Dual Use of Electronic Cigarettes and Traditional Cigarettes Among Adults: Psychosocial Correlates and Associated Respiratory Symptoms

Rachel E Culbreth, Claire A Spears, Kyle Brandenberger, Rafaela Feresin, Shannon Self-Brown, Lynda T Goodfellow, Monica H Swahn, and Douglas S Gardenhire

BACKGROUND: Prolonged use of both electronic cigarettes (e-cigarettes) and traditional cigarettes can increase breathing difficulties and other adverse health effects. Research is needed to provide a deeper understanding of predictors of dual use, particularly given rapid changes in the e-cigarette market and related public health communications and policy. METHODS: The sample consists of subjects in the National Longitudinal Study of Adolescent to Adult Health Wave 5 (cross-sectional) subsample (N = 3,800) from 2016 to 2018. Participants were 31–42 y old. Multinomial logistic regression analyses were used to determine predictors of mutually exclusive categories: e-cigarette use only, cigarette use only, and concurrent e-cigarette and traditional cigarette use (compared to no use). Predictors included sex, age, poverty status, race/ethnicity, self-reported diagnosed depression, self-reported diagnosed anxiety, and previous experience of child maltreatment. RESULTS: Among the total sample (N = 3,800), 2% reported e-cigarette use only, 20% reported traditional cigarette use only, and 3% reported dual use of both e-cigarettes and traditional cigarettes. Among subjects who reported any e-cigarette or traditional cigarette use (n = 957), 12% reported dual use. In the final adjusted multivariable multinomial model, dual use was associated with living at or below the poverty line (odds ratio 2.49 [95% CI 1.19–5.70]), self-reported diagnosed depression (odds ratio 1.99 [95% CI 1.10–3.61]), and a history of child maltreatment (odds ratio 1.80 [95% CI 1.10–2.95]). Additionally, Hispanic-American individuals were more likely to report dual use compared to cigarette-only use. CONCLUSIONS: Prolonged dual use of both e-cigarettes and traditional cigarettes is a considerable public health problem. While our study identified a low percentage of dual usage among U.S. adults, dual use was disproportionately prevalent among those with depression, history of child maltreatment, living at or below the poverty line, and among Hispanic-American individuals. Culturally appropriate interventions and increasing access to cessation programs may help mitigate health disparities pertaining to dual use. *Key words: electronic cigarettes; health disparities; respiratory symptoms; tobacco; poverty.* [Respir Care 0;0(0):1–●. © 0 Daedalus Enterprises]

Introduction

Tobacco use is the leading cause of preventable death and disease in the United States.[1] Much less is known about the health effects of electronic cigarettes (e-cigarettes) and, more specifically, the dual usage of e-cigarettes and combustible cigarettes. While the prevalence of dual usage in the United States is relatively low (estimated between 1.3% and 2%),[2,3] dual usage is rising among U.S. adults and adolescents with the surge in popularity of e-cigarettes. Additionally, among combustible tobacco users, dual usage is common. In the Population Assessment of Tobacco and Health (PATH) study, nearly 40% of adults who used

tobacco reported using multiple forms of tobacco, including dual use of traditional cigarettes and e-cigarettes.[4] Moreover, long-term dual usage is particularly concerning.[2,5,6] In fact, compared to cigarette smoking alone, dual use of combustible cigarettes with e-cigarettes has been associated with greater breathing difficulties.[2] The potential harms of dual use compared to only cigarette use include increased nicotine dependence,[7] higher risk for other substance use disorders,[8] and increased risk of asthma, COPD, and DNA damage.[9,10] Wang and colleagues reported that dual users had higher breathing difficulty scores and a higher prevalence of self-reported chest pain, coronary artery disease, and chest palpitations.[2] This is concerning for both respiratory and cardiac

conditions. The results of pulmonary toxicity studies from e-cigarettes alone indicate an increased risk for respiratory diseases for those who already smoke traditional cigarettes.[11] Research has shown that dual users have a 36% higher odds of cardiovascular disease compared to traditional cigarette-only users.[12]

Certain priority populations carry a disproportionate burden from combustible tobacco. For example, low-income adults and people with mental health conditions are significantly more likely to smoke, are less likely to quit, and experience higher tobacco-related morbidity and mortality.[13,14] It will be critical to understand whether sociodemographic factors are related to prolonged dual use versus switching to exclusive e-cigarette use. These patterns will have important implications for whether existing tobacco-related health disparities might narrow or widen on the basis of the availability of e-cigarettes. Few studies have examined correlates of dual usage. Kasza and colleagues observed that participants using multiple forms of tobacco use were more likely to be younger, male, have less education, and also more likely to report binge drinking.[4] Additionally, Osman and colleagues reported that White and Hispanic adults were more likely to report dual use compared to Black/African-American adults.[15]

Traditionally, combustible cigarette use is disproportionately prevalent among people experiencing psychological distress and those with psychiatric comorbidities, including depression and anxiety.[16,17] Smoking has been conceptualized as an attempt to relieve depression and anxiety symptoms (eg, the self-medication hypothesis),[16,18] although research suggests that smoking cessation can improve mental health in the long term.[17,19] Lechner and colleagues reported bidirectional associations between anxiety and depression with cigarette smoking.[20] Moreover, smoking cessation may exacerbate mental health symptoms due to nicotine withdrawal, including increased anxiety.[21] Research has also shown that nicotine

Drs Culbreth, Brandenberger, Goodfellow, and Gardenhire are affiliated with the Department of Respiratory Therapy, Byrdine F. Lewis College of Nursing and Health Professions, Georgia State University, Atlanta, Georgia. Drs Spears and Self-Brown are affiliated with the Department of Health Policy and Behavioral Sciences, School of Public Health, Georgia State University, Atlanta, Georgia. Dr Feresin is affiliated with the Department of Nutrition, Byrdine F. Lewis College of Nursing and Health Professions, Georgia State University, Atlanta, Georgia. Dr Swahn is affiliated with the Department of Population Health Sciences, School of Public Health, Georgia State University, Atlanta, Georgia.

Correspondence: Rachel E Culbreth PhD MPH RRT, Department of Respiratory Therapy, Byrdine F. Lewis College of Nursing and Health Professions, Georgia State University, PO Box 4019, Atlanta, GA, 30302-4019. E-mail: rculbreth@gsu.edu.

QUICK LOOK

Current knowledge

Tobacco use is the leading cause of preventable death in the United States The prevalence of electronic cigarettes (e-cigarettes) is increasing drastically, and examining respiratory symptoms and psychosocial correlates of dual usage of traditional cigarettes and e-cigarettes is warranted.

What this paper contributes to our knowledge

Our results indicate that living at or below the poverty line, self-reported diagnosed depression, and reporting a history of child maltreatment were all associated with dual usage among adults 31–42 y old. Additionally, Hispanic-American individuals were more likely to engage in dual usage compared to traditional cigarette use. Dual usage was also highly prevalent among those with cancer and cancer survivors.

withdrawal may be heightened among those with mental illness.[21] In fact, symptoms of nicotine withdrawal can include depression and irritability.[22] However, examining anxiety and depression in the context of dual use is understudied. Some recent studies indicate that cigarette smokers with versus without mental health conditions are more likely to use e-cigarettes.[23,24] Prevalence of e-cigarette use among people with depressive or anxiety disorders has been documented as at least double that of people without mental health conditions.[23,25] Moreover, people with mental health conditions might use e-cigarettes specifically in an attempt to reduce stress.[26]

Other psychosocial factors that have been linked to cigarette smoking and e-cigarette use are experiencing child maltreatment and adverse childhood experiences.[27-29] For people who have experienced trauma, smoking might reflect an attempt to escape or avoid trauma-associated distress. In fact, research has found that, among cigarette smokers, those with posttraumatic stress disorder expressed greater expectations that smoking would alleviate negative affect.[30]

While research has been conducted on dual use among adolescents,[7,31,32] less is known about the predictors and correlates of dual use among adults. With this study we sought to expand on previous literature by using a health disparities lens to understand patterns of dual use among adults. Furthermore, health-related correlates of dual use are understudied. As such, the research questions that inform this study are: What is the prevalence of dual e-cigarette and traditional cigarette use among a nationally representative sample of adults? What sociodemographic factors are associated with dual use among adults? What are the respiratory symptoms and health conditions that are

correlated with dual use among adults? Our hypotheses were that among adults, anxiety, depression, and history of child maltreatment would be associated with dual use, and respiratory symptoms and health conditions would be reported more frequently among dual users compared to single users and non-users.

Methods

Study Sample

Data were drawn from the National Longitudinal Study of Adolescent to Adult Health (Add Health) Wave 5. The initial sampling frame from Wave 1 consisted of 80 high schools from which students were randomly selected. The purpose of the original study was to determine adolescent health behaviors, risk behaviors, and health and behavioral outcomes over the life course. Wave 5, which is the current focus of this study, was conducted from 2016 to 2018 and consists of individuals 31–42 years of age.[33]

Measures

Demographics include age, sex, poverty status, and race/ethnicity. Age was included as a continuous variable, sex included males and females, and race/ethnicity included the categories "White," "Hispanic," "Black/African-American," and "Other." The "Other" race/ethnicity category included "Asian," "Pacific Islander," "American Indian or Alaska Native," and "Some other race or origin." Poverty status was calculated using the 2016–2018 federal poverty thresholds based on self-reported income and the number of individuals per household.

Individuals were classified as current smokers if they answered, "Yes" to "Have you ever smoked cigarettes regularly—that is, at least one cigarette every day for 30 days?" Additionally, e-cigarette use was measured with the question, "During the past 30 days, on how many days did you use an e-cigarette?" Individuals were classified as current e-cigarette users if they answered any response equal to 2 days or more. Four mutually exclusive categories were then composed: non-users, e-cigarette users only, cigarette users only, and dual users. Self-report of diagnosed depression was measured using, "Has a doctor, nurse, or other health care provider ever told you that you have or had depression?" Additionally, anxiety was measured using, "Has a doctor, nurse, or other health care provider ever told you that you have or had anxiety or panic disorder?" Child maltreatment was not assessed in Wave 5, so the child maltreatment variable was ascertained using the Wave 4 questions: "Before your 18th birthday, how often did a parent or adult caregiver hit you with a fist, kick you, or throw you down on the floor, into a wall, or down stairs?" and "How often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a

sexual way, or force you to have sexual relations?" If individuals answered "Yes" to the first question or "More than one time" to the second question, they were classified as reporting child maltreatment. Self-reports of other diagnosed conditions were ascertained in a health summary questionnaire, which asked subjects whether they were ever diagnosed with cancer, high blood cholesterol, high blood pressure, high blood sugar or diabetes, heart attack or past heart surgery, asthma, chronic bronchitis, emphysema, or sleep apnea. Respiratory symptomatology was measured using the question, "On most days, do you 1) Cough? 2) Bring up phlegm from your chest? and 3) Sound wheezy?" Responses were categorized as "Yes" or "No."

Statistical Analysis

The analytic sample consisted of subjects in the Wave 5 subsample ($N = 3,800$) conducted from 2016 to 2018. Subjects were 31–42 y old at the time of data collection. Wave 5 was selected primarily due to e-cigarette use only being assessed in Wave 5 of this study. Descriptive statistics were conducted among mutually exclusive categories (ie, e-cigarette use only, traditional cigarette use only, and dual use, each compared to no use). Predictors, demographics, health conditions, and respiratory symptomatology were computed among the 4 categories descriptively. Descriptive statistics are presented using the raw total number and the weighted percentages for this dataset. Chi-square tests were also conducted to determine whether differences existed between the 4 categories of use with respiratory indicators and health conditions. Finally, multinomial logistic regression analysis was conducted to determine predictors of dual use. On the basis of previous research, predictors included sex, age, poverty status, race/ethnicity, self-reported diagnosed depression, self-reported diagnosed anxiety, and previous experience of child maltreatment.

Results

Among the total sample of subjects in Add Health Wave V subsample ($N = 3,800$), the mean $\pm$ SD age of participants was 37.2 ± 1.7 y. Nearly 9.5% of subjects were classified as living in poverty. The majority of subjects were White (65.7%), followed by Black/African American (15.9%) and Hispanic-American/non-White (12.2%). Among all subjects, 40.1% reported previous cigarette use in Wave 4. Additionally, 26.0% of subjects reported diagnosed depression, 21.9% reported diagnosed anxiety, and 29.9% reported experiencing child maltreatment.

Regarding cigarette use, 74.8% of subjects reported no cigarette or e-cigarette use, 2.2% reported e-cigarette use only, 20.0% reported traditional cigarette use only, and 3.1% reported dual use (Table 1). Among subjects who reported any e-cigarette or traditional cigarette use ($n =$

Table 1. Demographics and Psychosocial Characteristics

	No Use	E-Cigarette Use Only	Cigarette Use Only	Dual Use	Whole Sample	Chi-Square Test or ANOVA	P
Subjects	2,843 (74.8)	77 (2.2)	761 (20.0)	119 (3.1)	3,800	NA	
Age, mean ± SD	37.1 ± 1.7	37.5 ± 1.7	37.3 ± 1.7	37.3 ± 1.7	37.2 ± 1.7	0.45	.72
Sex						33.15	< .001
Male	1,114 (66.0)	48 (3.1)	342 (25.8)	65 (5.1)	1,569 (49.5)		
Female	1,729 (73.0)	29 (1.7)	419 (22.4)	54 (2.9)	2,231 (50.5)		
Poverty status						15.11	< .002
No	2,344 (73.1)	57 (2.3)	522 (20.9)	83 (3.7)	3,006 (90.5)		
Yes	139 (43.4)	9 (4.5)	108 (48.8)	8 (3.3)	264 (9.5)		
Race						43.46	< .001
White	1,563 (64.1)	55 (3.0)	462 (24.7)	70 (4.5)	2,150 (65.7)		
Hispanic	447 (77.3)	3 (0.6)	68 (18.3)	16 (3.9)	534 (12.2)		
Black/African- American	460 (67.7)	6 (0.8)	140 (29.3)	16 (2.2)	622 (15.9)		
Other	254 (77.2)	7 (4.4)	50 (15.0)	13 (3.4)	324 (6.2)		
Previous cigarette use in Wave 4						1,335.2	< .001
No	2,112 (93.2)	19 (1.1)	102 (5.2)	12 (0.5)	2,245 (59.9)		
Yes	382 (34.1)	44 (4.0)	552 (52.0)	94 (10.0)	1,072 (40.1)		
Diagnosed depression						70.73	< .001
No	2,142 (73.7)	42 (1.8)	476 (21.5)	72 (3.0)	2,732 (74.0)		
Yes	565 (57.6)	29 (4.2)	240 (31.2)	42 (6.9)	876 (26.0)		
Diagnosed anxiety						46.14	< .001
No	2,213 (72.4)	47 (1.9)	513 (21.9)	82 (3.8)	2,855 (78.1)		
Yes	497 (59.2)	24 (4.2)	205 (32.0)	31 (4.7)	757 (21.9)		
Experienced child maltreatment						22.69	< .001
No	1,595 (73.5)	29 (1.6)	362 (21.3)	55 (3.6)	2,041 (70.1)		
Yes	626 (64.5)	25 (4.0)	204 (26.5)	34 (4.9)	889 (29.9)		

Data are presented as *n* (%) unless otherwise noted. Absolute frequencies (*n*) are actual survey respondent frequencies, and relative frequencies (%) are weighted percentages. Total cell rows may not add up to 3,800 due to missing values.
NA = not applicable

957), 12% reported dual e-cigarette and traditional cigarette use. A larger percentage of males reported any cigarette or e-cigarette use compared to females (34% vs 27%). The mean ages were similar across usage groups. Additionally, a higher percentage of individuals living at or below the poverty level also reported any cigarette or e-cigarette usage compared to individuals living above the poverty level. While there were no statistically significant differences in the prevalence of dual use by poverty status, a much higher percentage of individuals living below the poverty level reported e-cigarette use only (4.5% vs 2.3%) or traditional cigarette use only (48.8% vs 20.9%) compared to individuals living above the poverty level. Those who used cigarettes in the previous Wave 4 had a higher prevalence of e-cigarette or traditional cigarette use in Wave 5. Among these individuals, nearly half reported using cigarettes only (52.0%), 4.0% reported e-cigarettes only, and 10% reported dual use. Among those who did not report smoking

cigarettes in Wave 4, 5.2% started smoking cigarettes only in Wave 5, 1.1% started using e-cigarettes only, and 0.5% initiated dual usage by Wave 5. There were statistically significant differences with regard to cigarette and e-cigarette groups and all demographic and psychosocial predictors (eg, depression, anxiety, and reported child maltreatment).

Higher prevalence of using either cigarettes, e-cigarettes, or both were also reported among those with depression (42.4%), anxiety (40.8%), and history of child maltreatment (35.5%). Dual use was more than twice as high among those with versus those without depression (6.9% vs 3.0%, respectively). Dual use was also higher among those with versus those without anxiety (4.7% vs 3.8%, respectively) and among those who experienced child maltreatment compared to those without history of child maltreatment (4.9% vs 3.6%, respectively).

Health-related conditions are presented by smoking and e-cigarette use status in Table 2. Statistically significant

Table 2. Health-Related Conditions Among Smoking and E-Cigarette Behaviors of Subjects in the National Longitudinal Study of Adolescent to Adult Health, Wave 5

Previously Diagnosed Conditions	No Use	E-Cigarette Use Only	Cigarette Use Only	Dual Use	P
Subjects	2,843 (74.8)	77 (2.2)	761 (20.0)	119 (3.1)	
Cancer					
No	2,662 (69.6)	69 (2.4)	701 (24.1)	106 (3.8)	.008*
Yes	50 (64.9)	2 (3.0)	13 (19.5)	8 (12.7)	
High blood cholesterol					
No	2,248 (69.2)	59 (2.5)	597 (24.8)	85 (3.4)	.24
Yes	459 (71.3)	12 (2.3)	117 (20.1)	27 (6.3)	
High blood pressure					
No	2,271 (69.9)	58 (2.6)	567 (23.5)	91 (4.1)	.058
Yes	441 (69.0)	13 (2.0)	144 (25.1)	24 (3.9)	
High blood sugar or diabetes					
No	2,583 (69.4)	69 (2.5)	671 (24.4)	106 (3.7)	.18*
Yes	131 (71.7)	2 (1.1)	45 (17.0)	9 (10.1)	
Heart attack or past heart surgery					
No	2,700 (69.7)	71 (2.5)	707 (23.8)	112 (4.0)	.50*
Yes	14 (66.9)	0	6 (31.5)	1 (1.6)	
Asthma, chronic bronchitis, emphysema					
No	2,285 (69.5)	62 (2.5)	592 (23.8)	96 (4.2)	.64
Yes	426 (69.3)	9 (1.9)	124 (25.5)	18 (3.3)	
Sleep apnea					
No	2,541 (70.1)	66 (2.5)	665 (23.8)	101 (3.6)	.29
Yes	173 (65.0)	5 (1.6)	53 (26.9)	12 (7.5)	
Respiratory symptomatology†					
Coughing most days					
No	2,443 (87.6)	57 (81.9)	472 (62.5)	62 (52.9)	< .001
Yes	263 (12.4)	14 (18.1)	240 (37.5)	47 (47.1)	
Phlegm most days					
No	2,562 (94.2)	58 (86.7)	562 (74.4)	80 (74.6)	< .001
Yes	136 (5.8)	12 (13.3)	153 (25.6)	33 (25.4)	
Wheezing					
No	2,610 (96.1)	64 (95.1)	617 (85.1)	90 (82.5)	< .001
Yes	77 (3.9)	6 (4.9)	94 (14.9)	19 (17.5)	

Data are presented as *n* (%). Absolute frequencies (*n*) are actual survey respondent frequencies, and relative frequencies (%) are weighted percentages.
* Fisher exact test used for expected frequency counts < 5.
† Column percentages presented.

differences were found between smoking behavior patterns and cancer (*P* = .008). Overall, among those who reported cancer (2.6%), the prevalence of e-cigarette use was 3.0%, the prevalence of cigarette use only was 19.5%, and the prevalence of both e-cigarette and cigarette use was 12.7%. There were no statistically significant differences in prevalence of high blood cholesterol, high blood pressure, diabetes, heart attacks/past heart surgery, respiratory conditions (eg, asthma, chronic bronchitis, and emphysema), or sleep apnea by cigarette or e-cigarette use status.

There were statistically significant differences in respiratory symptoms by smoking and e-cigarette use status. Those who reported dual use had the highest percentages of coughing and wheezing on most days, compared to those who reported cigarette use only, e-cigarette use only, and no usage. However, phlegm production percentages were similar for those who reported cigarette use only and those who reported dual use (25.6% vs 25.4%, respectively).

Table 3 presents results from the multivariable multinomial logistic regression analysis with the referent category of no cigarette or e-cigarette use. Females were less likely to use any cigarette or e-cigarette product compared to males, and living below the poverty level was associated with higher prevalence of e-cigarette use only, cigarette use only, and dual use. Self-reported diagnosed depression was associated with all types of cigarette and e-cigarette usage. Additionally, experiencing child maltreatment was associated with all smoking behavior patterns: e-cigarette use only (odds ratio [OR] 2.26, 95% CI 1.25–4.09), cigarette

Table 3.   Predictors of Cigarette and E-Cigarette Use Among Subjects in the National Longitudinal Study of Adolescent to Adult Health, Wave 5

	E-Cigarette Use Only	Cigarette Use Only	Dual Use
Sex			
Male	1.00	1.00	1.00
Female	.35 (0.19–0.65)	0.61 (0.02–2.28)	0.40 (0.24–0.66)
Age	0.95 (0.81–1.14)	0.99 (0.94–1.06)	1.03 (0.88–1.19)
Poverty status			
No	1.00	1.00	1.00
Yes	2.77 (1.29–7.97)	3.57 (2.56–4.91)	2.49 (1.19–5.70)
Race			
White	1.00	1.00	1.00
Hispanic	0.21 (0.05–0.88)	0.33 (0.25–0.54)	1.29 (0.43–1.69)
Black/African-American	0.33 (0.10–1.09)	0.98 (0.74–1.29)	0.63 (0.25–1.28)
Other	1.29 (0.55–3.01)	0.57 (0.42–0.96)	0.82 (0.34–1.97)
Diagnosed depression			
No	1.00	1.00	1.00
Yes	2.36 (1.16–4.79)	1.70 (1.31–2.20)	1.99 (1.10–3.61)
Diagnosed anxiety			
No	1.00	1.00	1.00
Yes	1.52 (0.73–3.21)	1.31 (0.99–1.72)	1.13 (0.59–2.15)
Experienced child maltreatment			
No	1.00	1.00	1.00
Yes	2.26 (1.25–4.09)	1.43 (1.15–1.78)	1.80 (1.10–2.95)

Data are presented as odds ratios (95% CI). $N = 3,703$. Approximately 97 individuals were listwise deleted due to missing responses on predictor variables (2.6% of total data). Reference is "No cigarette or e-cigarette use."

use only (OR 1.43, 95% CI 1.15–1.78), and dual use (OR 1.80, 95% CI 1.10–2.95).

Multivariable multinomial logistic results for alternative referent categories are presented in the supplementary materials (available at http://www.rcjournal.com). For the referent category (ie, e-cigarette use only), compared to White/non-Hispanic individuals, Hispanic-American individuals were more likely to report no usage (OR 4.78, 95% CI 1.1–, 20.17) compared to e-cigarette use only. Similarly, compared to cigarette use only, Hispanic-American individuals were more likely to report no use (OR 2.75, 95% CI 1.87–4.06). Additionally, those with self-reported diagnosed depression (OR 0.59, 95% CI 0.45–0.76) and history of experiencing child maltreatment (OR 0.70, 95% CI 0.56–0.87) were more likely to report cigarette smoking compared to no cigarette use. Lastly, compared to dual use, those with self-reported diagnosed depression (OR 0.50, 95% CI 0.28–0.91) and those living below the poverty level (OR 0.38, 95% CI 0.18–0.84) were more likely to report dual use than no cigarette use. Compared to White/non-Hispanic individuals, Hispanic-American individuals were more likely to report dual use compared to cigarette-only use.

Discussion

Based on 2016–2018 data from the National Longitudinal Study of Adolescent to Adult Health (Add Health), we found that the prevalence of dual use was 3.1% among a nationally representative sample of adults. We also determined the sociodemographic correlates of dual usage, such that dual usage was associated with being male, living at or below the poverty level, self-reported depression, and experiencing child maltreatment. Additionally, Hispanic-American individuals were more likely to report dual use than cigarettes only compared to White/non-Hispanic individuals. Previous research indicates that males were more likely than females to use cigarettes or e-cigarettes.[34] Additionally, any cigarette or e-cigarette usage was higher among those reporting diagnosed depression and child maltreatment in previous research.[16,27,28,35] Specifically, our study identified an association between depression and child maltreatment with dual use, which expands on previous studies examining singular use of cigarettes and e-cigarettes.[16,27,28,35]

Individuals living at or below the poverty line were more likely to report dual use compared to individuals living above the poverty line. Long-term dual use presents multiple health issues pertaining to respiratory and cardiovascular health, nicotine dependence, and DNA damage.[7-11] This is particularly concerning because the tobacco industry has a history of targeting individuals living at or below the poverty line and communities with low socioeconomic status.[36] Also, those living at or below the poverty line may face additional barriers to cessation, including reduced access to smoking cessation programs and lower self-efficacy for quitting.[37] Those

who live at or below the poverty line may benefit from targeted approaches that address the emotional, financial, and social stressors of poverty.[38] Additionally, tobacco control strategies such as increased tobacco prices, mass media campaigns, and increased access to cessation programs for both cigarettes and e-cigarettes are needed for individuals living at or below the poverty line.[38]

Our results indicate that Hispanic-American individuals, compared to White/non-Hispanic individuals, were more likely to report dual use compared to traditional cigarette use. However, it should be noted that this association was not detected between other smoking behaviors. For example, Hispanic-American individuals were less likely to use e-cigarettes or traditional cigarettes compared to White individuals overall; however, Hispanic-American individuals were significantly more likely to engage in dual use compared to traditional cigarette use only. Tobacco companies have previously targeted Hispanic communities, including sponsoring Hispanic/Latino music festivals, advertising in specific Hispanic/Latino communities, and developing relationships with Hispanic/Latino leadership organizations.[36] Additionally, Harlow and colleagues[39] reported that Hispanic individuals were more likely to use multiple tobacco products compared to White/non-Hispanic individuals in the Population Assessment of Tobacco and Health (PATH) study. Previous research has noted a strong, positive association between depressive symptoms and cigarette smoking among Hispanic/Latino individuals.[40] Lo and colleagues[41] reported that race/ethnicity moderated the association between cigarette use and health care access, which was more beneficial to White/non-Hispanic individuals compared to racial/ethnic minority individuals. Developing culturally appropriate interventions and addressing the tobacco industry marketing toward Hispanic-American individuals may be beneficial for cessation efforts among this population.[41]

The third aim of our study was to determine the associated health-related conditions and respiratory symptomatology associated with dual use. Specifically, we identified an association between history of cancer and cigarette/e-cigarette usage. Individuals who reported history of cancer had a much higher percentage of dual usage compared to those without such history, which was statistically significant. This association was also clinically important, such that dual usage was $> 9\%$ higher than e-cigarette usage only. Antwi and colleagues[42] also noted a high prevalence of dual use among cancer survivors. Cancer survivors may have difficulty with tobacco cessation and may turn to dual usage as a poorly informed attempt at cessation. Additionally, cigarette smoking among cancer survivors is associated with an exponential increase in cancer recurrence, heart disease, and infections.[42,43] Oncologists and medical providers should be aware of the high prevalence of dual use among this population and properly inform patients of the harms of dual usage.[42]

Current respiratory symptomatology was more prevalent among individuals who reported dual use compared to cigarette-only use. This is consistent with previous studies demonstrating pulmonary toxicity of e-cigarettes, which is particularly concerning among those individuals who already smoke traditional cigarettes.[11] For patients seeking care for respiratory symptoms, health care providers should provide education and interventions to address not only cigarette smoking but also potentially dual usage.

We also observed that dual use was associated with self-reported history of self-reported diagnosed depression. Although anxiety was not associated with dual use in the multivariable models, the prevalence of dual use among those with anxiety was higher compared to those without anxiety. Previous research indicates that those with mental health conditions are significantly more likely to smoke, less likely to quit, and more likely to experience higher tobacco-related morbidity and mortality compared to those without mental health conditions.[13,14] Pham and colleagues[44] reported that the prevalence of adverse mental health symptoms was the highest among dual users, consistent with our findings. Cessation interventions for those with depression and depressive symptoms should address dual use and potentially the long-term damages of dual usage.[20]

Limitations

Several limitations must be noted. First, this is a subsample release of Wave 5 data from Add Health, and the complete sample was not released at the time of the analysis. Second, these data represent only the cross-sectional survey collected in Wave 5; therefore, we did not assess trajectories of dual usage (eg, whether dual users transitioned to e-cigarette-only use, no tobacco product use, continued dual use, or combustible tobacco only use). Future research should evaluate predictors of various patterns of dual use over time, in addition to health outcomes associated with different usage patterns. Because tobacco use variables were self-reported, these variables may be underrepresented in the dataset. This study did not test biological specimens for cotinine or other substances, thus limiting the categorization of subjects to self-response and recall bias. Child maltreatment was not assessed in the current Wave 5, which may be subject to measurement error because this variable was collected in Wave 4; however, the question asked about maltreatment before age 18, and at both Waves 4 and 5 the subjects were > 18 y old. Depression and anxiety were self-reported as previously diagnosed, which limits generalizability to those who have symptoms and were never diagnosed. Finally, data were collected between 2016 and 2018; given continual changes in the tobacco market, public health communications, and relevant policies, continued surveillance is necessary.

Conclusions

Our results indicate that males, Hispanic-American individuals, those with depression or history of child maltreatment, and those living at or below the federal poverty line were more likely to report dual use compared to single use or no use of cigarettes or e-cigarettes. Respiratory symptoms (eg, coughing, phlegm, and wheezing) were more frequently reported among dual users compared to single users of cigarette smoking. Lastly, the prevalence of dual usage was significantly high among those with cancer and cancer survivors.

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