

# Predictors of electronic cigarettes use and its association with mental health in Nigeria: A community survey

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## KEYWORDS

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## ABSTRACT

**INTRODUCTION** The deleterious health effects of tobacco smoking on mental health and other components of overall wellbeing have been well documented. Though the side effects of electronic cigarettes (ECs) need further investigation, ECs are widely gaining popularity and are chiefly marketed as a safer alternative to conventional cigarette smoking. This study assessed the predictors of electronic cigarette use as well as its association with mental health among residents of Lagos state, Nigeria.

**METHODS** This was a cross-sectional study which employed the use of a validated interviewer-administered questionnaire, among participants aged  $\geq 18$  years. The survey had six sections: sociodemographic information, smoking and lifestyle characteristics, the Generalized Anxiety Disorder-7 (GAD-7), knowledge and attitude about e-cigarettes, the Patient Health Questionnaire-9 (PHQ-9), and Susceptibility to smoking cigarettes. Bivariate and multivariate logistic regression analysis was done using sociodemographic variables and clinical variables, to identify factors associated with poor knowledge, negative attitude, and predictors of e-cigarette use. A  $p < 0.05$  was considered

significant.

**RESULTS** Data from 898 participants were analyzed; the respondents were predominantly male (65.1%) and the mean age was  $33.00 \pm 18.38$  years. A total of 117 persons (13.1%) were electronic cigarette (EC) users, and the mean duration of EC use was  $11.99 \pm 14.25$  months. Amongst EC users, the factors associated with use were socializing (30.8%) and conventional tobacco smoking cessation (15.4%). The majority (56.2%) of the study participants had good knowledge of ECs while 52.9% had a negative attitude. There was a significant association ( $p < 0.05$ ) between poor knowledge and negative attitude about ECs use, cigarette smoking, alcohol drinking, and susceptibility to smoking. Depression was also a strong predictor of e-cigarette use.

**CONCLUSIONS** This study found that cigarette smoking, alcohol consumption and susceptibility to smoking cigarettes and depression were strong predictors of EC use. Policymakers in Nigeria should consider forging policies which aim at ensuring correct information dissemination on ECs in the media, and discourage the use of ECs by social vapers.

## INTRODUCTION

Tobacco use is the leading preventable cause of morbidity and mortality in the world, with over 8 million global deaths annually attributed to tobacco use<sup>1</sup>. Tobacco cigarette smoke contains more than 7000 compounds, many of which are known toxic and carcinogens. Compared to non-exposed individuals, regular and prolonged exposure to tobacco cigarette smoke is associated with a significantly

increased risk of developing cancers, chronic obstructive pulmonary disease (COPD), coronary heart disease, stroke, and infectious diseases<sup>2</sup>. Estimates suggest 5.7% of global health expenditure is directed towards smoking-attributable diseases, and the total economic cost from smoking has been calculated to amount to almost 2% of the world's entire gross domestic product (GDP)<sup>3</sup>. It also hits the world's poorest the hardest, as research indicates tobacco is driving increases in

health inequalities in nations with the most enduring rates of smoking<sup>4</sup>. At a global level, disadvantaged smokers aged 35–69 years have been shown to have far higher mortality rates than others<sup>5</sup>.

Electronic nicotine delivery systems (ENDS) or e-cigarettes (EC) are battery-powered devices that generate an aerosol, typically containing nicotine, for inhalation. Vigorous debate in the public sphere and scientific literature concerns the potential for ENDS as a safer alternative to tobacco cigarettes for smokers unable or unwilling to quit or for use as a cessation aid<sup>6</sup>. Proponents argue that ENDS are appealing to smokers as a harm-reduction tool because they mimic cigarettes in appearance, method of inhalation, production of smoke-like aerosol, and taste, and are likely safer than tobacco cigarettes. E-cigarette smoking is becoming a fast-growing trend among young adults. The handheld electronic devices, commonly known as electronic cigarettes or e-cigarette, are gaining wide acceptance as they do not cause bad breath and have no flame and carbon monoxide emission, as opposed to the conventional tobacco cigarettes. The availability in different flavors and the less known side effects have contributed to its increasing popularity. It can be consumed as a vapor (vaping, inhalation of aerosols) or an atomizer (heating element that atomizes the e-liquid)<sup>7</sup>. Even though they are primarily marketed as a smoking cessation aid, EC use may increase the likelihood of cigarette smoking by increasing intentions to smoke cigarettes<sup>8</sup>; this is concerning because the global market for e-cigarettes has grown to about US\$26 billion<sup>8,9</sup>. Significant variation exists internationally in the availability of these devices given the diverse regulatory approaches adopted by different countries based on inadequate data on their proper role and usefulness<sup>10</sup>.

The risks associated with e-cigarette use remain controversial within the scientific and public health communities<sup>11</sup>. Debate has largely centered on their potential to aid in 'harm reduction', as well as their potential to enlist tobacco-naïve adolescents and young adults to become dependent on nicotine via new nicotine delivery devices<sup>12</sup>. EC is less hazardous for smokers seeking to quit than combustible cigarettes, while creating more harm for former or never smokers<sup>13</sup>. Although highly debatable, there have been emerging concerns about the ability of ECs to act as a gateway to tobacco cigarettes or to act as new tools for nicotine dependence<sup>13</sup>. ECs are particularly appealing to the youth and adolescents due to several reasons such as curiosity, social status, availability of a wide array of attractive flavors, and even peer influence<sup>14</sup>. The perceived harm of e-cigarettes relative to conventional cigarettes was lowest among those who were current smokers, followed by former smokers, and non-smokers<sup>15</sup>.

Another possible harm associated with EC use is depression which is a common mood or affective disorder, generally characterized by feelings of sadness and hopelessness, and is a significant cause of disability. Anxiety

disorder on the other hand is characterized by the presence of extreme worry, anxiety or fear that is significant enough to interfere with daily life. 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<sup>16</sup>. Traditionally, combustible cigarette use is disproportionately prevalent among people experiencing psychological distress and those with psychiatric comorbidities, including depression and anxiety<sup>17</sup>. Smoking has been conceptualized as an attempt to relieve depression and anxiety symptoms by self-medication<sup>17</sup>. Prevalence of e-cigarette use among people with depressive or anxiety disorders has been documented as being higher than that of people without mental health conditions (MHCs)<sup>18</sup>. Smoking prevalence for individuals with MHCs is estimated to be about 70% higher than that for those without them, and the rates of smoking differ by diagnosis, ranging from approximately 38% for those with anxiety disorder, 45% for those with affective disorders, and 64% for those with substance use disorders<sup>19</sup>. A study involving American adolescents showed that continuing use of e-cigarettes was related to increases in the rate of depressive symptoms, and a higher frequency of e-cigarette use was related to greater severity of depressive symptoms<sup>20</sup>. In a study on American college students, e-cigarette use was linked with depressive symptoms and mental health problems, and college students with depression were more likely to use e-cigarettes relative to those without depression<sup>21</sup>. In contrast, a study from 2017 reported that the association between e-cigarettes and depression in adolescents was barely discernible<sup>22</sup>.

Susceptibility to smoking is a concept used to describe a person who is cognitively predisposed to smoke, as indicated by lack of a firm commitment not to smoke in the future<sup>23</sup>. Among the non-smoker population, those susceptible to smoking are in an early step in a sequence of cognitive changes that may result in experimentation with cigarettes, regular smoking, or addiction to tobacco. One way to prevent or delay smoking initiation is to interrupt the emergence of this susceptibility to smoking among non-smoking youth<sup>24</sup>. There are insufficient data available about awareness of e-cigarettes and its effect on mental health as well as the role of susceptibility to cigarette smoking on its use in Nigeria. The aim of this study is to identify the predictors of electronic cigarette use as well as its association with mental health among residents of Lagos state, Nigeria.

## METHODS

### Study design and settings

This descriptive study was conducted between January and March 2022 in Lagos State, Nigeria. Lagos has a population of over 17 million people residing in approximately 2000 communities. It is one of the most densely populated states in the country, a commercial nerve center, and a cultural melting pot of the diverse population of Nigerians of different

cultures and backgrounds, making studies conducted in it more representative than in other sectors in the country. The state is divided into administrative and political geographical units called local government areas (LGAs) and our study was conducted in the Ikeja, Ikorodu, and Somolu, LGAs of Lagos State.

### Study participants and sampling method

Data were collected using randomly selected sample of respondents aged  $\geq 18$  years. A multi-stage cluster random sampling method was utilized to enlist the study participants. At the first stage, three LGAs were selected out of the 20 LGAs in Lagos State, while three wards were selected in each LGA, using simple random sampling. Stage 2 involved the enumeration of household in the selected wards to create a sampling frame and the selection of eligible households within the enumeration sites. This was done by systematic sampling, with every fourth building on each street considered eligible for recruitment of a study participant, after a random starting point on the street was determined. At the third stage, one household selected in each building and a member of that household, aged  $\geq 18$  years, was randomly recruited for interview after obtaining their informed consent. If there was no person in the selected household, the next eligible household or building was selected for recruitment.

### Sample size calculation

The minimum sample size,  $n$ , was obtained using the formula for cross-sectional studies:

$$n = \frac{Z^2 \times p(1-p)}{d^2}$$

where  $Z=1.96$  at 95% confidence level,  $p$  is the proportion of respondents who use e-cigarettes, and  $d$  is the acceptable margin of error of 5% precision. Using a prevalence of 57.5% for knowledge about electronic cigarettes from a previous study<sup>25</sup>, we get:

$$n = (1.96)^2 \times 0.57 \times 0.43 / 0.05^2 = 3.841 \times 0.57 \times 0.43 / 0.05^2 = 377.$$

Provision for incomplete responses of 20% gives a final minimum sample size of 456 respondents.

### Data collection tool

A validated interviewer-administered questionnaire partly adapted from the Global Youth Tobacco Survey (GYTS) and Global Adult Tobacco Survey (GTAS) version 1.2 (2014) was used. The survey had six sections: sociodemographic information, smoking and lifestyle characteristics, the Generalized Anxiety Disorder-7 (GAD-7), knowledge and attitude about e-cigarettes, the Patient Health Questionnaire-9 (PHQ-9), and susceptibility to smoking cigarettes.

Section A determined the sociodemographic characteristics of the participants; baseline characteristics of the participants, including age, gender and education level. Section B comprised questions about the smoking behavior of participants, smoking status and type of tobacco used (cigarettes, waterpipe, cigars, electronic cigarettes) as well as other lifestyle variables of the participants. EC users were identified as individuals who answered 'yes' to the question: 'Have you ever used an EC?'. Within this population, current EC users were identified as individuals who reported using an EC at least one day in the last 30 days.

Section C assessed knowledge and attitude towards ECs, adapting questions utilized in a similar study<sup>25</sup>. Fifteen knowledge questions about ECs included whether participants had ever heard of ECs and how much they knew about ECs and their association with lung cancer, lung functions and contribution to secondhand smoking, among others. Those with a knowledge score of 8–15 points were categorized as having good knowledge, and 0–6 points as poor knowledge. Thirteen questions assessed beliefs and attitudes about ECs, which included beliefs whether they are safe, aid smoking cessation, encourage smoking initiation and continuation, cause long-term health effects, are a public health concern, should be avoided in public areas, can lower cancer risk than traditional cigarettes, and whether they recommend the use of ECs. Those with an attitude score 7–13 points were categorized as having a good attitude, and 0–6 points a poor attitude. The mean attitude scores were utilized for bivariate associations. A binary scale was utilized with 'Yes/No' responses to knowledge questions, and 'Positive/Negative' responses to attitude questions.

In Section D, the 7-item Generalized Anxiety Disorder (GAD-7) scale (range: 0–21) was used to assess self-reported symptoms and severity of anxiety, respectively. The total scores of GAD-7 were categorized as normal (0–5), mild (6–10), and moderate to severe ( $\geq 11$ ) anxiety. The Patient Health Questionnaire 9 (PHQ-9), a 9-item self-report questionnaire was used to assesses depression symptoms and severity, in Section E. The PHQ-9 questionnaire was scored from 0 to 27, with higher scores indicating more severe depressive symptoms. The total score was interpreted as indicating none–minimal depression (score 0–4), mild depression (score 5–9), moderate depression (score 10–14), or moderately severe depression (score 15–19), and severe depression (score 20–27).

In Section F, susceptibility to smoking cigarettes, defined by the absence of a firm decision not to smoke, was assessed using a composite index of three questions: 1) 'If one of your friends offered you a cigarette, would you smoke it?'; 2) 'Do you think you will smoke a cigarette at any time during the next year?'; and 3) 'What is the likelihood that you will be smoking cigarettes soon?'. Participants who answered anything other than 'definitely not' to any of the three items were classified as susceptible.

### Statistical analysis

Statistical analysis was done using SPSS version 26.0 software (Version 26.0. Armonk, NY: IBM Corp). Demographic data were analyzed using descriptive statistics. Bivariate associations between variables were assessed using chi-squared and ANOVA tests. Bivariate and multivariate logistic regression analysis was done using sociodemographic variables, depression and anxiety, to identify factors associated with poor knowledge, negative attitude and predictors of EC use. A  $p < 0.05$  was considered significant.

### RESULTS

Table 1 presents participants' sociodemographic characteristics. Their mean age was  $33.00 \pm 18.38$  years, with 65.1% being male. The majority (47.4%) were aged 21–30 years and had a secondary school level of education (51.8%). With regard to their self-reported lifestyle characteristics, 62.8% stated that they exercise regularly, 73.2% reported that they follow a healthy diet, and 56.1% drank alcohol. The number of current smokers was 145 (16.1%), of which 84 (57.6%) had made prior cessation efforts. Reducing number of cigarettes per day ( $n=30$ ; 35.7%) was the most common type of cessation method tried by smokers. In all, 117 respondents (13.0%) currently used e-cigarettes.

About a third of study participants (37.1%) had heard about ECs and this was mainly through the social media (45.0%) and friends (37.8%) (Table 2). Of the 117 participants who were EC users, fruit flavors were most commonly used (41.0%). The mean duration of EC use was  $11.99 \pm 14.25$  months. Of the EC users, 35.0% used nicotine containing ECs, even though 23.9% did not know if the EC contained nicotine. Among EC users, socializing (30.8%) was the most common reason for use, while only 18 (15.4%) reported using it to quit smoking. Apart from the majority (77.3%) who had no desire to use ECs, the other most commonly cited reason for not using ECs was lack of access to ECs (8.8%). Only 20.5% of EC users reported getting more satisfaction from ECs compared to regular cigarettes or other tobacco products.

The responses to the questions assessing the knowledge of the participants are presented in Supplementary file Table 1. The mean knowledge score of the respondents was 10.92; (15 representing the maximum score and the highest level of knowledge); 43.8% had poor knowledge while 56.2% had good knowledge. Good knowledge was more associated with knowing that swallowing the liquid in e-cigarettes accidentally can cause poisoning that is potentially fatal (67.9%); that e-cigarettes may impair lung functions (80.2%), and harmful flavorings and toxins can be found in the e-cigarette aerosol (78.2%). Poor knowledge was, however, more associated with reporting that e-cigarettes are not addictive (54.9%) and that e-cigarettes are harmless (50.3%).

The distribution of responses to the questions

**Table 1. Demographic, socioeconomic and lifestyle characteristics, and smoking habits of study participants (N=898)**

| Characteristics                                | n   | %    |
|--|-----|------|
| <b>Sex</b>                                     |     |      |
| Female   | 313 | 34.9 |
| Male   | 585 | 65.1 |
| <b>Age (years), mean <math>\pm</math> SD</b>   |     |      |
| <b>Age (years)</b>                             |     |      |
| 18–20  | 93  | 10.4 |
| 21–30  | 426 | 47.4 |
| 31–40  | 219 | 24.4 |
| 41–50  | 103 | 11.5 |
| >50  | 57  | 6.3  |
| <b>Education level</b>                         |     |      |
| No schooling completed                         | 13  | 1.3  |
| Primary school                                 | 87  | 9.7  |
| Secondary school                               | 465 | 51.8 |
| University                                     | 324 | 36.1 |
| Postgraduate                                   | 9   | 1.0  |
| <b>Smoker</b>                                  |     |      |
| Yes  | 145 | 16.1 |
| No   | 753 | 83.9 |
| <b>Tobacco products smoked</b>                 |     |      |
| Cigarettes                                     | 128 | 14.3 |
| Cigars   | 3   | 0.3  |
| More than one product                          | 48  | 5.3  |
| Shisha   | 59  | 6.5  |
| <b>Ever thought of quitting</b>                |     |      |
| No   | 61  | 42.1 |
| Yes  | 84  | 57.9 |
| <b>Methods of smoking cessation used/using</b> |     |      |
| Behavioral therapy                             | 15  | 17.8 |
| E-cigarettes                                   | 18  | 21.4 |
| Medication                                     | 0   | 0.0  |
| Nicotine gum                                   | 18  | 21.4 |
| Nicotine patches                               | 3   | 3.7  |
| Reducing number of cigarettes per day          | 30  | 35.7 |
| <b>Exercise regularly</b>                      |     |      |
| No   | 334 | 37.2 |
| Yes  | 564 | 62.8 |
| <b>Follow a healthy diet</b>                   |     |      |
| No   | 241 | 26.9 |
| Yes  | 657 | 73.2 |
| <b>Drink alcohol</b>                           |     |      |
| No   | 394 | 43.8 |
| Yes  | 504 | 56.1 |

**Table 2. Frequency distribution of e-cigarette perceptions and smoking habits among study participants (N=898)**

| E-cigarette perceptions and smoking habits           | n             | %    |
|--|---------------|------|
| <b>Heard of e-cigarettes</b>                         |               |      |
| No   | 565           | 62.9 |
| Yes  | 333           | 37.1 |
| <b>Where have you heard of e-cigarettes?</b>         |               |      |
| Advertisements                                       | 3             | 0.9  |
| Family   | 15            | 4.5  |
| Friends  | 126           | 37.8 |
| Social media   | 150           | 45.0 |
| University/school                                    | 39            | 11.7 |
| <b>Use e-cigarettes</b>                              |               |      |
| No   | 781           | 87.0 |
| Yes  | 117           | 13.0 |
| <b>Period using e-cigarettes (months), mean ± SD</b> | 11.99 ± 14.25 |      |
| <b>E-cigarette flavor used</b>                       |               |      |
| Coffee   | 12            | 10.3 |
| Fruit  | 48            | 41.0 |
| Menthol/mint   | 27            | 23.1 |
| Others   | 3             | 2.6  |
| Tobacco  | 27            | 23.1 |

Continued

assessing the attitude of the participants are presented in Supplementary file Table 2. The mean attitude score of the respondents was  $6.59 \pm 1.24$ ; 52.9% had a negative attitude while 47.1% had a positive attitude (13 representing the maximum score and the most positive attitude). Positive attitude was highly associated with not recommending ECs to a non-smoker (78.0); not using e-cigarettes in places that do not allow smoking (79%); and believing that it is not acceptable to experiment with e-cigarettes for pleasure (75.3%). Negative attitude was, however, more associated with the 10 other questions that assessed attitude including believing that ECs are not harmful (61.2%); that the use of E-cigarettes cannot lead to reliance (61.2%); not being comfortable using or openly talking about smoking e-cigarettes, compared to cigarettes (73.6%), and not believing that e-cigarettes can help people cut down on cigarettes or smoking (74.6%).

Table 3 shows the bivariate association between sociodemographic and clinical variables with knowledge and attitude about e-cigarette use among the study participants. There was more significant negative attitude to e-cigarette

**Table 2. Continued**

| E-cigarette perceptions and smoking habits                               | n   | %    |
|--|-----|------|
| <b>E-cigarettes used contain nicotine</b>                                |     |      |
| I don't know   | 28  | 23.9 |
| No   | 48  | 41.0 |
| Yes  | 41  | 35.0 |
| <b>Reason started e-cigarette use</b>                                    |     |      |
| Effects (relaxant, etc.)   | 9   | 7.7  |
| Quit smoking   | 18  | 15.4 |
| Social smoking   | 36  | 30.8 |
| Taste  | 24  | 20.5 |
| Trend  | 30  | 25.6 |
| <b>Reason not using e-cigarettes</b>                                     |     |      |
| Expensive  | 30  | 3.8  |
| Harmful/unhealthy  | 21  | 2.7  |
| No need  | 604 | 77.3 |
| Never considered it  | 57  | 7.4  |
| No access  | 69  | 8.8  |
| <b>Satisfaction from e-cigarettes compared to other tobacco products</b> |     |      |
| Less   | 64  | 54.7 |
| More   | 24  | 20.5 |
| Don't use other tobacco products   | 29  | 24.8 |

use among primary school educated respondents ( $6.38 \pm 1.28$ ), those aged 18–35 years ( $6.52 \pm 0.95$ ), current alcohol drinkers ( $6.43 \pm 1.17$ ) and those susceptible to smoking ( $6.33 \pm 1.34$ ). Poorer knowledge was also significantly higher among male respondents ( $9.36 \pm 5.05$ ), those susceptible to smoking ( $10.23 \pm 4.28$ ), those depressed ( $9.86 \pm 4.22$ ), anxious respondents ( $9.87 \pm 4.15$ ), current smokers ( $9.94 \pm 4.73$ ), and current e-cigarette users ( $10.55 \pm 4.28$ ).

Table 4 displays the regression analysis showing the odds ratio and adjusted odds ratio, and 95% CI, for predictors of e-cigarette use. There was a significant association ( $p < 0.05$ ) between poor knowledge (AOR=1.369; 95% CI: 1.256–2.352), negative attitude (AOR=3.347; 95% CI: 1.896–5.910), cigarette smoking (AOR=14.149; 95% CI: 7.512–26.648), alcohol drinking (AOR=5.181; 95% CI: 2.748–9.767), susceptibility to smoking (AOR=5.076; 95% CI: 3.134–8.197), and depression (AOR=2.837; 95% CI: 1.579–5.096), and e-cigarette use. There was also increased odds of e-cigarette use among males and those aged 18–35 years, although, the association was not significant.

**Table 3. Bivariate association between sociodemographic and clinical variables with knowledge and attitude about e-cigarette use**

| Variable                         | Attitude    | F statistic <sup>a</sup> | p             | Knowledge    | F statistic <sup>a</sup> | p             |
|----------------------------------|-------------|--------------------------|---------------|--------------|--------------------------|---------------|
| <b>Sex</b>                       |             | 0.048                    | 0.087         |              | 9.086                    | <b>0.003*</b> |
| Female                           | 6.56 ± 1.24 |                          |               | 10.99 ± 4.40 |                          |               |
| Male                             | 6.53 ± 1.17 |                          |               | 9.36 ± 5.05  |                          |               |
| <b>Education level</b>           |             | 5.647                    | <b>0.004*</b> |              | 0.136                    | 0.872         |
| Primary                          | 6.38 ± 1.28 |                          |               | 9.58 ± 5.90  |                          |               |
| Secondary                        | 6.40 ± 0.77 |                          |               | 9.91 ± 5.17  |                          |               |
| Tertiary                         | 6.89 ± 1.21 |                          |               | 11.21 ± 3.81 |                          |               |
| <b>Age (years)</b>               |             | 10.600                   | <b>0.000*</b> |              | 1.361                    | 0.050         |
| 18–35                            | 6.52 ± 0.95 |                          |               | 10.70 ± 4.25 |                          |               |
| 36–55                            | 6.57 ± 1.70 |                          |               | 10.52 ± 5.47 |                          |               |
| ≥56                              | 7.50 ± 1.15 |                          |               | 10.00 ± 3.01 |                          |               |
| <b>Alcohol use</b>               |             | 7.873                    | <b>0.005*</b> |              | 2.087                    | 0.150         |
| Yes                              | 6.43 ± 1.17 |                          |               | 10.73 ± 4.90 |                          |               |
| No                               | 6.82 ± 1.28 |                          |               | 9.95 ± 4.34  |                          |               |
| <b>Susceptibility to smoking</b> |             | 9.038                    | <b>0.003*</b> |              | 6.539                    | <b>0.001*</b> |
| Yes                              | 6.33 ± 1.34 |                          |               | 10.23 ± 4.28 |                          |               |
| No                               | 6.73 ± 1.25 |                          |               | 11.53 ± 4.67 |                          |               |
| <b>Depression</b>                |             | 0.052                    | 0.820         |              | 18.741                   | <b>0.000*</b> |
| Yes                              | 6.60 ± 1.19 |                          |               | 9.86 ± 4.22  |                          |               |
| No                               | 6.63 ± 1.21 |                          |               | 12.14 ± 4.69 |                          |               |
| <b>Anxiety</b>                   |             | 0.398                    | 0.528         |              | 7.594                    | <b>0.003*</b> |
| Yes                              | 6.46 ± 1.32 |                          |               | 9.87 ± 4.15  |                          |               |
| No                               | 6.55 ± 1.32 |                          |               | 11.35 ± 5.23 |                          |               |
| <b>Cigarette use</b>             |             | 0.852                    | 0.357         |              | 5.407                    | <b>0.021*</b> |
| Yes                              | 6.50 ± 1.27 |                          |               | 9.94 ± 4.73  |                          |               |
| No                               | 6.62 ± 1.14 |                          |               | 11.12 ± 4.53 |                          |               |
| <b>E-cigarette use</b>           |             | 2.768                    | 0.097         |              | 5.601                    | <b>0.019*</b> |
| Yes                              | 6.39 ± 1.05 |                          |               | 10.55 ± 4.28 |                          |               |
| No                               | 6.65 ± 1.30 |                          |               | 11.93 ± 4.59 |                          |               |

<sup>a</sup> ANOVA. \*Significant at p<0.05.

**Table 4. Predictors of e-cigarette use**

| Variable         | OR    | 95% CI |       | p             | AOR   | 95% CI |       | p             |
|------------------|-------|--------|-------|---------------|-------|--------|-------|---------------|
|                  |       | Lower  | Upper |               |       | Lower  | Upper |               |
| <b>Knowledge</b> |       |        |       |               |       |        |       |               |
| Good @           | 1     |        |       |               | 1     |        |       |               |
| Poor             | 1.293 | 0.984  | 1.484 | <b>0.025*</b> | 1.369 | 1.256  | 2.352 | <b>0.020*</b> |

Continued

Table 4. Continued

| Variable                      | OR    | 95% CI |       | p             | AOR    | 95% CI |        | p             |
|-------------------------------|-------|--------|-------|---------------|--------|--------|--------|---------------|
|                               |       | Lower  | Upper |               |        | Lower  | Upper  |               |
| <b>Attitude</b>               |       |        |       |               |        |        |        |               |
| Positive ®                    | 1     |        |       |               | 1      |        |        |               |
| Negative                      | 1.238 | 0.751  | 2.041 | 0.403         | 3.347  | 1.896  | 5.910  | <b>0.017*</b> |
| <b>Sex</b>                    |       |        |       |               |        |        |        |               |
| Female ®                      | 1     |        |       |               | 1      |        |        |               |
| Male                          | 1.419 | 0.592  | 1.808 | 0.064         | 1.521  | 0.965  | 2.396  | 0.071         |
| <b>Age (years)</b>            |       |        |       |               |        |        |        |               |
| 56–70 ®                       | 1     |        |       |               | 1      |        |        |               |
| 36–55                         | 1.011 | 0.294  | 1.153 | 0.549         | 1.006  | 0.566  | 1.159  | 0.211         |
| 18–35                         | 1.024 | 0.825  | 1.271 | 0.829         | 1.172  | 0.775  | 1.773  | 0.452         |
| <b>Cigarette smoker</b>       |       |        |       |               |        |        |        |               |
| No ®                          | 1     |        |       |               | 1      |        |        |               |
| Yes                           | 2.650 | 2.355  | 6.728 | <b>0.000*</b> | 14.149 | 7.512  | 26.648 | <b>0.000*</b> |
| <b>Alcohol use</b>            |       |        |       |               |        |        |        |               |
| No ®                          | 1     |        |       |               | 1      |        |        |               |
| Yes                           | 2.383 | 1.645  | 5.116 | <b>0.023*</b> | 5.181  | 2.748  | 9.767  | <b>0.000*</b> |
| <b>Patient susceptibility</b> |       |        |       |               |        |        |        |               |
| Not susceptible ®             | 1     |        |       |               | 1      |        |        |               |
| Susceptible                   | 1.623 | 1.417  | 3.611 | <b>0.000*</b> | 5.076  | 3.134  | 8.197  | <b>0.000*</b> |
| <b>Depression</b>             |       |        |       |               |        |        |        |               |
| No depression ®               | 1     |        |       |               | 1      |        |        |               |
| Depression                    | 2.078 | 1.407  | 2.524 | <b>0.000*</b> | 2.837  | 1.579  | 5.096  | <b>0.000*</b> |
| <b>Anxiety</b>                |       |        |       |               |        |        |        |               |
| No anxiety ®                  | 1     |        |       |               | 1      |        |        |               |
| Anxiety                       | 0.933 | 0.891  | 0.997 | 0.690         | 0.883  | 0.590  | 1.324  | 0.548         |

AOR: adjusted odds ratio. Other variables in the table served as control variable for each variable being considered. ® Reference categories. \*Significant at p<0.05.

## DISCUSSION

About a third of study participants had heard about ECs and this was in contrast with a population study conducted in the Netherlands that reported that 91.4% of surveyed respondents were aware of them<sup>26</sup>. The source of information was mainly through the social media and friends, which was in agreement with previous studies, and with a systematic review of studies on electronic cigarettes that reported that the most common sources of awareness were the Internet, friends or personal contacts, and advertisements<sup>27,28</sup>. Other researchers have also identified a link between exposure to e-cigarette advertising and e-cigarette use initiation<sup>29,30</sup>, especially among those that had high levels of exposure to online advertising. Consumer perceptions of the risks and benefits and decisions to use e-cigarettes are heavily

influenced by how they are marketed. The marketing of combustible cigarettes has been limited in Nigeria on traditional media, but, currently, Nigeria has no advertising restrictions on e-cigarettes, thus e-cigarette companies have a strong presence on social media, which reinforces their marketing messages<sup>31</sup>. Although these messages claim to target smokers, there is cause for concern that these products will appeal to those who have never smoked, including adolescents.

Over 13% of study participants were EC users and the fruit flavors were most commonly used. A previous study among adolescents and young adults in Nigeria by Erinoso et al.<sup>32</sup> obtained a prevalence of 7.9%<sup>32</sup> while the Behavioral Risk Factor Surveillance System (BRFFSS) study in 2016 found that ever use of e-cigarettes ranged from 16.2% to

28.4%, and current use ranged from 2.4% to 6.7%, across the United States<sup>33</sup>. A total of 117 cigarette smokers were current EC users. The duration of EC use was less than 2 years for most of the respondents, and 35.0% used nicotine containing ECs while 23.9% were not sure if the EC contained nicotine. A possibility, however, exists that the 23.9% that did not know if the EC contains nicotine, were also exposed to nicotine. It is disconcerting, however, that among EC users, socializing was the most common reason for use, while only 15.4% reported using it to quit smoking. Moreover, 8.8% of respondents stated that they were currently not using ECs due to lack of access to them. The major reasons that have been advanced for vaping include its usefulness in smoking cessation, decreasing cigarette consumption, abating tobacco craving, and mitigating harm, when used as a substitute for regular cigarettes. These logical reasons do not appear to be the main motives for its use in this survey and only 20.5% of smokers who were currently using ECs reported getting more satisfaction from ECs compared to regular cigarettes or other tobacco products, which could potentially discourage cessation efforts among this important group seeking smoking cessation. These findings should concern policymakers because e-cigarette use among adults was found to be associated with current subsequent use of combustible cigarettes across all states in the US, with states possessing a higher prevalence of combustible cigarette use also having high prevalence of current EC use<sup>33</sup>.

The mean knowledge score of the respondents was  $10.92 \pm 4.40$  and a higher proportion of the respondents had good knowledge about ECs, their potential as a cessation tool and some of the harms associated with it. Many, however, had poor knowledge with regard to the addictive potential of nicotine-containing e-cigarettes. The mean attitude score of the respondents was low and many participants had a negative attitude regarding ECs, believing that ECs are not harmful nor addictive and that ECs are not a useful cessation tool. There was more significant negative attitude to EC use among primary school educated respondents, those aged 18–35 years, current alcohol drinkers, and those susceptible to smoking. Poorer knowledge was also significantly higher among male respondents, those susceptible to smoking, those with depression or anxiety, and current smokers. ECs have been suggested as a potential harm reduction tool for smokers who otherwise are unable to quit smoking. However, many smokers lack knowledge about e-cigarettes, particularly the risk of e-cigarettes relative to combusted cigarettes, which is an important factor that can facilitate smokers' full transition to ECs<sup>34,35</sup>. Smokers need information to understand the patterns of using e-cigarettes that will harm their health or reduce the health risks associated with continued combusted cigarette use<sup>36</sup>.

Poor knowledge and negative attitude were found to be strong predictors of EC use in this study. Evidence suggests negative attitudes, tobacco and substance use, high levels of sensation seeking, poor mental health, and exposure to EC

marketing, are factors associated with initiating e-cigarette use<sup>28</sup>. Previous studies have also found that a correlation exists between lower knowledge of smoking risk and higher use of tobacco<sup>37</sup>. Prior research has similarly shown a relationship between knowledge or perceptions about the safety of e-cigarettes and the likelihood of using ECs<sup>38</sup>, which the results of this study support. Significant differences were seen in knowledge scores for users when compared to never users. Cigarette smoking and alcohol consumption were also significant indicators of EC use. A study of current and former smokers by Giovenco et al.<sup>39</sup> showed that 50% of respondents had previously used e-cigarettes, while 16% were current users. Another study observed that the use of other substances like alcohol, cannabis and cigarettes was strongly associated with e-cigarette initiation. They observed that while alcohol use posed the greatest risk for females, cigarette use posed the greatest risk for males<sup>39</sup>.

Susceptibility to smoking cigarettes and was also observed to be significant predictors of EC use which was in agreement with findings by previous research<sup>40</sup> that showed that 40% of college e-cigarette users had never previously smoked combustible cigarettes, and that e-cigarette use among young adults is positively associated with being open to trying combustible cigarettes<sup>41</sup>. These findings indicate that e-cigarette use is creating a new population of individuals vulnerable to developing nicotine addiction. Prevention programs that aim to reduce experimentation with substances should therefore address multiple substances and the underlying reasons that predispose to the use of these substances.

Moreover, depression was also shown to be a significant predictor of EC use. A previous cross-sectional study that used Behavioral Risk Factor Surveillance System data from 2016–2017 found that never cigarette smokers who used e-cigarettes were two times more likely to be depressed compared to the reference group of non-vaping individuals<sup>42</sup>. This suggests that e-cigarettes are associated with depression even in the absence of current or former combustible cigarette smoking. High rates of e-cigarette use have also been linked to an increase in depressive symptoms among young adults<sup>20</sup>. One study found that former e-cigarette users had 1.6 times higher odds of reporting a history of clinical diagnosis of depression than never users, and current e-cigarette users had 2.10 times higher odds<sup>42</sup>. A bi-directional relationship between depression symptoms and e-cigarette use has been suggested, implying that depressed individuals may smoke as a form of self-medication and that smoking may lead to increased depressive symptoms<sup>43</sup>.

There was also increased odds of e-cigarette use among males and those aged 18–35 years, although, the association was not significant. Research has identified several demographic predictors of EC use in young adults including gender, ethnicity, university attendance, and socioeconomic status (SES). Young adult males have been found to have



higher intentions to use ENDS<sup>44</sup>, and are more likely to use ENDS than young adult females. Younger people were also more likely to initiate e-cigarette use, possibly because they are less resistant to peer influence<sup>45</sup>. This suggests that e-cigarette prevention efforts towards non-smokers should be started early especially among secondary school-aged male students.

Since most e-cigarette users in this study among Nigerians were recently initiated to its use, as evidenced by the mean duration of use being less than 2 years, the public health community has the opportunity to seize the initiative to discourage the use of ECs by social and recreative users who are non-cigarette smokers from becoming current cigarette smokers who find other cessation methods ineffective.

#### Strengths and limitations

The main strength of this study is the use of a large, community-based dataset which was obtained by probability sampling to examine factors associated with attitude and knowledge about ECs and the predictors of e-cigarette use. This study has some limitations. First, since the questionnaire was based on self-report and interviewer-administered, data may be subject to recall and social desirability biases. Secondly, due to the descriptive nature of the study design, causal inferences cannot be made about the direction of the associations.

## CONCLUSIONS

Our findings suggest a higher prevalence of e-cigarette use than previously obtained among young adults in Nigeria by Erinoso et al.<sup>32</sup> (7.9%). Though we observed that majority of the studied group had good general knowledge on ECs, many, however, had poor knowledge with regard to the tendency of addiction to nicotine-containing e-cigarettes and the potential use of ECs in smoking cessation. This highlights the need for policymakers and actors in nicotine dependence prevention and tobacco use regulation to ensure that media outlets are saturated with the right information on e-cigarettes in order to discourage the use of ECs by social non-cigarette smokers. It is also noteworthy in this study that though a causal relationship could not be established, e-cigarette use is associated with depression even in the absence of current or former combustible cigarette smoking. Given the significant role of mental health in overall wellbeing, it is imperative that policies to discourage non-smokers from EC or tobacco initiation are implemented.

## REFERENCES

1. Global Burden of Disease Study 2019 (GBD 2019) Data Resources. GHDx; 2019. Accessed 11 September 2023. <https://ghdx.healthdata.org/gbd-2019>
2. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion (US) Office on smoking and health. The health consequences of smoking—50 years of progress: a report of the Surgeon General. CDC; 2014. Accessed September 11, 2023. [www.ncbi.nlm.nih.gov/books/NBK179276/](https://www.ncbi.nlm.nih.gov/books/NBK179276/)
3. Goodchild M, Nargis N, Tursan d'Espaignet E. Global economic cost of smoking-attributable diseases. *Tob Control*. 2018;27(4):478. doi:10.1136/tobaccocontrol-2016-053305
4. Hiscock R, Bauld L, Amos A, Fidler JA, Munafò M. Socioeconomic status and smoking: a review. *Ann N Y Acad Sci*. 2012;1248:107-23. doi:10.1111/j.1749-6632.2011.06202.x
5. David A, Esson K, Perucic A-M, Fitzpatrick C. Tobacco use: equity and social determinants. In: Blas E, Kurup AS. *Equity, social determinants and public health programmes*. WHO; 2010. Accessed September 11, 2023. [https://www.researchgate.net/publication/273321745\\_Tobacco\\_use\\_Equity\\_and\\_social\\_determinants](https://www.researchgate.net/publication/273321745_Tobacco_use_Equity_and_social_determinants)
6. Chapman S. Should electronic cigarettes be as freely available as tobacco cigarettes? *BMJ*. 14;346:f3840. doi:10.1136/bmj.f3840
7. Farsalinos KE, Romagna G, Tsiapras D, Kyrzopoulos S, Voudris V. Characteristics, perceived side effects and benefits of electronic cigarette use: a worldwide survey of more than 19,000 consumers. *Int J Environ Res Public Health*. 2014;11(4):4356-73. doi:10.3390/ijerph110404356
8. Zhong J, Cao S, Gong W, Fei F, Wang M. Electronic cigarettes use and intention to cigarette smoking among never-smoking adolescents and young adults: a meta-analysis. *Int J Environ Res Public Health*. 2016;13(5):465. doi:10.3390/ijerph13050465
9. Allied Market Research. *Electronic Cigarette Market by Product Type (Disposable, Rechargeable, and Modular), Flavor (Tobacco, Botanical, Fruit, Sweet, Beverage, and Others) and Distribution Channel (Specialist E-Cig Shops, Online, Supermarkets, Tobacconist, and Others) - Global Opportunity Analysis and Industry Forecast, 2017- 2023*. AMR; 2018. Accessed 11 September, 2023. <https://www.alliedmarketresearch.com/electronic-cigarettemarket>
10. Kennedy RD, Awopegba A, De León E, Cohen JE. Global approaches to regulating electronic cigarettes. *Tob Control*. 2017;26(4):440-445. doi:10.1136/tobaccocontrol-2016-053179
11. National Institute on Drug Abuse. What are electronic cigarettes? NIDA; Accessed 11 September, 2023. <https://www.drugabuse.gov/publications/research-reports/tobacco-nicotine-e-cigarettes/what-are-electronic-cigarettes>
12. Grabovac I, Oberndorfer M, Fischer J, Wiesinger W, Haider S, Dorner TE. Effectiveness of electronic cigarettes in smoking cessation: a systematic review and meta-analysis. *Nicotine Tob Res*. 2021;23(4):625-634. doi:10.1093/ntr/ntaa181
13. Rigotti NA. Balancing the benefits and harms of e-cigarettes: a national academies of Science, Engineering, and Medicine Report. *Ann Intern Med*. 2018;168(9):666-667. doi:10.7326/M18-0251
14. Kong G, Morean ME, Cavallo DA, Camenga DR, Krishnan-Sarin S. Reasons for electronic cigarette experimentation and discontinuation among adolescents and young adults. *Nicotine Tob Res*. 2015;17(7):847-54. doi:10.1093/ntr/ntu257

15. Richardson A, Pearson J, Xiao H, Stalgaitis C, Vallone D. Prevalence, harm perceptions, and reasons for using noncombustible tobacco products among current and former smokers. *Am J Public Health*. 2014;104(8):1437-44. doi:[10.2105/AJPH.2013.301804](https://doi.org/10.2105/AJPH.2013.301804)
16. Kasza KA, Ambrose BK, Conway KP, et al. Tobacco-product use by adults and youths in the United States in 2013 and 2014. *N Engl J Med*. 2017;376(4):342-353. doi:[10.1056/NEJMsa1607538](https://doi.org/10.1056/NEJMsa1607538)
17. Prochaska JJ, Das S, Young-Wolff KC. Smoking, mental illness, and public health. *Annu Rev Public Health*. 2017;38:165-185. doi:[10.1146/annurev-publhealth-031816-044618](https://doi.org/10.1146/annurev-publhealth-031816-044618)
18. Kaplan B, Thrul J, Cohen JE. Association of cigarette and electronic nicotine delivery systems use with internalizing and externalizing problems among US adults: findings from wave 3 (2015-2016) of the PATH study. *PLoS One*. 2021;16(6):e0253061. doi:[10.1371/journal.pone.0253061](https://doi.org/10.1371/journal.pone.0253061)
19. Spears CA, Jones DM, Weaver SR, Yang B, Pechacek TF, Eriksen MP. Electronic nicotine delivery system (ENDS) use in relation to mental health conditions, past-month serious psychological distress and cigarette smoking status, 2017. *Addiction*. 2019;114(2):315-325. doi:[10.1111/add.14464](https://doi.org/10.1111/add.14464)
20. Lechner WV, Janssen T, Kahler CW, Audrain-McGovern J, Leventhal AM. Bi-directional associations of electronic and combustible cigarette use onset patterns with depressive symptoms in adolescents. *Prev Med*. 2017;96:73-78. doi:[10.1016/j.ypmed.2016.12.034](https://doi.org/10.1016/j.ypmed.2016.12.034)
21. Bandiera FC, Loukas A, Li X, Wilkinson AV, Perry CL. Depressive symptoms predict current e-cigarette use among college students in Texas. *Nicotine Tob Res*. 2017;19(9):1102-1106. doi:[10.1093/ntr/ntx014](https://doi.org/10.1093/ntr/ntx014)
22. Dunbar MS, Tucker JS, Ewing BA, et al. Frequency of e-cigarette use, health status, and risk and protective health behaviors in adolescents. *J Addict Med*. 2017;11(1):55-62. doi:[10.1097/ADM.0000000000000272](https://doi.org/10.1097/ADM.0000000000000272)
23. Pierce JP, Choi WS, Gilpin EA, Farkas AJ, Merritt RK. Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychol*. 1996;15(5):355-61. doi:[10.1037//0278-6133.15.5.355](https://doi.org/10.1037//0278-6133.15.5.355)
24. Leatherdale ST, McDonald PW, Cameron R, Jolin MA, Brown KS. A multi-level analysis examining how smoking friends, parents, and older students in the school environment are risk factors for susceptibility to smoking among non-smoking elementary school youth. *Prev Sci*. 2006;7(4):397-402. doi:[10.1007/s11121-006-0049-y](https://doi.org/10.1007/s11121-006-0049-y)
25. Abo-Elkheir OI, Sobh E. Knowledge about electronic cigarettes and its perception: a community survey, Egypt. *Respir Res*. 2016;17(1):58. doi:[10.1186/s12931-016-0365-0](https://doi.org/10.1186/s12931-016-0365-0)
26. Hummel K, Hoving C, Nagelhout GE, et al. Prevalence and reasons for use of electronic cigarettes among smokers: findings from the International Tobacco Control (ITC) Netherlands Survey. *Int J Drug Policy*. 2015;26(6):601-608. doi:[10.1016/j.drugpo.2014.12.009](https://doi.org/10.1016/j.drugpo.2014.12.009)
27. Oyapero A, Erinoso O, Osoba M, Amure M, Osibogun O, Wright K, Osibogun A. Exposure to anti-tobacco messaging and quit attempts among adolescent and young adult in Lagos, Nigeria: a population-based study. *West Afr J Med*. 2021; 38(11):1058-1064
28. Pepper JK, Emery SL, Ribisl KM, Southwell BG, Brewer NT. Effects of advertisements on smokers' interest in trying e-cigarettes: the roles of product comparison and visual cues. *Tob Control*. 2014;23 Suppl 3(Suppl 3):iii31-6. doi:[10.1136/tobaccocontrol-2014-051718](https://doi.org/10.1136/tobaccocontrol-2014-051718)
29. Cruz TB, McConnell R, Low BW, et al. Tobacco marketing and subsequent use of cigarettes, e-cigarettes, and hookah in adolescents. *Nicotine Tob Res*. 2019;21(7):926-932. doi:[10.1093/ntr/nty107](https://doi.org/10.1093/ntr/nty107)
30. D'Angelo H, Patel M, Rose SW. Convenience store access and e-cigarette advertising exposure is associated with future e-cigarette initiation among tobacco-naïve youth in the PATH study (2013-2016). *J Adolesc Health*. 2021;68(4):794-800. doi:[10.1016/j.jadohealth.2020.08.030](https://doi.org/10.1016/j.jadohealth.2020.08.030)
31. Hammond D, Reid JL, Burkhalter R, Rynard VL. E-cigarette marketing regulations and youth vaping: cross-sectional surveys, 2017-2019. *Pediatrics*. 2020;146(1):e20194020. doi:[10.1542/peds.2019-4020](https://doi.org/10.1542/peds.2019-4020)
32. Erinoso O, Oyapero A, Amure M, et al. Electronic cigarette use among adolescents and young adults in Nigeria: prevalence, associated factors and patterns of use. *PLoS One*. 2021;16(10):e0258850. doi:[10.1371/journal.pone.0258850](https://doi.org/10.1371/journal.pone.0258850)
33. Hu SS, Wang TW, Homa DM, Tsai J, Neff L. Cigarettes, smokeless tobacco, and e-cigarettes: state-specific use patterns among U.S. adults, 2017-2018. *Am J Prev Med*. 2022;62(6):930-942. doi:[10.1016/j.amepre.2021.12.014](https://doi.org/10.1016/j.amepre.2021.12.014)
34. Huang J, Feng B, Weaver S R, Pechacek T F, Slovic P, Eriksen M P. Changing perceptions of harm of e-cigarette vs cigarette use among adults in 2 US national surveys from 2012 to 2017. *JAMA Network Open* 2019;2(3),e191047. doi:[10.1001/jamanetworkopen.2019.1047](https://doi.org/10.1001/jamanetworkopen.2019.1047)
35. Romijnders KAGJ, van Osch L, de Vries H, Talhout R. A deliberate choice? Exploring the decision to switch from cigarettes to e-cigarettes. *Int J Environ Res Public Health*. 2019;16(4):624. doi:[10.3390/ijerph16040624](https://doi.org/10.3390/ijerph16040624)
36. Abrams DB, Glasser AM, Pearson JL, Villanti AC, Collins LK, Niaura R S. Harm minimization and tobacco control: reframing societal views of nicotine use to rapidly save lives. *Annual Review of Public Health*, 2018;39(1),193-213. doi:[10.1146/annurevpublhealth040617-013849](https://doi.org/10.1146/annurevpublhealth040617-013849)
37. Finney Rutten LJ, Augustson EM, Moser RP, Beckjord EB, Hesse BW. Smoking knowledge and behavior in the United States: sociodemographic, smoking status, and geographic patterns. *Nicotine Tob Res*. 2008;10(10):1559-70. doi:[10.1080/14622200802325873](https://doi.org/10.1080/14622200802325873)
38. Wiseman KP, Margolis KA, Bernat JK, Grana RA. The association between perceived e-cigarette and nicotine addictiveness, information-seeking, and e-cigarette trial among U.S. adults. *Prev Med*. 2019;118:66-72. doi:[10.1016/j.ypmed.2018.10.003](https://doi.org/10.1016/j.ypmed.2018.10.003)
39. Giovenco DP, Hammond D, Corey CG, Ambrose BK, Delnevo CD. E-cigarette market trends in traditional U.S. Retail

- Channels, 2012-2013. *Nicotine Tob Res.* 2015;17(10):1279-83. doi:[10.1093/ntr/ntu282](https://doi.org/10.1093/ntr/ntu282)
40. QuickStats: Cigarette Smoking Status\* Among Current Adult E-cigarette Users,† by Age Group - National Health Interview Survey,§ United States, 2015. *MMWR Morb Mortal Wkly Rep.* 2016;65(42):1177. doi:[10.15585/mmwr.mm6542a7](https://doi.org/10.15585/mmwr.mm6542a7)
41. Coleman BN, Apelberg BJ, Ambrose BK, et al. Association between electronic cigarette use and openness to cigarette smoking among US young adults. *Nicotine Tob Res.* 2015;17(2):212-8. doi:[10.1093/ntr/ntu211](https://doi.org/10.1093/ntr/ntu211)
42. Obisesan O, Mirbolouk M, Osei AD, et al. Association between e-cigarette use and depression in the Behavioral Risk Factor Surveillance System, 2016–2017. *JAMA Netw. Open.* 2019;2:e1916800. doi:[10.1001/jamanetworkopen.2019.16800](https://doi.org/10.1001/jamanetworkopen.2019.16800)
43. Chan G, Morphett K, Gartner C, et al. Predicting vaping uptake, vaping frequency and ongoing vaping among daily smokers using longitudinal data from the International Tobacco Control (ITC) Four Country Surveys. *Addiction.* 2019;114 Suppl 1(Suppl 1):61-70. doi:[10.1111/add.14537](https://doi.org/10.1111/add.14537)
44. Lee A, Lee KS, Park H. Association of the use of a heated tobacco product with perceived stress, physical activity, and internet use in Korean adolescents: a 2018 national survey. *Int. J. Environ. Res. Public Health* 2019; 16:ijerh16060965. doi:[10.3390/ijerph16060965](https://doi.org/10.3390/ijerph16060965)
45. Sumter SR, Bokhorst CL, Steinberg L, Westenberg PM. The developmental pattern of resistance to peer influence in adolescence: will the teenager ever be able to resist? *J Adolesc.* 2009;32(4):1009-1021. doi:[10.1016/j.adolescence.2008.08.010](https://doi.org/10.1016/j.adolescence.2008.08.010)

#### CONFLICTS OF INTEREST

The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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#### ETHICAL APPROVAL AND INFORMED CONSENT

Ethical approval was obtained from the Health Research and Ethics Committee of the Lagos State University Teaching Hospital (Approval

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#### DATA AVAILABILITY

The data supporting this research are available from the authors on reasonable request.

#### PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed.