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The Prevalence of e-Cigarette Use According to Educational Attainment Among Young Adults in the Population Assessment of Tobacco and Health (PATH) Study

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THE PREVALENCE OF E-CIGARETTE USE ACCORDING TO EDUCATIONAL ATTAINMENT AMONG YOUNG ADULTS IN THE POPULATION ASSESSMENT OF TOBACCO AND HEALTH (PATH) STUDY

by

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ABSTRACT

Prior studies indicate a link between poor academic performance and e-cigarette use in high school students (18 years and below). However, the effect of post high school education on e-cigarette use is poorly summarized in literature.

The objective of the current study was to determine if there was a difference in prevalence of past 30-day e-cigarette use in a national sample of young adults due to different educational levels. Four groups of young adults were studied based on their level of education: High School Dropouts, High School Graduates/GED, Current College Students, and College Graduates. Data from the Population Assessment of Tobacco and Health (PATH) study was used to assess the association between educational attainment and e-cigarette use in young adults (ages 18-24). Relative e-cigarette use was measured via a survey, along with other control variables, across the four groups. Common factors affecting use across each educational attainment group were also analyzed.

It was found that e-cigarette use tended to decrease as educational attainment increased among young adults. That is, higher levels of education seemed to be a protective factor against e-cigarette use when controlled for other factors.

This study expands past research on this topic to include young adults as they transition from adolescents to adults. Prior studies established a link between academic performance at the same educational level (high school). This study indicates a difference in e-cigarette use between different educational levels. This study also

differentiates between e-cigarette use among High School Dropouts and High School Graduates/GED.

ACKNOWLEDGMENTS

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I would also like to thank my family for encouraging me to strive for greater achievements in my education and life. Their presence has served as an anchor this past year, especially due to the uncertainty caused by the 2020 COVID pandemic.

The support I have received through these difficult times reminds me that there is an end to hard times and perseverance bears fruition.

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LIST OF ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
FDA	Food and Drug Administration
MTF	Monitoring the Future
NMUPO	Non-Medical Use of Prescription Opioids
OD	Opioid Disorders
GED	General Educational Development
PATH	Population Assessment of Tobacco and Health Study
NIH	National Institute of Health
PDM	Prescription Drug Misuse
U.S. DHHS	United States Department of Health and Human Services

INTRODUCTION

The rise of e-cigarette use has been profound among adolescents and young adults. Companies marketed e-cigarettes as safe alternatives to traditional tobacco smoking, and their easy availability led to their popularity with the youth population (Mantey, Barroso, Kelder, & Kelder, 2019). The U.S. Surgeon General's report stated that by 2014, current young adult (18-24 years) e-cigarette users had doubled since 2013, exceeding current adult (25 years and older) e-cigarette users. As of 2015, 13.6% of past 30-day e-cigarettes users were young adults, and 16.0% were high school students (U.S. Department of HHS, 2016). This trend continued between 2017 and 2018 when the CDC and FDA's National Youth Tobacco Survey found that high school student e-cigarette use in the past 30 days increased by more than 75%, while use among middle school students rose by almost 50% (U.S. & Adams, 2020).

Even though studies indicate that most college students support banning e-cigarette use on campus, vaping is still highly prevalent in colleges (Brown, Henes, & Olson, 2016). The Monitoring the Future (MTF) study sponsored by the National Institute on Drug Abuse found that between 2017 and 2018, college student use of e-cigarettes in the past 30 days increased from 6.1% to 16%. The researchers noted that this increase was so drastic that it was the most massive rise in use between two years for any substance since the MTF study began in 1975 (Schulenberg et al., 2019).

As the use of e-cigarettes rises amongst young adults, many studies have postulated educational attainment as a possible factor in determining rates of substance use. One study found that there was a consistent relationship between failing to

graduate high school (dropping out) and substance use among young adults ages 18-22 years (Townsend, Flisher, & King, 2007). Other studies have shown that substance use in general decreases as educational attainment increases. In general, high school students who were non-substance users had better academic performance than their counterparts who used substances (Bugbee, Beck, Fryer, & Arria, 2019). High school graduates have lower long-term rates of marijuana and tobacco use in adulthood than high school dropouts (Gonzalez et al., 2014). High school graduates were also less likely to be current smokers than high school dropouts (Gonzalez et al., 2014).

However, there are a few exceptions as college students have higher rates of alcohol use and prescription stimulant misuse. One study showed that full-time college students were more likely to report non-medical prescription drug use than their same-age peers who were non-college students (Ford & Pomykacz, 2016). The data did not indicate a significant difference between part-time college students and peers who were not college students (Ford & Pomykacz, 2016). In a 2015 study, past-year rates of NMUPO (non-medical use of prescription opioids) and OD (opioid disorders) secondary to NMUPO among non-college young adults were higher than NMUPO and OD use rates among college students (Martins et al., 2015). However, past-year prevalence of nonmedical prescription stimulant use is higher among college students than among non-college young adults.

However, few studies have analyzed the effect of educational attainment from high school dropouts to high school graduates/GED to current college students to college graduates, on e-cigarette use. According to prior research, higher levels of

education generally indicate lower e-cigarette use. Therefore, this analysis determines whether e-cigarette usage decreases as educational attainment level increases (college graduates would be expected to have lowest e-cigarette use amongst the 4 educational groups). If higher educational attainment is found to be a protective factor in e-cigarette usage, then people with lower educational attainment can be identified as individuals at increased risk for e-cigarette use. Resources and policies can be made to target these at-risk young adults.

METHODS

The data for the current study is from the Population Assessment of Tobacco and Health Study (PATH); an annual nationally representative longitudinal survey conducted by the National Institute on Drug Abuse with the U.S. Food and Drug Administration under a contract with Westat (U.S. DHHS and NIH, 2016). Data from a nationally representative sample (N = 45,971) was collected using a four-stage, stratified area-probability sample design (U.S. DHHS and NIH, 2016). Households from random sampling regions were selected. Individuals were recruited through address-based, area-probability sampling, using an in-person household screener to select up to two adults and two youth from each household. The PATH youth self-interview used audio computer-prompts and display screens to aid respondents. Wave 1 subject response rate was 78.4%.

The current research was interested in college students, so analysis was limited to young adult respondents (aged 18–24, N=7,865) in Wave 1 of the study. Table 1 provides the sample characteristics for all measures included in the analysis. This study was verified as a nonhuman subject study by the Institutional Review Board of UCF due to the public availability of the PATH survey data.

The dependent variable being studied in this analysis is the use of e-cigarettes in the past 30 days, coded no/yes. The main independent variable is educational attainment. Respondents were divided into four categories based on their level of education: High School Dropouts, High School Graduates/GED, Current College Students, and College Graduates.

Other variables included basic demographics such as: sex/gender (Male/Female), Hispanic (No/Yes), race (White, Black, or Other), and sexual identity (Straight or Lesbian, Gay, Bisexual, Something else). Socio-economic variables were also asked: total household income in the past 12 months: less than $10,000 -$24,999, $25,000 - $49,999, $50,000 - $99,999, and $100,000 or more). Respondents also reported the total hours worked during the past week: 35 or more hours, 15 to 34 hours, less than 15 hours, and not currently working. Respondent's social media use (Facebook, Google Plus, MySpace, Twitter) was also recorded according to frequency of access: several times a day, daily, weekly, monthly, or less, or lacks internet/social networking accounts.

Respondents were also asked about the total number of hours they were in contact with smokers during the past 7 days. Respondent's perception of other people's attitude toward smoking tobacco was measured as: very positive, positive, neutral, negative, or very negative. Subjects were asked to self-rate their physical health, mental health (includes stress, depression, and problems with emotions), and quality of life as: excellent, very good, good, fair, or poor. Alcohol and marijuana use in past 30 days was asked (No/Yes). Subjects also reported prescription drug misuse in past 30 days (includes prescription stimulants, painkillers, sedatives, or tranquilizers) and other illegal drug use (includes cocaine, methamphetamine, heroin, inhalants, hallucinogens) as no or yes.

The PATH study Wave 1 data was analyzed to assess any associations between the use of e-cigarettes and educational attainment among young adults. The first step in

the analysis is a chi-square (Table 2) that shows the bivariate association between e-cigarette use and educational attainment. The second step is multivariable logistic regression (Table 3) analysis to assess the association between educational attainment and e-cigarette use while accounting for other pertinent factors. The reference category for the education variable changes between different models to allow comparisons across all categories. Finally, a logistic regression model (Table 4) shows how the included measures correlate with e-cigarette use for all respondents and for each of the four educational attainment groups.

RESULTS

Table 1 shows the descriptive statistics for all measures used. The current study included 7,865 young adults between the ages of 18 to 24 years, with 12.63% reporting the use of e-cigarettes in the past 30-days. The distribution of respondents according to educational attainment was: High School Dropouts (10.24%), High School Graduates/GED (42.43%), Current College Students (33.53%), and College Graduates (13.80%). 49.71% of all respondents were female. Other control measures such as Race (70.49% white) and sexual identity (8.91% are non-heterosexual), income and employment status, and frequency of internet and social media use are also provided in Table 1. The responses for self-rated physical and mental health and quality of life were measured on a scale of Excellent, Very Good, Good, Fair, or Poor. Finally, respondents' attitudes towards smoking (Very Positive, Positive, Neutral, Negative, Very Negative) and past 30-day substance use (alcohol, marijuana, prescription drug misuse, and illegal drugs) were reported.

Table 1: Sample Characteristics (N= 7,865)

Measure	Coding	% or Mean
E-cigarette Use	Yes	12.63%
Educational Attainment	HS Dropout	10.24%
	HS Grad/GED, not in school	42.43%
	Current College Student	33.53%
	College Graduate	13.80%
Sex/gender	Female	49.71%
Hispanic	Hispanic	20.47%
Race	White	70.49%
	Black	14.73%
	Other	14.78%

Sexual Identity	Lesbian/Gay/Bisexual	8.91%
Income	< $10,000	28.93%
	$10,000 - $24,999	24.28%
	$25,000- $49,999	19.61%
	$50,000 - $99,999	16.01%
	$100,000	11.17%
Hours Worked Past Week	35+ hours	33.70%
	15-34 hours	24.50%
	<15 hours	9.50%
	Not currently working	32.30%
Internet Use	Several times a day	76.44%
	About once a day	11.41%
	3-5 times a week	6.11%
	1-2 days a week	2.03%
	Every few weeks	0.86%
	Less often	1.04%
	Does not have regular internet access	2.11%
Social Media Use	Several times a day	46.93%
	Daily	29.49%
	Weekly	8.81%
	Monthly or less	3.47%
	Does not use social media	11.30%
Contact with smokers	Total hours in past week	7.45 (mean)
Attitudes toward smoking	Very Positive	1.47%
	Positive	5.06%
	Neutral	28.79%
	Negative	48.65%
	Very Negative	16.03%
Self-rated Physical Health	Excellent	21.27%
	Very Good	37.44%
	Good	30.28%
	Fair	9.99%
	Poor	1.02%
Self-rated Mental Health	Excellent	24.37%
	Very Good	32.21%
	Good	26.61%
	Fair	13.15%
	Poor	3.66%
Self-rated Quality of Life	Excellent	28.29%
	Very Good	39.71%
	Good	24.95%
	Fair	6.53%
	Poor	0.52%
Past 30-day Alcohol Use	Yes	52.89%

Past 30-day Marijuana Use	Yes	18.23%
Past 30-day Prescription Drug Misuse	Yes	5.34%
Past 30-day Other Illegal Drug Use	Yes	1.80%

In the first stage of the analysis, Table 2 (chi-square test) was estimated to show the prevalence of past 30-day e-cigarette use among each of the four educational attainment groups: High School Dropouts (16.81%), High School Graduates/GED (15.03%), Current College Students (9.88%), and College Graduates (7.31%). This bivariate analysis indicates a significant impact of educational attainment on e-cigarette use. That is, the prevalence of e-cigarette use declines as educational attainment increases. It shows that High School Dropouts are twice as likely to use e-cigarettes than college graduates. However, it only accounts for educational attainment and control measure must be applied.

Table 2: Prevalence of Past 30-day E-Cigarette Use by Educational Group Among Young Adults

	No Past 30-day E-Cig Use	**Yes Past 30-day E-Cig Use**
	% (95% CI)	% (95% CI)
High School Dropout	83.19% (80.53, 85.56)	16.81% (14.44, 19.47)
High School Graduate or GED	84.97% (83.78, 86.09)	15.03% (13.91, 16.22)
Currently in College	90.12% (88.70, 91.37)	9.88% (8.63, 11.30)
College Graduate	92.69% (90.65, 94.32)	7.31% (5.68, 9.35)

In the second step, multivariant logistic regression analysis (Table 3) is used to assess the association between educational attainment and e-cigarette use while accounting for other measures such as sex/gender, Hispanic, race, sexual identity, income, hours worked, internet use, social media use, contact with smokers, attitudes toward smoking, physical health, mental health, quality of life, alcohol use., marijuana use, prescription drug misuse, and other illegal drug use. The reference category for the education variable changes between different models to allow comparisons across all categories. In Table 3, it shows that college students and college graduates are less likely to use e-cigarettes than high school dropouts and high school graduates (not in college). College graduates (aOR = 0.64, 95% CI = 0.46, 0.89) are also less likely to report past 30-day e-cigarette use compared to individuals still in college. These findings demonstrate a “protective effect” of increased education against e-cigarette use. It was also found that there was no significant difference between past 30-day e-cigarette use of high school dropouts and high school graduates.

Table 3: Logistic Regression

	Adjusted Odds Ratio	95% CI
High School Dropout	1.00 (reference)	--
High School Grad/GED	0.86	(0.67, 1.09)
Current College Student	0.61***	(0.47, 0.79)
College Graduate	0.40***	(0.27, 0.57)
High School Dropout	0.43	(0.91, 1.48)
High School Grad/GED	1.00 (reference)	--
Current College Student	0.62***	(0.60, 0.85)
College Graduate	0.74***	(0.33, 0.63)
High School Dropout	1.63***	(1.25, 2.11)
High School Grad/GED	1.40***	(1.17, 1.66)
Current College Student	1.00 (reference)	--
College Graduate	0.64**	(0.46, 0.89)
High School Dropout	2.52***	(1.72, 3.68)
High School Grad/GED	2.16***	(1.57, 2.97)
Current College Student	1.55**	(1.12, 2.14)
College Graduate	1.00 (reference)	--

- * $p < .05$. ** $p < .01$, $p < .001$
- All models include the following measures: sex/gender, Hispanic, race, sexual identity, income, hours worked, internet use, social media use, contact with smokers, attitudes toward smoking, physical health, mental health, quality of life, alcohol use., marijuana use, prescription drug misuse, and other illegal drug use.

Finally, a logistic regression model (Table 4) shows how the included measures correlate with e-cigarette use for each of the four educational attainment groups. Certain measures proved to be significant across the educational attainment groups. Female respondents across 3 educational groups (High School Dropouts, High School Graduates/GED, and Current College Students) reported lower past 30-day e-cigarette use when compared to males of the same group. Contact with a smoker was significant across all groups and respondents with higher contact with smokers were more likely to

report e-cigarette use compared to respondents of each educational group who reported less contact. Alcohol was significant across all three groups (except college graduates) and marijuana use was significant across all educational groups for higher e-cigarette use. In fact, college graduates who used marijuana were four times more likely to report e-cigarette use than college graduates who did not use marijuana. Hours worked proved significant in the higher educational groups (currently in college and college graduates). Current college students and graduates who worked less hours were less likely to report e-cigarette use. Among college students, prescription drug misuse (PDM) and other drug use was significant. College students who engaged in PDM and other drug use were more likely to report e-cigarette use than college students who did not engage in PDM or other drug use.

Table 4: Factors Associated with E-Cigarette Use Among Young Adults by Educational Attainment

	Dropout	HS Grad/GED	In College	College Grad
	N = 942	N = 3,615	N = 2,450	N = 858
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Female	0.53**	0.55***	0.53***	0.87
	(0.36, 0.77)	(0.45, 0.67)	(0.39, 0.70)	(0.51, 1.45)
Hispanic	0.74	0.79	0.76	1.75
	(0.48, 1.14)	(0.62, 1.00)	(0.51, 1.11)	(0.82, 3.71)
White	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Black	0.64	0.44***	0.66	0.53
	(0.36, 1.11)	(0.33, 0.58)	(0.41, 1.05)	(0.15, 1.85)
Other	1.00	1.08	1.06	1.65
	(0.56, 1.76)	(0.79, 1.46)	(0.71, 1.56)	(0.81, 3.35)
Sexual Identity	0.85	1.55**	1.44	2.28
	(0.48, 1.50)	(1.18, 2.03)	(0.95, 2.17)	(0.95, 5.45)
Income	0.97	0.92	0.93	0.95
	(0.83, 1.12)	(0.84, 1.01)	(0.84, 1.02)	(0.79, 1.14)
Hours Worked	0.91	0.98	0.79**	0.78*
	(0.78, 1.04)	(0.91, 1.06)	(0.69, 0.90)	(0.61, 0.99)
Internet	0.94	1.09**	1.21*	0.55
	(0.84, 1.04)	(1.02, 1.17)	(1.00, 1.46)	(0.27, 1.11)
Social Media	0.94	0.89**	0.85*	1.22
	(0.81, 1.08)	(0.82, 0.95)	(0.72, 0.99)	(0.97, 1.51)
Smoker Contact	1.01**	1.01***	1.01*	1.04**
	(1.00, 1.02)	(1.00, 1.01)	(1.00, 1.02)	(1.01, 1.06)
Attitude	1.25	1.01	1.09	1.42*
Smoking	(0.98, 1.59)	(0.90, 1.11)	(0.91, 1.31)	(1.00, 2.00)
Physical Health	1.07	1.07	1.01	1.14
	(0.85, 1.33)	(0.95, 1.21)	(0.85, 1.21)	(0.77, 1.68)
Mental Health	1.09	1.14*	0.98	0.81
	(0.91, 1.29)	(1.02, 1.26)	(0.83, 1.16)	(0.57, 1.15)
Quality of Life	1.07	1.03	1.07	1.30
	(0.83, 1.38)	(0.90, 1.18)	(0.85, 1.35)	(0.82, 2.06)
Alcohol Use	1.86**	1.81***	1.74**	2.25
	(1.27, 2.73)	(1.43, 2.28)	(1.23, 2.47)	(0.88, 5.68)
Marijuana Use	2.52***	2.14***	3.11***	4.00***
	(1.68, 3.76)	(1.72, 2.64)	(2.17, 4.44)	(2.33, 6.86)
PDM	0.98	1.39	1.89**	1.05
	(0.46, 2.06)	(0.95, 2.02)	(1.22, 2.90)	(0.37, 2.95)
Other Drug Use	1.95	1.09	2.75**	2.29
	(0.75, 5.03)	(0.64, 1.84)	(1.30, 5.82)	(0.71, 7.37)

- * $p < .05$. ** $p < .01$, $p < .001$

DISCUSSION

This study provided evidence that educational attainment is significantly associated with e-cigarette use among young adults. Overall, higher educational attainment corresponded with lower e-cigarette use. These findings are consistent with prior research that shows college educated individuals tend to mature out of substance use and have greater access to resources to overcome drug use than non-college educated individuals (Martins et al., 2015).

Other literature suggests education acts as a protective factor against a “default unhealthy American lifestyle” (Mirowsky & Ross, 2015). Education allows people to over-ride this default lifestyle and higher education corresponded with better measures of health in general. Individuals with higher educational attainment reported healthier biological and mental functioning and experiences lower levels of morbidity, depression, and disability (Mirowsky & Ross, 2015). Higher education provides financial stability and social capital by improving access to better employment, which gives people a greater sense of personal control over their lives (Mirowsky & Ross, 2015). Individuals with lower educational attainment experience greater stress associated with unemployment leaving them vulnerable to health risks such as e-cigarette use. It was shown that education leads to acquisition of knowledge and critical thinking skills to better evaluate health-related risks (Mirowsky & Ross, 2015). Therefore, education seems to have a strong correlation to healthier decisions and outcomes.

One limitation of this study is the inability to account for the ages of the students. Generally, it can be assumed that college graduates are older than current college

students, but the respondents in high school dropouts and high school graduates can be any age between 18-24. The PATH data is cross-sectional, so it is difficult to interpret any causal association between educational attainment and e-cigarette use (U.S. DHHS and NIH, 2016). The accuracy of the data is must also be considered as the questionnaire was self-reported and may reflect inaccuracies according to subjective recall of each respondent.

The PATH questionnaire also did not differentiate between enrollment in a 2-year and 4-year college (U.S. DHHS and NIH, 2016). There may be differences between e-cigarette use due to varying risk behavior prevalence between 2- and 4-year college students. Further study to differentiate these 2 college enrollment groups is recommended. Another issue is that the measure of e-cigarette use is past 30-day use, which limited analysis on young adults who have used e-cigarettes before the past 30 days or on youth who have ever tried e-cigarettes (U.S. DHHS and NIH, 2016).

Students who vape are more likely to use other substances, such as other tobacco products, cigarettes, alcohol, and even cocaine and methamphetamines (U.S. Department of HHS, 2016). Therefore, increased susceptibility to using other substances can negatively influence academic achievement. In a 2019 study, researchers studied the correlations between polysubstance use and environmental and internal factors in youth data set (15-17 years) obtained from Wave 1 of the PATH study. It found a direct correlation between substance use and higher risk-seeking and lower academic grades. (Silveira, Green, Iannaccone, Kimmel, & Conway, 2019).

Due to the relative recency of e-cigarettes, long-term effects on users are uncertain, especially among adolescents. Most of the studies conducted on adolescent use of e-cigarettes focus on under age 18. However, the studies do not follow through on the effects of adolescent e-cigarette use on the users when they enter college (18 and above). The effects of early onset vaping during adolescence on academic performance during college are worth studying. E-cigarette smoking was found to be linked to increased depression and lower GPAs (worse academic performances) (Mojtabai & Crum, 2013). However, the study was unsure whether the e-cigarette use caused the lower academic grades, or if the students with lower GPAs were more likely to use e-cigarettes.

APPENDIX: IRB LETTER

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

NOT HUMAN RESEARCH DETERMINATION

March 23, 2021

Dear Jason Ford:

On 3/23/2021, the IRB reviewed the following protocol:

Type of Review:	Initial Study
Title of Study:	Population Assessment of Tobacco Health Study (secondary analysis)
Investigator:	Jason Ford
IRB ID:	STUDY00002901
Funding:	None
Grant ID:	None
Documents Reviewed:	• IRB Ford 2341 HRP-250-FORM-Request for NHSR.docx, Category: IRB Protocol. • PATH_codebook.pdf, Category: Survey / Questionnaire

The IRB determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are research involving human in which the organization is engaged, please submit a new request to the IRB for a determination. You can create a modification by clicking **Create Modification / CR** within the study.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Katie Kilgore
Designated Reviewer

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