Adolescent smoking: The relationship between cigarette smoking, E-cigarette smoking and BMI.

Molly Jacobs*

Department of Health Sciences Information and Management, College of Allied Health Science, East Carolina University, Greenville, United States

Abstract

Background: There has been rapid growth in ever and current electronic cigarette (e-cigarettes) use over the past 4 years. Use is highest among adolescents and current cigarette smokers. This trend follows a rise in the number of overweight and obese adolescents and teens. This study examined the relationship between BMI and the use of both electronic and conventional cigarette in high school aged youth.

Methods: Data from the Youth Risk Behavior Surveillance System (YRBSS)-a nationally representative survey of 9th through 12th grade students conducted every two years-was used for analysis. Two different statistical models-a multinomial logit (mlogit) and quantile regression (QR) of BMI levels-tested the relationship between BMI and electronic/conventional cigarette use among adolescents.

Results: BMI was positively related to age, race, and ethnicity. Those who use either conventional or electronic cigarettes had higher BMI than those using neither product. Magnitude vary by demographic groups, particularly among women. While solitary product use was associated with elevated weight, simultaneous use of both products was associated with lower BMI values. Overweight and obese adolescents were more frequent tobacco users than other weight classes. Associations were impervious to model specification.

Conclusion: Findings showed that use of either conventional and electronic cigarettes was associated with higher BMI. However, these findings suggest the need for additional research into the health impacts of substance use by adolescents. Research into the physical, emotional and psychological health impacts of electronic tobacco needs to be fully explored as it continues to grow in popularity among adolescents.

Keywords: BMI, Adolescence, E-Cigarette, Vaping, Smoking.

Accepted on September 11th, 2018

Research Implications

Using a large, nationally representative database of adolescents, this study provides examines the relationship between BMI and various forms of cigarette use. Results show that regular use of conventional cigarettes is associated with higher BMI increases adolescent weight impacts vary of conventional cigarette, electronic cigarette and dual product use by youth age 12 to 18. Results show that, while electronic cigarettes result in a lower BMI compared to non-users. The growing popularity of vaping products signals the need for additional examination of the health effects of these devices.

Introduction

Use of electronic cigarettes (e-cigarettes) among young adults has grown substantially in recent years [1,2]. E-cigarette use is highest among middle and high school students [3]. Although research has documented a relationship between conventional cigarette smoking and adolescent weight outcomes [4-8] few comprehensive, nationally representative studies have evaluated the correlation between adolescent weight (body mass index) and electronic tobacco use.

As electronic tobacco use becomes wide spread among youth [9-11], it is important to gain a better understanding of the relationship between these products and BMI. The current study examines weight status as a correlate of electronic and conventional cigarette. E-cigarettes could serve as a gateway to other forms of tobacco use. Among those who try e-cigarettes, 25% had taken at least one puff on a cigarette within the next year, compared to only 10% of those who never tried vaping [12,13].

Many are under the impression that because e-cigarettes do not contain tobacco, they pose little health risk, but the consequences of vaping and dual use have yet to be fully explored [14]. A handful of studies have linked e-cigarette usage to bleeding mouths and throats, gum disease, cancer, delayed wound healing, coughing and bronchitis [15].

A third of e-cigarette users are nonsmokers, suggesting that e-cigarettes contribute to primary nicotine addiction and

renormalization of tobacco [1]. Recent evidence also shows elevated levels of dual use, with over 80% of current high school e-cigarette users concurrently smoking conventional cigarettes [10,16].

While e-cigarettes were originally used by those hoping to quit smoking, motivations appear to be evolving [17,18]. In 2012, 85% of e-cigarette users reported using e-cigarettes as a cessation aid [19-21]. By 2015, less than 30% cited quitting smoking regular cigarettes as a reason for vaping. Most reported using e-cigarettes because of expeditious consumption, ease of concealment, accessibility, healthier than tobacco cigarettes, and aesthetically pleasing [22].

However, studies are not consistent in the assertion the e-cigarettes serve as a gateway to other forms of tobacco. Low prices, ease of access, targeted advertising and popularity could contribute to initiation and use [23]. The cigarette industry has a significant online presence and promotes electronic cigarettes as a safer alternative to conventional cigarettes [23]. Therefore, the willingness to try e-cigarettes may vary by the degree to which individuals are influenced by marketing. E-cigarettes may appeal to adolescents with novelty-seeking characteristics [24]. While older smokers may use e-cigarettes to quit smoking, intention to quit does not play a crucial role in the e-cigarette use among the young [7]. Conventional and e-cigarettes could appeal to young people in the process of forming a smoker identity [24]. Also, peer cigarette smoking has a significant association with e-cigarette use in adolescent nonsmokers, and this association was greater on never than former smokers [14]. This analysis, however, does not attempt to determine causality of motivation for use.

Studies examining the relationship between BMI and conventional cigarette use have found a positive impact on adolescent BMI [25-27]. Many cite high BMI is a risk factor for smoking initiation as it is often used to curb appetite. Few studies have linked BMI and e-cigarettes. One adult study found that those who vape for weight loss/control, or to prevent post smoking-cessation weight gain were more successful [28]. One regional study linked vaping to higher weight and showed robust correlations [29].

This analysis uses data from the Youth Risk Behavior Surveillance System (YRBSS)-a nationally representative survey that monitors health risk behaviors among high school students in 9th through 12th grade-to examine the association between these behaviors and adolescent BMI. Multinomial logistic regressions and quantile regression estimate this relationship. The paper proceeds with a description of the data and methodology. Section III presents results. Finally, Section IV briefly summarizes the primary findings and topics for additional research.

Materials and Methods

The YRBSS was established by the CDC to monitor the prevalence of health-related behaviors in U.S. youth. It contains information on risky behavior established during childhood and early adolescence including sexual behavior, alcohol and drug use, physical activity, tobacco use, behaviors that contribute to unintentional injuries, violence and unhealthy dietary behavior. The YRBSS also monitors the prevalence of obesity, asthma and other priority health-related behaviors. It is conducted every other year beginning in 1991 with 2015 being the most recent available.

Subjects included boys and girls ages 12 to 18 years enrolled in 9th through 12th at a public and private school. Average respondent age is 15 to 16 (Table 1). Racial groups included whites, blacks and Hispanics. Other ethnic groups (American Indians and Pacific Islanders) were not separately classified. The sample is roughly 20% black and 27% Hispanic with equal percentages of males and females.

BMI ranges from 13 to 55 for males and females with an average of 23. Based on CDC recommendations, respondents are placed into weight categories—underweight, normal weight, overweight and obese-by their BMI ranges listed below. Roughly 35% of males and females are underweight-less than 18.5 BMI-and 40% normal weight-between 18.5 and 24.9 BMI. The remaining 25% are either overweight or obese with slightly more obese males than females. Means are listed in Table 1. The lower panel shows the age and BMI disaggregation.

The BMI-for-age percentiles are also provided in Table 1, percentile rank weight compared to that of others of the same age and sex. While adolescent BMI can be interpreted as both a raw value and a percentile, given that males and females are analyzed separately within the same age range, the form of use did not significantly change results. Therefore, BMI is utilized for ease of interpretation.

YRBSS respondents are between ages 12 and 18. These, however, are recorded using values of one through seven. A mean age of five is roughly 16 years of age. The survey captures electronic and conventional cigarette use. Two primary elements from the YRBSS are used. First, youth are considered current conventional smokers if they report having smoked at least one cigarette in the last 30 days. Roughly 7.5% and 5.5% of males and females respectively are conventional cigarette smokers. Second, youth are considered current e-cigarette users if they have used electronic vapor products on one of the last 30 days-28% and 23% of males and females.

In these data electronic cigarettes refers to vapor products, such as blu, NJOY, Vuse, MarkTen, Logic, Vapin Plus, eGo, and Halo. Electronic vapor products include e-cigarettes, e-cigars, e-pipes, vape pipes, vaping pens, e-hookahs, and hookah pens. Vaping is also used interchangeably in this work. Conventional cigarettes are considered tobacco-containing commercial cigarettes. Conventional and e-cigarette use is captured with binary dummy variables. All analyses are run separately for males and females. YRBSS oversamples racial and ethnic groups to enable small sample subsets, therefore estimates are weighted to mimic national demographic profiles. YRBSS sample weights are used as recommended in the data documentation. Statistical work uses SAS software. Due to time and cohort heterogeneity, survey stratum is used as the analysis class.

Most respondents are non-smokers with only five percent of overweight and obese respondents report smoking conventional cigarettes, but 30% use electronic cigarettes. Most e-cigarette smokers have BMI within the under or normal weight range suggesting an apparent association between lower BMI and use. However, means cannot properly address the behavioral impact

on BMI therefore, two forms of regression are used to assess the BMI relationship. First, multinomial logistic regression models test the probability of having a high BMI category given cigarette or e-cigarette use. Second, quantile regression describes the relationship between BMI and smoking at different points in the conditional BMI. The relationship between cigarette use and BMI could vary along the BMI distribution and QR considers the impact of smoking on weight along the entire BMI distribution, not just the conditional mean.

This study faces several limitations. First, all estimates were based on self-reported data, which might be affected by reporting bias. Given that estimates resemble others' findings for the youth population, findings do hold some legitimacy [30]. Secondly, the YRBSS contains relatively few demographic control covariates. It would have been desirable to include income, region of residence, urban/rural classification, household size and other factors. In additionally, there is no information on the smoking behavior of friends, family members or peer of the respondents. This can be significant when considering cigarette use as social influence is a very strong driver of the initiation and habituation of behavior among adolescents [31]. Finally, data did not allow assessment of willingness to quit tobacco smoking or motivation.

Result

All regressions use the SAS software package. Table 2 includes results for the multinomial logit. A multinomial logit models the probability of an individual with the given characteristic assuming a higher BMI category. For example, a positive coefficient value for smoking indicates that respondents who smoke have a higher BMI category than those who do not smoke. Age is significantly associated with higher BMI categorization denoting higher BMI and higher ages. Electronic cigarette use is significantly related to higher BMI among both males and females, consistent with other findings. Conventional cigarette

***Table 1a**. Covariate descriptive statistics.*

Covariate Descriptive Statistics				
Variables	**Mean**	**Std Dev**	**Min**	**Max**
Males				
Age	5.222	1.235	1	7
BMI percentile	64.258	28.83	0	99.96
BMI	23.832	4.966	13	55
BMI category	0.967	0.948	0	3
Black	0.213	0.41	0	1
Hispanic	0.272	0.445	0	1
Uses E-Cigarettes	0.28	0.449	0	1
Daily smoker	0.074	0.262	0	1
Female				
Age	5.112	1.229	1	7
BMI percentile	61.218	27.691	0	99.8
BMI	23.1	4.819	13	55
BMI category	0.881	0.842	0	3
Black	0.232	0.422	0	1
Hispanic	0.275	0.447	0	1
Uses E-Cigarettes	0.23	0.421	0	1
Daily smoker	0.054	0.226	0	1

***Table 1b.** YRBSS: Categorical covariate frequencies.*

YRBSS: Categorical Covariate Frequencies					
Male			**Female**		
Age	**N**	**Percent**	**Age**	**N**	**Percent**
Age					
12	150	0.16	12	109	0.12
13	99	0.11	13	104	0.11
14	7841	8.54	14	9647	10.25
15	20005	21.78	15	21719	23.09
16	23314	25.39	16	24219	25.74
17	23889	26.01	17	24298	25.83
18	16532	18	18	13985	14.86
BMI					
Underweight	32781	35.7	Underweight	33424	35.53
Normal Weight	39442	42.95	Normal Weight	44586	47.39
Overweight	9501	10.35	Overweight	9871	10.49
Obese	10106	11.01	Obese	6200	6.59
Currently used electronic vapor products					
No	5340	71.97	No	5767	76.95
Yes	2080	28.03	Yes	1727	23.05
Currently smoked cigarettes daily					
No	80487	92.61	No	85757	94.62
Yes	6427	7.39	Yes	4880	5.38

use is related to substantially higher weight for females, but not males. The interaction-representing individuals who report both simultaneously vaping and smoking regularly-is related negatively associated with BMI. Dual product use could be used to curb eating or in place of other types of consumption.

Results from the second specification, the quantile regression, are listed in Table 3. Quantile regression divides the BMI distribution at the 25th, 50th and 75th percentiles and estimates the covariates with respect to the conditional median of each segment (Table 3). Age, race and ethnicity continue to be related to higher BMI for both males and females at all BMI levels as noted above. Results for electronic and conventional cigarette use vary by gender. In the bottom 25th percentile, males see an association between vaping and BMI, but it diminishes at higher

Table 1c. *BMI-for-age percentile.*

Weight Status	BMI
Underweight	Below 18.5
Normal or Healthy weight	Between 18.5 and 24.9
Overweight	Between 25.0 and 29.9
Obese	30 and above

Table 2. *YRBSS: Multinomial logit of BMI category by sex.*

YRBSS: Multinomial logit of BMI category by sex		
Male		
Response Profile		
Category	**Frequency**	
Obese	838	
Overweight	1346	
Normal Weight	3883	
Overweight	1053	
Goodness of Fit		
Criterion	**Intercept**	**Intercept and Covariates**
Chi-Square	63.1505***	--
AIC	16766.424	16585.989
SC	16787.036	16647.825
-2 Log L	16760.424	16567.989
Parameter	**Estimate**	**Std Error**
Intercept 1	-5.841***	0.3061
Intercept 2	-4.5836***	0.3033
Intercept 3	-1.8385***	0.2983
Age	0.2249	0.0186
Black	-0.1053	0.0681
Hispanic	0.0795	0.0559
Current Smoker	0.2298***	0.0541
Current Vaper	0.2379	0.3026
Smoke and Vape	-0.886*	0.3516
Female		
Response Profile		
Category	**Frequency**	
Obese	679	
Overweight	1209	
Normal Weight	4245	
Overweight	1162	
Goodness of Fit		
Criterion	**Intercept**	**Intercept and Covariates**
Chi-Square	99.9938***	--
AIC	15726.452	15596.941
SC	15747.137	15658.995
-2 Log L	15720.452	15578.941
Parameter	**Estimate**	**Std Error**
Intercept 1	-5.2196***	0.313
Intercept 2	-3.9323***	0.3102
Intercept 3	-1.1287***	0.306
Age	0.1663***	0.0192
Black	0.2912***	0.0703
Hispanic	0.2124***	0.0569
Current Smoker	0.1784***	0.0577
Current Vaper	1.1969***	0.2631
Smoke and Vape	-0.8452*	0.3287
Dependent Variable: BMI Category		
***=99%, **=95%, *=90%		

Table 3. *YRBSS: Quantile regression by sex.*

YRBSS: Quantile regression by sex						
Male						
Summary Statistics						
Variable	**Q1**	**Median**	**Q3**	**Mean**	**Std Dev**	**MAD**
Age	15	16	17	16.0949	1.2181	1.4826
Black	0	0	0	0.1021	0.3028	0
Hispanic	0	0	1	0.3278	0.4694	0
Vaper	0	0	1	0.2699	0.4439	0
Smoker	0	0	0	0.0256	0.1579	0
Interaction	0	0	0	0.0193	0.1375	0
lnBMI	3.0079	3.1239	3.2721	3.1515	0.2012	0.1869
Quantile Level: 0.25						
Parameter	**Estimate**	**Std Dev**	--	--		--
Intercept	2.6543***	0.0459	--	--	--	--
Age	0.0217***	0.0028	--	--	--	--
Black	0.0101	0.0102	--	--	--	--
Hispanic	0.0112	0.0071	--	--	--	--
Vaper	0.0186***	0.0064	--	--	--	--
Smoker	0.0365	0.0348	--	--	--	--
Interaction	-0.0447	0.0443	--	--	--	--
Quantile Level: 0.50						
Parameter	**Estimate**	**Std Dev**	--	--		--
Intercept	2.6745***	0.053	--	--	--	--
Age	0.027***	0.0032	--	--	--	--
Black	-0.0024	0.0117	--	--	--	--
Hispanic	0.0208**	0.0082	--	--	--	--
Vaper	0.0105	0.0101	--	--	--	--
Smoker	0.015	0.0381	--	--	--	--
Interaction	-0.0374	0.0517	--	--	--	--
Quantile Level: 0.75						
Parameter	**Estimate**	**Std Dev**	--	--		--
Intercept	2.7921***	0.0772	--	--	--	--
Age	0.0279***	0.0047	--	--	--	--
Black	0.0053	0.0211	--	--	--	--
Hispanic	0.0387***	0.0123	--	--	--	--
Vaper	0.0138	0.014	--	--	--	--
Smoker	0.1479	0.1294	--	--	--	--
Interaction	-0.1786	0.1329	--	--	--	--
Female						
Summary Statistics						
Variable	**Q1**	**Median**	**Q3**	**Mean**	**Std Dev**	**MAD**
Age	15	16	17	16.0127	1.216	1.4826
Black	0	0	0	0.104	0.3053	0
Hispanic	0	0	1	0.3292	0.47	0
Vaper	0	0	0	0.223	0.4163	0
Smoker	0	0	0	0.0175	0.131	0
Interaction	0	0	0	0.0124	0.1108	0
lnBMI	3.0056	3.1035	3.2429	3.1386	0.1939	0.1691
Quantile Level: 0.25						
Parameter	**Estimate**	**Std Err**	--	--		--
Intercept	2.7933***	0.0458	--	--	--	--
Age	0.0119***	0.0029	--	--	--	--
Black	0.0399***	0.0126	--	--	--	--
Hispanic	0.0363***	0.0072	--	--	--	--
Vaper	0.0125	0.0093	--	--	--	--
Smoker	0.1304**	0.0534	--	--	--	--
Interaction	-0.1064	0.0691	--	--	--	--
Quantile Level: 0.50						
Parameter	**Estimate**	**Std Err**	--	--		--
Intercept	2.85***	0.0419	--	--	--	--
Age	0.0141***	0.0026	--	--	--	--
Black	0.0588***	0.0111	--	--	--	--
Hispanic	0.0503***	0.0063	--	--	--	--
Vaper	0.0252**	0.0095	--	--	--	--

Smoker	0.1846***	0.0563	--	--	--	--
Interaction	-0.1046	0.0794	--	--	--	--
Quantile Level: 0.75						
Parameter	**Estimate**	**Std Err**	--	--		--
Intercept	2.903***	0.08	--	--	--	--
Age	0.0181***	0.0052	--	--	--	--
Black	0.102***	0.0181	--	--	--	--
Hispanic	0.0615***	0.011	--	--	--	--
Vaper	0.0335**	0.0161	--	--	--	--
Smoker	0.1443	0.0999	--	--	--	--
Interaction	-0.039	0.1112	--	--	--	--
Dependent Variable: lnBMI						
***= 0.01, **=0.10, *=0.15						

levels. Females, however, have a positive relationship between conventional cigarette smoking at all ranges of BMI and a positive association with electronic cigarettes in the middle quantile only. Interestingly, these magnitudes increase as BMI increases suggesting a stronger relationship at higher weights.

Discussion and Conclusion

Findings indicate that electronic and conventional cigarette use is associated with higher BMI both male and female high school students. The relationship is stronger among females than males and among higher BMI individuals than low. This result could indicate that higher BMI youth choose to smoke to curb appetite or use it as a substitute for meals. Or show a strong preference for all forms of consumption, both cigarettes and food. While the underlying reason behind the association is beyond the scope of this analysis, it exists along the BMI distribution and appears among both genders.

While e-cigarettes have a positive BMI association, it varies by gender along the BMI distribution. Females at the higher end of the BMI distribution experience larger associations between electronic cigarettes and BMI, while males at the lower end tend find a stronger relationship. The positive association could result from the 100-140 calories in every ounce of vaping liquid and added sweeteners and flavors, though it is not clear how many of these calories are ingested after the liquid is vaporized. It could also be related to post-cessation weight gain by respondents who use e-cigarettes as a substitute product when trying to quit smoking. There is anecdotal evidence that e-cigarettes make users feel more sluggish after continued use, but no scientific evidence exists to support this claim.

While causality is outside the scope of this analysis, these results raise many questions regarding the BMI and other health effects of adolescent smoking. The popularity of electronic cigarettes has increased rapidly, while that of conventional cigarettes has declined [30,32]. Adolescence is a time marked by exploration and experimentation [33]. Sensation seeking, or the need for new experiences combined with the willingness to take risks to achieve them, has been associated with adolescent substance use and may increase cigarette/e-cigarette experimentation [34].

While limited in several ways, this analysis utilizes a nationally representative sample of individuals from all states, races, ethnic groups and income classes. It employs statistical tools to account for weighted estimation, covariate dispersion and cross-sectional panel integration. By providing insight into the prevalence, patterns and correlates of adolescent conventional and e-cigarette use, this study underscores the need for further research assessing whether e-cigarettes may curb weight gain or enable current cigarette smokers to curb use. Motives and risk factors currently remain unresolved. More research is needed to understand safety and health effects of e-cigarette use in adolescents.

Funding

The author reports no monetary interests in the publication of this manuscript. No external funding was used in the research contained herein.

Ethical Approval Disclosure

This manuscript does not contain any studies with human participants or animals performed by the author.

Conflicts of Interest Disclosure

The author certifies that he/she has NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

References

1. McMillen RC, Gottlieb MA, Shaefer RM, et al. Trends in electronic cigarette use among US adults: Use is increasing in both smokers and nonsmokers. Nicotine Tob Res. 2014;17:1195-202.
2. Weaver SR, Majeed BA, Pechacek TF, et al. Use of electronic nicotine delivery systems and other tobacco products among USA adults, 2014: Results from a national survey. Int J Public Health. 2016;61:177-88.
3. Centers for Disease Control and Prevention (CDC). Notes from the field: Electronic cigarette use among middle and high school students-United States, 2011-2012. MMWR. Morbidity and Mortality Weekly Report. 2013;62:729-30.
4. Kenne DR, Mix D, Banks M, et al. Electronic cigarette initiation and correlates of use among never, former, and current tobacco cigarette smoking college students. J Subst Use. 2016;21:491-4.

5. Loukas A, Batanova M, Fernandez A, et al. Changes in use of cigarettes and non-cigarette alternative products among college students. Addict Behav. 2015;49:46-51.

6. Sutfin EL, Reboussin BA, Debinski B, et al. The impact of trying electronic cigarettes on cigarette smoking by college students: A prospective analysis. Am J Public Health. 2015;105:e83-9.

7. Sutfin EL, McCoy TP, Morrell HE, et al. Electronic cigarette use by college students. Drug Alcohol Depend. 2013;131:214-21.

8. Trumbo CW, Harper R. Use and perception of electronic cigarettes among college students. J Am Coll Health. 2013;61:149-55.

9. Choi K, Forster J. Characteristics associated with awareness, perceptions, and use of electronic nicotine delivery systems among young US Midwestern adults. Am J Public Health. 2013;103:556-61.

10. Pearson JL, Richardson A, Niaura RS, et al. E-Cigarette awareness, use and harm perceptions in US adults. Am J Public Health. 2012;102:1758-66.

11. Wills TA, Knight R, Williams RJ, et al. Risk factors for exclusive e-cigarette use and dual e-cigarette use, and tobacco use in adolescents. Pediatrics. 2015;135:e43–51.

12. Primack BA, Soneji S, Stoolmiller M, et al. Progression to traditional cigarette smoking after electronic cigarette use among US adolescents and young adults. JAMA Pediatr. 2015;169:1018-23.

13. Leventhal AM, Strong DR, Kirkpatrick MG, et al. Association of electronic cigarette use with initiation of combustible tobacco product smoking in early adolescence. JAMA. 2015;314:700-7.

14. Hwang JH, Park SW. Association between peer cigarette smoking and electronic cigarette smoking among adolescent nonsmokers: A national representative survey. PloS one. 2016;11:e0162557.

15. McConnell R, Barrington-Trimis JL, Wang K, et al. Electronic cigarette use and respiratory symptoms in adolescents. Am J Respir Crit Care Med. 2017;195:1043-9.

16. Regan AK, Promoff G, Dube SR, et al. Electronic nicotine delivery systems: Adult use and awareness of the 'e-cigarette'in the USA. Tob Control. 2013;22:19-23.

17. Berg CJ, Barr DB, Stratton E, et al. Attitudes toward e-cigarettes, reasons for initiating e-cigarette use, and changes in smoking behavior after initiation: A pilot longitudinal study of regular cigarette smokers. J Prev Med. 2014;4:789.

18. Rutten LJ, Blake KD, Agunwamba AA, et al. Use of e-cigarettes among current smokers: Associations among reasons for use, quit intentions, and current tobacco use. Nicotine Tob Res. 2015;17:1228-34.

19. Adkison SE, O'Connor RJ, Bansal-Travers M, et al. Electronic nicotine delivery systems: International tobacco control four-country survey. Am J Prev Med. 2013;44:207-15.

20. Niaura RS, Glynn TJ, Abrams DB. Youth experimentation with e-cigarettes: Another interpretation of the data. JAMA. 2014;312:641-2.

21. Ayers JW, Leas EC, Allem JP, et al. Why do people use electronic nicotine delivery systems (electronic cigarettes)? A content analysis of Twitter, 2012-2015. PloS one. 2017;12:e0170702.

22. Peters Jr RJ, Meshack A, Lin MT, et al. The social norms and beliefs of teenage male electronic cigarette use. J Ethn Subst Abuse. 2013;12:300-7.

23. Vardavas C, Filippidis F, Agaku I. Determinants and prevalence of e-cigarette use throughout the European Union: A secondary analysis of 26,566 youth and adults from 27 Countries. Tob Control. 2015;24:442–8.

24. Kinnunen JM, Ollila H, El-Amin SE, et al. Awareness and determinants of electronic cigarette use among Finnish adolescents in 2013: A population-based study. Tob Control. 2015;24:e264-70.

25. Chatkin R, Chatkin JM. Smoking and changes in body weight: Can physiopathology and genetics explain this association?. J Bras Pneumol. 2007;33:712-9.

26. Chiolero A, Jacot-Sadowski I, Faeh D, et al. Association of cigarettes smoked daily with obesity in a general adult population. J Obes. 2007;15:1311-8.

27. Chiolero A, Faeh D, Paccaud F, et al. Consequences of smoking for body weight, body fat distribution, and insulin resistance. Am J Clin Nutr. 2008;87:801-9.

28. Morean ME, Wedel AV. Vaping to lose weight: Predictors of adult e-cigarette use for weight loss or control. Addict Behav. 2017;66:55-9.

29. Lanza HI, Pittman P, Batshoun J. Obesity and cigarette smoking: Extending the link to e-cigarette/vaping use. Am J Health Behav. 2017;41:338-47.

30. Goniewicz ML, Gawron M, Nadolska J, et al. Rise in electronic cigarette use among adolescents in Poland. J Adolesc Health. 2014;55:713-5.

31. Polańska K, Wojtysiak P, Bąk-Romaniszyn L, et al. Susceptibility to cigarette smoking among secondary and high school students from a socially disadvantaged rural area in Poland. Tob Induc Dis. 2016;14:14-28.

32. Goniewicz ML, Zielinska-Danch W. Electronic cigarette use among teenagers and young adults in Poland. Pediatrics. 2012;130:e879.

33. Wu LT, Woody GE, Yang C, et al. Racial/ethnic variations in substance-related disorders among adolescents in the United States. Arch Gen Psychiatry. 2011;68:1176-85.

34. Crawford AM, Pentz MA, Chou CP, et al. Parallel developmental trajectories of sensation seeking and regular substance use in adolescents. Psychol Addict Behav. 2003;17:179-92.

*Correspondence to:

Molly Jacobs

Department of Health Sciences Information and Management

College of Allied Health Science

East Carolina University

North Carolina, United States

Tel: +2527446182

E-mail: Jacobsm17@ecu.edu