young people has primarily focused on individual-level SES measures of family income, parent education, and material-based proxy measures, with mixed findings. Some research with U.S. and European youth, for example, has found no association between SES and e-cigarette use (Kinnunen et al., 2018; Barrington-Trimis et al., 2015; Moore et al., 2015). Other research among Canadian and U.S. samples has found higher use among adolescents with more disposable income (Czoli et al., 2015; Lippert, 2015), while recent research among U.S. high school students has found lower family affluence predictive of different polytobacco user groups that include e-cigarette use (Simon et al., 2017).

Ecological models of health behavior may provide additional perspectives for exploring the role of SES in adolescent e-cigarette use.

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These models stem from the premise that health behavior is influenced by the interaction of people and their environmental context, as well as the behavioral settings (e.g., schools, workplaces, community) that encompass multiple environments (Sallis and Owen, 2015). In exploring how the school socioeconomic context may shape adolescent e-cigarette use, we examined the prevalence of e-cigarette susceptibility and ever use among central Texas middle school students by the level of economic disadvantage of their school. As a secondary aim, we explored gender and ethnic differences (Hispanic vs. White) in e-cigarette susceptibility across levels of school economic disadvantage.

## 2. Methods

### 2.1. Study design & population

A cross-sectional analysis was conducted of baseline data collected in January 2017 as part of *CATCH My Breath* (CMB), a school-based study aimed at preventing e-cigarette use in central Texas adolescents. The CMB study, funded by the St. David's Foundation Opportunity Grant, included 23 middle schools from six central Texas school districts, representing a middle school participation rate from these districts of 65.7%. Analysis was limited to 6th grade students with the aim of assessing e-cigarette susceptibility and use in this first year of secondary school. Intervention and comparison data were pooled for the analysis.

### 2.2. Measures & data collection

A self-administered questionnaire delivered via PE/health classes assessed e-cigarette susceptibility and use, as well as age, gender and race/ethnicity. E-cigarette susceptibility was adapted from measures of cigarette smoking susceptibility shown to predict future smoking (Pierce et al., 1996) that asked students if they: are curious about what it would be like to use an e-cigarette, think they will use e-cigarettes in the next year, and would use e-cigarettes if their best friend offered them one. Students responding “definitely no” to all three questions were considered not susceptible. E-cigarette susceptibility was restricted to never users of e-cigarettes. Ever use of e-cigarettes was also adapted from cigarette smoking measures (CDC, 2017) and asked “Have you ever used an E-cigarette, even one or two puffs?” School economic disadvantage (ED) was determined by data from Texas Education Agency (TEA) on student eligibility for free and reduced lunch, with the school-level percentage of economically disadvantaged students assigned to each student for a given school. Four levels of school ED (1 = lowest, 4 = highest) were then created based on the quartile distribution.

### 2.3. Analysis

Descriptive statistics were based on percentages for categorical variables, and means and standard deviations for continuous variables. Chi-square tests of significance were conducted to examine differences in e-cigarette susceptibility and use by gender, race/ethnicity, and school ED, with unadjusted point estimates presented in text and figures. Multi-level logistic regression analyses, accounting for school-level clustering by treating school as a random effect and adjusting for age, gender, and race/ethnicity, were then conducted to assess differences in e-cigarette susceptibility and use prevalence by school ED. With the exception of the race/ethnic-specific analyses, all race/ethnicities were included in analyses. For race/ethnic-specific analyses, we limited the sample to Hispanic ( $n = 1800$ ) and non-Hispanic White ( $n = 1847$ ) students as they represented the largest subsamples that allowed for school ED stratification. Statistical analyses were conducted using IBM SPSS v.25 (Chicago, IL) and Stata v.14 (College Station, TX), with statistical significance set at  $p < .05$ .

This study was reviewed and approved by the UTHealth Committee

for the Protection of Human Subjects and participating school districts. Parental consent and student assent were obtained for student participation in study, which included sending a letter of invitation and written informed consent to parents prior to the study that provided the option to decline their child's participation. Of the parents who received a study invitation for their child, 13 parents declined their child's participation in the study.

## 3. Results

The final sample consisted of  $n = 5278$  6th graders from 23 central Texas middle schools. Students participating in the study had a mean age of 12 years (SD.40), and just under half were female (48.9%). Hispanic (34.4%) and White (35.3%) represented the largest ethnic groups, followed by Asian (10.2%), African American (6.5%), and other ethnicities (13.5%). The distribution of school ED was as follows: Quartile (Q) 1: 5%–11% (highest SES); Q2: > 11%–27.0%; Q3: > 27% to 60.5%; Q4: > 60.5%–94% (lowest SES).

We found significant gender and ethnic differences in e-cigarette susceptibility and use in this 6th grade sample. Boys reported significantly higher *e-cigarette susceptibility* compared to girls (37.8% vs. 29.4%,  $p < .0001$ ); no significant gender differences were found for *e-cigarette ever use* (2.4% vs. 2.0%,  $p = 2.92$ ). Hispanic students reported significantly higher e-cigarette susceptibility (38.7% vs. 29.7%,  $p < .0001$ ) and ever use (3% vs. 1.5%,  $p = .003$ ) compared to White students.

The prevalence of e-cigarette susceptibility and use for the total sample varied across school ED strata ( $p < .0001$ ). With regard to e-cigarette susceptibility for the total sample, a higher prevalence was found for each increasing level (quartile) of school ED ( $p < .0001$ ) (Fig. 1). Students in the highest school ED quartile (Q4) (i.e., lowest SES) were two times as likely to report e-cigarette susceptibility compared with students in the lowest quartile (referent) (Adjusted Odds Ratio (AOR) = 2.01, 95% Confidence Interval (CI): 1.49–2.71). Students in school ED Q3 also had increased odds of e-cigarette susceptibility (Q3: AOR = 1.84 (95% CI: 1.38–2.46)), while no significant differences were found for Q2 students compared to Q1 students (AOR = 1.12, 95% CI: 0.82–1.53). Significant gender differences in e-cigarette susceptibility persisted within quartiles 1–3; however, in the highest level of ED (Q4), girls had similar e-cigarette susceptibility as boys ( $p = .537$ ) (Fig. 1). A similar pattern was found for *ever use* of e-cigarettes, with the highest percentage of use found in students attending schools in the highest ED quartile (Q4: 4.4%, Q3: 2.1%, Q2: 1.2%, Q1: 0.4%,  $p < .0001$ ). Students in the highest school ED quartile (Q4) had an AOR of 8.12 (95% CI: 2.58–26.30) for having ever used e-cigarettes compared with Q1 students; higher odds of use were also found for students in Q3 (AOR = 4.21, 95% CI: 1.31–13.57). No significant differences were found for Q2 (AOR = 2.12, 95% CI: 0.59–7.54).

In exploring ethnic/racial differences in e-cigarette susceptibility by school ED, White and Hispanic students had similar prevalence of e-cigarette susceptibility within each quartile ( $p > .05$ ), with the exception of quartile 3, in which Hispanic students reported significantly higher e-cigarette susceptibility ( $p = .012$ ) (Fig. 2).

## 4. Discussion

In examining the role of school economic disadvantage in e-cigarette use in central Texas 6th grade students, we found the prevalence of e-cigarette susceptibility and ever use increased by the level of school ED, with students attending the most economically disadvantage schools two times and eight times as likely to report susceptibility and use, respectively, compared to students attending the lowest ED schools. We also found that school ED played an important role in further understanding gender and ethnic similarities and differences in e-cigarette susceptibility and use in this sample of central Texas 6th

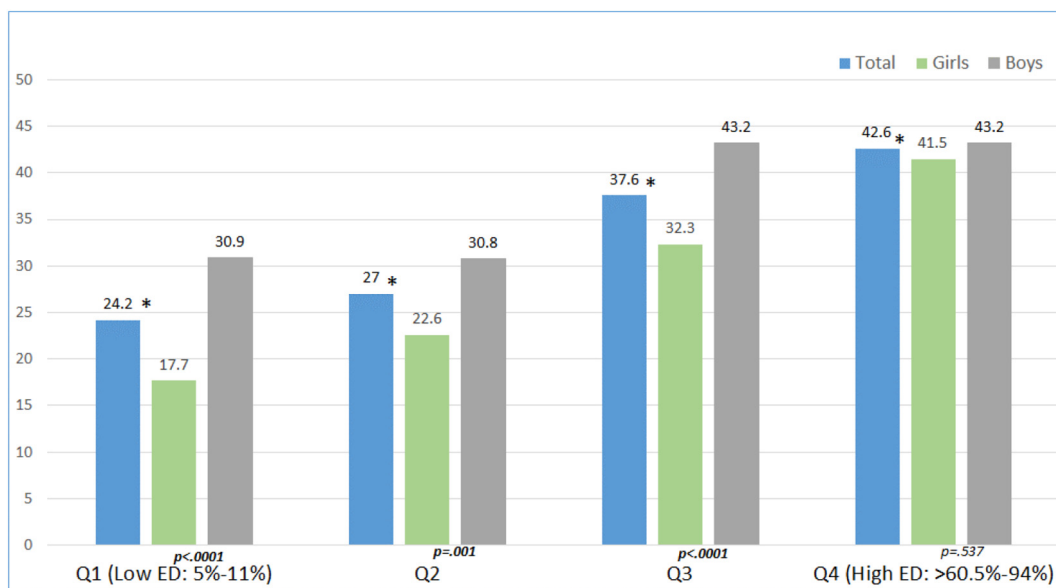


Fig. 1. E-cigarette susceptibility (%) by school economic disadvantage (ED) quartiles (Q) for total sample and by gender, 6th grade students - Central Texas (n = 4373), CATCH My Breath Study, January 2017 \*Chi-square: p < .0001.

grade students, which varied by school ED level.

In contrast to previous research based on measures of individual or family SES (see studies above), a specific contribution of the current study is the assessment of e-cigarette susceptibility and use in relation to the school SES context. Our findings of higher e-cigarette susceptibility and ever use among students attending schools with higher ED mirror research with Irish adolescents that found students attending socioeconomically disadvantaged schools had higher risk of e-cigarette use (Babineau et al., 2015).

Among our key findings, we documented similar prevalence rates of e-cigarette susceptibility between White and Hispanic students within three of the four school ED strata, despite overall higher prevalence of e-cigarette susceptibility and use among Hispanic students. While ethnic differences have been found for a range of health behaviors in young people in the U.S. (e.g., Kann et al., 2016), several studies have documented that ethnic disparities are reduced or eliminated when comparing students of different ethnicities within the same schools and

school SES levels, including research on U.S. adolescents' physical activity (Richmond et al., 2006), obesity (Springer et al., 2015), and a range of other health risk behaviors- including exposure to violence (Schuster et al., 2012).

In exploring the potential influence and norming effect of the school context on e-cigarette use, Corsi and Lippert (2016) found that school-level clustering of e-cigarette use is associated with individual-level use among students, with effect modification found for student race/ethnicity (Yu and Lippert, 2017). The authors cite Frohlich et al.' (2001) theory of generated health practices as a potential explanation for this school effect, in which high prevalence e-cigarette use schools create a self-reinforcing cycle of use, while low prevalence use schools may promote collective abstinence norms against use (Yu and Lippert, 2017). The theory of generated health practice perspective, which aligns with ecological perspectives of health behavior (Sallis and Owen, 2015), may help to explain why White and Hispanic students in this study reported no differences in e-cigarette susceptibility when

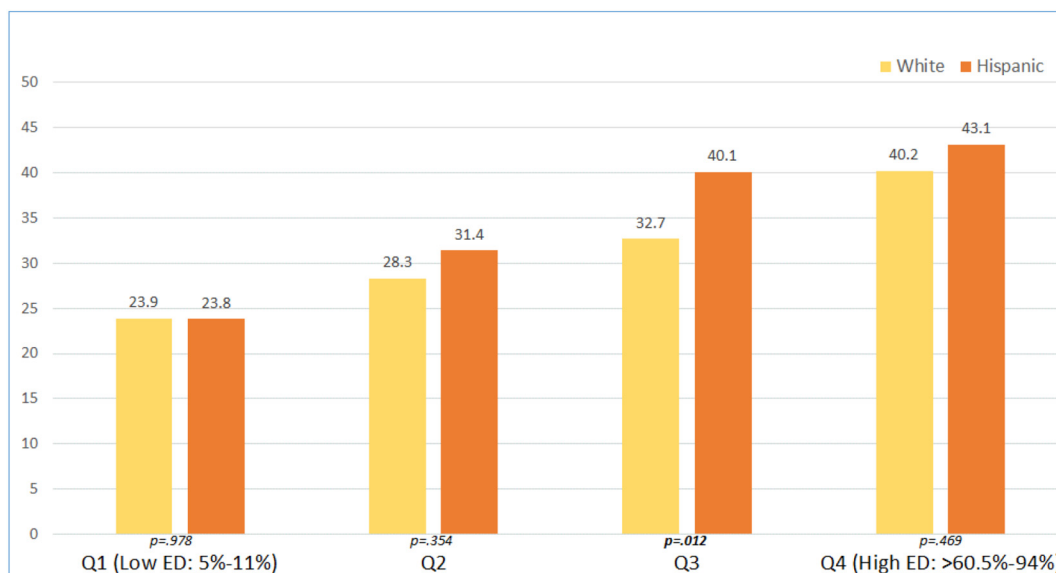


Fig. 2. E-cigarette susceptibility (%) by White and Hispanic 6th grade students, stratified by school economic disadvantage quartiles (Q) - Central Texas (n = 3647), CATCH My Breath Study, January 2017.

attending schools in the highest and lowest ED strata.

Lastly, we found 6th grade boys reported significantly higher e-cigarette susceptibility, yet similar levels of ever use, as 6th grade girls. Our findings of higher e-cigarette susceptibility for boys mirror recent findings on research of middle and high school students in Connecticut in which boys also reported higher susceptibility (Bold et al., 2017). The lack of significant gender differences in e-cigarette use in this study is supported by findings from the latest national survey on e-cigarette use among U.S. middle school students (Jamal et al., 2017). An important contribution of this study was our finding of consistent gender disparities in e-cigarette susceptibility for three lower ED school strata, yet no gender differences for schools that occupy that highest ED stratum (quartile). These findings underscore a heightened risk for e-cigarette use for both boys and girls attending high ED schools.

This study is among the first from the U.S. to examine e-cigarette susceptibility and use by school socioeconomic context. Other strengths include the large and ethnically and economically diverse sample of 6th grade students, and use of data on school SES as determined by the TEA. Limitations include the cross-sectional study design, which precludes inferences on the causal nature of the associations examined, as well as the lack of measures of individual-level SES, which limits our ability to more fully examine the contributions of individual versus contextual effects of SES on e-cigarette susceptibility and use.

## 5. Conclusion

Findings from this study underscore a higher risk for e-cigarette susceptibility/use among central Texas first year middle school students attending high ED schools and provide foundation for further exploration of the school socioeconomic context in adolescent e-cigarette use.

## Conflicts of interest

None.

## Acknowledgments

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## References

Babineau, K., Taylor, K., Clancy, L., 2015. Electronic cigarette use among Irish youth: a

- cross sectional study of prevalence and associated factors. *PLoS One* 10 (5), e0126419. <http://dx.doi.org/10.1371/journal.pone.0126419>.
- Barrington-Trimis, J.L., Berhane, K., Unger, J.B., et al., 2015. Psychosocial factors associated with adolescent electronic cigarette and cigarette use. *Pediatrics* 136 (2), 308–317. <http://dx.doi.org/10.1542/peds.2015-0639>.
- Bold, K.W., Kong, G., Cavallo, D.A., 2017. E-cigarette susceptibility as a predictor of youth initiation of E-cigarettes. *Nicotine Tob. Res.* 20 (1), 140–144.
- Centers for Disease Control and Prevention (CDC), 2017. 2017 Middle School Youth Risk Behavior Survey - Youth Risk Behavior Surveillance System (at). <https://www.cdc.gov/healthyyouth/data/yrbs/questionnaires.htm>, Accessed date: 10 March 2018.
- Corsi, J., Lippert, A.M., 2016. An examination of the shift in school-level clustering of US adolescent electronic cigarette use and its multilevel correlates, 2011–2013. *Health Place* 38, 30–38.
- Czoli, C.D., Hammond, D., Reid, J.L., Cole, A.G., Leatherdale, S.T., 2015. Use of conventional and alternative tobacco and nicotine products among a sample of Canadian youth. *J. Adolesc. Health* 57 (1), 123–125. <http://dx.doi.org/10.1016/j.jadohealth.2015.03.006>.
- Frohlich, K.L., Corin, E., Potvin, L., 2001. A theoretical proposal for the relationship between context and disease. *Sociol. Health Illn.* 23, 776–797.
- Jamal, A., Gentzke, A., Hu, S.S., et al., 2017. Tobacco use among middle and high school students – United States, 2011–2016. *MMWR* 66 (23), 597–603. <http://dx.doi.org/10.15585/mmwr.mm6623a1>.
- Kann, L., McManus, T., Harris, W.A., et al., 2016. Youth Risk Behavior Surveillance—United States 2015. *MMWR Surveill. Summ.* 65 (SS-6), 1–174.
- Kinnunen, J.M., Ollila, H., Minkinen, J., Lindfors, P.L., Rimpela, A.H., 2018. A longitudinal study of predictors of adolescent electronic cigarette experimentation and comparison with conventional smoking. *Int. J. Environ. Res. Public Health* 15 (2), 305. <http://dx.doi.org/10.3390/ijerph15020305>.
- Lippert, A.M., 2015. Do adolescent smokers use e-cigarettes to help them quit? The sociodemographic correlates and cessation motivations of U.S. adolescent e-cigarette use. *Am. J. Health Promot.* 29 (6), 374–379. <http://dx.doi.org/10.4278/ajhp.131120-QUAN-595>.
- Moore, G., Hewitt, G., Evans, J., et al., 2015. Electronic-cigarette use among young people in Wales: evidence from two cross-sectional surveys. *BMJ Open* 5, e007072. <http://dx.doi.org/10.1136/bmjopen-2014-007072>.
- National Academies of Sciences, Engineering, and Medicine, 2018. Public Health Consequences of E-cigarettes. The National Academies Press, Washington, DC. <http://dx.doi.org/10.17226/24952>.
- Pierce, J.P., Choi, W.S., Gilpin, E.A., Farkas, A.J., Merritt, R.K., 1996. Validation of susceptibility as a predictor of which adolescents take up smoking in the U.S. *Health Psychol.* 15 (5), 355–361.
- Richmond, T.K., Hayward, R.A., Gahagan, S., Field, A.E., Heisler, M., 2006. Can school income and racial/ethnic composition explain the racial/ethnic disparity in adolescent physical activity? *Pediatrics* 117 (6), 2158–2166. <http://dx.doi.org/10.1542/peds.2005-1920>.
- Sallis, J.F., Owen, N., 2015. Ecological models of health behavior. In: Glanz, K., Rimer, B., Viswanath, K. (Eds.), *Health Behavior: Theory, Research, and Practice*, Fifth ed. Jossey-Bass, San Francisco, CA, pp. 43–64.
- Schuster, M.A., Eillott, M.N., Kanouse, D.E., et al., 2012. Racial and ethnic health disparities among fifth-graders in three cities. *N. Engl. J. Med.* 367 (8), 735–745. <http://dx.doi.org/10.1056/NEJMs1114353>.
- Simon, P., Camenga, D.R., Kong, G., et al., 2017. Youth E-cigarette, blunt, and other tobacco use profiles: does SES matter? *Tob Regul. Sci.* 3 (1), 115–127. <http://dx.doi.org/10.18001/TRS.3.1.12>.
- Springer, A.E., Li, L., Ranjit, N., et al., 2015. School-level economic disadvantage and obesity in middle school children in central Texas. *Int. J. Behav. Nutr. Phys. Act.* 12 (Suppl. 1), S8. <http://dx.doi.org/10.1186/1479-5868-12-S1-S8>.
- US Department of Health and Human Services (USDHHS), 2012. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General. USDHHS, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta: GA.
- Yu, E., Lippert, A.M., 2017. Race/ethnicity modifies the association between school prevalence of e-cigarette use and student-level use: results from the 2014 US National Youth Tobacco Survey. *Health Place* 46, 114–120. <http://dx.doi.org/10.1016/j.healthplace.2017.05.003>.