

Differences in risk indicators associated with electronic cigarette use and tobacco smoking among adolescents and young people in Nigeria

Morenike Oluwatoyin Folayan ,¹ Omolola Alade,² Yewande Adeyemo,³ Heba Jafar Sabbagh,^{4,5} Afolabi Oyapero,⁶ Elizabeth O Oziegbe,⁷ Bamidele Olubukola Popoola ,⁸ Maryam Quritum,⁹ Maha El Tantawi¹⁰

To cite: Folayan MO, Alade O, Adeyemo Y, *et al*. Differences in risk indicators associated with electronic cigarette use and tobacco smoking among adolescents and young people in Nigeria. *BMJ Open Res* 2022;**9**:e001285. doi:10.1136/bmjresp-2022-001285

► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/bmjresp-2022-001285>).

Received 21 April 2022
Accepted 24 August 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to
Dr Morenike Oluwatoyin Folayan;
toyinukpong@yahoo.co.uk

ABSTRACT

Introduction The study determined the proportion of adolescents and young persons (AYP) in Nigeria who use e-cigarettes and smoke tobacco; and identified factors associated with the use of e-cigarettes and tobacco smoking.

Methods AYP aged 11–23 years were recruited to participate in an online survey. The independent variables were respondents' health, HIV and COVID-19 status and their level of anxiety. The dependent variables were tobacco smoking and use of e-cigarettes. Binary logistic regression was used to determine the associations between the dependent and independent variables after adjusting for confounders (age, sex, educational level and vulnerability status).

Results There were 2206 respondents of which 568 (19.8%) used e-cigarettes and 787 (27.4%) smoked tobacco. Individual (18–23 years, having a health condition, high anxiety and being vulnerable) and familial (having father, mother, siblings or friends who used e-cigarettes) factors were associated with both the use of e-cigarettes and tobacco smoking. Tobacco smoking was a significant risk indicator for e-cigarettes use and vice versa. COVID-19 infection (adjusted OR, AOR: 3.602) and living with HIV (AOR: 1.898) were associated with higher odds of using e-cigarettes. Males (AOR: 1.577), 15–17 years (AOR: 6.621) and moderate anxiety (AOR: 2.500) were associated with higher odds of tobacco smoking. AYP with health conditions had higher odds of using e-cigarettes (AOR: 1.514) while AYP with moderate anxiety had lower odds of using e-cigarettes (AOR: 0.627).

Conclusion The proportion of AYP in Nigeria who used e-cigarettes and smoked tobacco is high. Public health interventions that target the common risk factors for e-cigarettes use and tobacco smoking among AYP in Nigeria are urgently needed.

INTRODUCTION

Adolescents and young people who smoke have more health problems such as upper respiratory tract infection due to decreased mucociliary clearance of the mucous membrane of the airway, immature lung

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Smoking is associated with more health risks.

WHAT THIS STUDY ADDS

⇒ The high proportion of adolescents and young people who use e-cigarettes and smoke tobacco in Nigeria is a growing public health crisis that needs to be addressed.
⇒ There are a number of common individual and familiar risk indicators for using e-cigarettes and smoking tobacco among adolescents and young people in Nigeria.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ A cost-effective tobacco control policy and guidelines can be designed and implemented in Nigeria to be implemented by agencies who work with young people to actively integrate tobacco use prevention counselling into all their programmes.

development, dysfunction of the peripheral airway, reduced maximum vital capacity, bronchial inflammation, increased permeability of airway mucous membrane and fibrosis.¹ Also, smoking causes a decrease in the blood immunoglobulins, weakening antigen–antibody reactions, inhibiting cytokine secretion by weakening the function of phagocytes and decreasing the CD4+ lymphocytes count thereby increasing the risk for viral and bacterial respiratory infections.^{1 2} Smoking is also a causal factor for lung cancer and a gateway to substance abuse.² The use of e-cigarettes is also associated with deleterious health effects including a high risk for adverse mental health³ and anxiety disorders.^{4 5}

The health problems associated with smoking lead to preventable premature deaths. Yet, the global prevalence of smoking of at least one cigarette per day during the



past 30 days among adolescents aged 13–15 years is as high as 11.3% in boys and 6.1% in girls.⁶ In Africa, about 4.6%–36.6% of adolescents are tobacco smokers and the prevalence in boys is 7.8%–35.5%.⁷ There is little data on the prevalence and factors associated with the use of e-cigarettes and tobacco smoking among adolescents in sub-Saharan Africa.

In Nigeria, the number of adolescents and young people in Nigeria who use e-cigarettes and smoke tobacco is high.^{8–9} Young people also perceive e-cigarettes as less harmful than tobacco smoking.¹⁰ The use of e-cigarettes is higher among males, older young persons, and associated with alcohol use, friend's use, use of other tobacco products and substance use¹⁰ but not with anxiety disorder.⁸ Tobacco smoking is also higher among men, starts at an age younger than 18 years and is associated with familial (smoking by parents, siblings and friends)^{11–13} and individual (males, older age and lower educational status) factors.^{12–13}

The COVID-19 pandemic may also be a risk factor for smoking in adolescents. A diagnosis of COVID-19 is associated with more people using e-cigarettes and smoking of tobacco.¹⁴ Also, tobacco smoking is positively associated with COVID-19 progression and an increased risk of death especially in younger adults.¹⁵ During the pandemic, as high as 60% of e-cigarette users in the USA either quit or reduced its use.¹⁶ Those who increased tobacco smoking were more likely to have mental and financial stress or felt lonely and isolated during the pandemic.^{17–18}

Living with HIV and having other health conditions are also associated with an increase in the risk for mental and financial stress, as well as e-cigarette use and tobacco smoking.¹⁹ There is, however, little information on the pattern of use of e-cigarettes and tobacco smoking among adolescents and young people who have health conditions, who live with HIV, and who had COVID-19 infection. This is important in helping to design targeted tobacco smoking and electronic cigarette use prevention and support programmes during the pandemic or other similar pandemics in the future.

This study is based on the theory of planned behaviour²⁰ that links parental factor as a risk indicator for smoking. Parental smoking directly affects the attitude, self-efficacy and acceptance of smoking as a social norm by young people.²¹ In addition, we explored the threat appraisal (health status, HIV status, COVID-19 status) and coping appraisal pathways (change in the frequency of smoking) of the protection motivation theory^{22–24} to explore individual factors that may be associated with the use e-cigarettes and smoking of tobacco by adolescents and young adults in Nigeria during the COVID-19 pandemic. We postulated that identifying the individual and familial risk indicators for the use e-cigarettes and smoking of tobacco will make it easier to plan interventions that can promote tobacco smoking and e-cigarette use cessation programmes using the incremental theory of smoking.²⁵

The aim of this study, therefore, was to determine the proportion of adolescents and young persons in Nigeria who use e-cigarettes and smoke tobacco; and identify differences in the factors associated with the use of e-cigarettes and tobacco smoking in this population. We hypothesised that individual and familial factors will be positively associated with higher risk of using e-cigarettes and tobacco smoking.

METHODS

Patient and public involvement in research

This study was implemented along with YouthRise, a non-governmental organisation working with vulnerable populations in Nigeria. YouthRise complemented the work of the study team by engaging its peer educators working in the 36 States of Nigeria and the Federal Capital Territory in Nigeria, to mobilise members of the community to take the survey. The survey was conducted between 1 November and 30 December 2021. Online supplemental file 1 provides details of the distribution of the study participants by state.

The questionnaire began by explaining the purpose of the study, assuring participants of the confidentiality of their responses, and their freedom to withdraw from the survey at any time. Study participants had to check a consent box indicating they had read the information sheet and consented to participate in the study. For minors, parents had to first check the consent box before the information sheet and assent form for the adolescent popped up for checking. All participants who indicated they were not willing to participate in the study after reading the informed consent sheet were thanked and exited from the survey.²⁶

Study design, study participants and study setting

This was a cross-sectional study conducted between 1 November 2021 and 30 December 2021. The study participants were 11–23 years who filled an online survey launched using the Survey Monkey platform. There were no exclusion criteria for study participation.

Recruitment of study participants

Study participants were recruited using a combination of non-probability sampling techniques: convenience sampling and respondent-driven sampling. The study investigators reached out to networks of adolescents and young persons, shared their unique survey link with their contacts and encouraged them to share the link with their peers. The survey link was also posted on social media groups (Facebook, Twitter and Instagram) and network email lists and WhatsApp groups of young people. In addition, the study team recruited a diverse population of 37 adolescent and young persons (one per state and the Federal Capital Territory), trained them on the study protocol and asked them to share their unique

link with their peers. Each young person got paid N10 000 (US\$26.32) to recruit 50 online participants.

Data collection instrument

Data were collected using a questionnaire that was developed for a multicountry study exploring the impact of COVID-19 on smoking and oral health of adolescents and young people.²⁷ The links to the survey were prepared with settings to ensure that participants could change their answers freely before they chose to submit, that responses were anonymous and were not time-limited. Only one submission was allowed for an electronic device. The questionnaire was developed in Arabic and translated by native speakers into French, Malay, Turkish and English. The English version was used for data collection in Nigeria (online supplemental file 2).

The questionnaire was validated by 10 experts who reviewed a draft to assess its comprehensiveness in capturing all the elements of oral health and smoking related to the study objectives; ensure the sequence of the questions was logical; that the questions were culturally appropriate and that they would not breach any ethical concerns. The review was conducted between the 20th October 2021 and 25 October 2021. Four comments were received from 4 of the 10 experts. The finalised questionnaire included 39 questions. The Content Validity Index calculated for the finalised questionnaire was 0.87.²⁸ The questions were closed-ended, took an average of 10 min to complete and were answered anonymously.

Study variables

Independent variables

Health status

Participants were asked about their health problems. They were required to tick 1 or more of 23 health conditions. There was also an option to select other health conditions not in the list. The health conditions listed were arthritis, diabetes, broken bones, dermatologic problems, cancer, depression, heart condition, hepatitis, herpes, hypertension, migraines, neuropathy, neurological problems, respiratory problems, pneumonia, shingles and other sexually transmitted infections, stroke, hearing loss, vision loss and others. There was also an option to select if the participants had no health condition. These questions were adopted from a questionnaire that had been validated for global use.²⁹ Participants' responses were dichotomised into those who had no health condition (those who checked the 'none' options) and those who had a health condition (anyone who ticked an option).

HIV status

Participants identified if their HIV status was positive, negative or unknown. Respondents with unknown HIV status were excluded from further analysis.

COVID-19 status

Participants were asked if they had tested positive for COVID-19 (yes/no).

Anxiety level

Participants' psychological status was assessed using the Generalised Anxiety Disorder 7-item scale.³⁰ The scale included seven items: (1) feeling nervous, anxious or on edge; (2) being able to stop or control worrying; (3) worrying too much about different things; (4) trouble relaxing; (5) being restless; (6) becoming easily annoyed or irritable and (7) feeling afraid as if something awful might happen. The items were assessed on a 4-point scale ranging from 0: not at all to 3: nearly every day. The total score was the sum of points of all items ranging from 0 to 21. The cut-off points were 5, 10 and 15 for mild, moderate and severe anxiety, respectively.³¹ The scale had been validated for use in many countries^{32 33} and in Nigeria using a large and diverse sample of the population.³⁴ The Cronbach's alpha score for the score in this study was 0.87.

Dependent variables

Smoking status

Participants were also asked about cigarette smoking (hitherto referred to as tobacco smoking) and the use of e-cigarettes using the Global Youth Tobacco Survey.³⁵ Participants were asked if they were current, former or never smokers of tobacco. Respondents were categorised as smokers if they selected 'current' and non-smokers if they selected 'former' or 'never'. Respondents were also asked if they had ever used e-cigarettes (yes/ no). In addition, respondents were asked if any of the following persons were e-cigarettes users: father, mother, siblings, close friends on a yes/ no basis.

Confounders

Participant were asked about their age (categorised into 11–14, 15–17 and 18–23 years), sex at birth (male, female and others) and educational level (none, primary, secondary and college/university). Participants were categorised as vulnerable if they ticked any of these options: engaged in transactional sex, used illegal drugs or prescription drugs without prescription and injected drugs without a needle.

Statistical analysis

Frequencies and percentages were calculated for the study variables. The associations between the dependent and independent variables were assessed by using the χ^2 test. Binary logistic regression modelling using IBM SPSS for Windows V.22.0 (IBM) was used to determine the independent variables associated with use of e-cigarettes and with tobacco smoking. Adjusted ORs (AORs), 95% CIs and p values were calculated. Statistical significance was set at $p < 0.05$.



RESULTS

The number of responses per the geopolitical zones in Nigeria is highlighted in online supplemental file 1.

Table 1 shows that there were 2206 (76.9%) of the 2870 respondents who were 18–23 years, 1449 (50.0%) males and 1294 (45.1%) university students. In addition, 568 (19.8%) participants reported using e-cigarettes and 787 (27.4%) participants reported current smoking of tobacco.

Table 1 also shows that 173 (6%) participants reported living with HIV, 344 (12%) participants were infected with COVID-19 and 313 (10.9%) participants had severe anxiety. Also, 1233 (43.0%) participants considered themselves vulnerable. More respondents who were 18–23 years ($p<0.001$), male ($p<0.001$), had secondary school level education or less ($p<0.001$), had a health condition ($p<0.001$), was living with HIV ($p<0.001$), was vulnerable ($p<0.001$), was infected with COVID-19 ($p<0.001$) or has moderate or severe levels of anxiety ($p<0.001$) used e-cigarettes. Also, more respondents who used e-cigarettes also currently smoked tobacco ($p<0.001$), and had father ($p<0.001$), mother ($p<0.001$), siblings ($p<0.001$) or close friends ($p<0.001$) used e-cigarettes.

Like e-cigarette use, more respondents who were 18–23 years ($p<0.001$), male ($p=0.013$), had secondary school level education or less ($p<0.001$), had a health condition ($p<0.001$), was living with HIV ($p<0.001$), was vulnerable ($p<0.001$), was infected with COVID-19 ($p<0.001$) or has moderate or severe levels of anxiety ($p<0.001$) currently smoked tobacco. Also, more respondents who had father ($p<0.001$), mother ($p<0.001$), siblings ($p<0.001$) or close friends ($p<0.001$) who used e-cigarettes, currently smoked tobacco.

Table 2 shows that risk indicators with statistically significant higher odds with e-cigarette use were: 18–23 years (AOR 3.354; 95% CI 1.507 to 7.465), senior secondary school level of education (AOR 2.082; 95% CI 1.537 to 2.819), with a health condition (AOR 1.514; 95% CI 1.150 to 1.994); with a COVID-19 infection (AOR 3.602; 95% CI 2.199 to 4.263); living with HIV (AOR 1.898; 95% CI 1.276 to 2.823); high anxiety (AOR 1.872; 95% CI 1.335 to 2.627), tobacco smoking (AOR 3.554; 95% CI 2.625 to 4.812) and being vulnerable (AOR 2.000; 95% CI 1.522 to 2.628). On the other hand, respondents with moderate anxiety (AOR 0.627; 95% CI 0.450 to 0.874) had statistically significant lower odds of using e-cigarettes when compared with persons with low anxiety.

The following familial variables were associated with statistically significant higher odds of e-cigarette use: having father (AOR 1.520; 95% CI 1.089 to 2.122), mother (AOR 2.158; 95% CI 1.519 to 3.065), sibling (AOR 2.334; 95% CI 1.731 to 3.148) or close friends (AOR 2.724; 95% CI 2.106 to 3.523) who used e-cigarettes

The risk indicators for tobacco smoking that were associated with significantly higher odds of tobacco smoking were: 18–23 years (AOR 11.335; 95% CI 5.146 to 24.968), 15–17 years (AOR 6.621; 95% CI 2.778 to 15.782), male (AOR 1.577; 95% CI 1.238 to 2.008), had junior

secondary school education (AOR 1.870; 95% CI 1.217 to 2.872), had high (AOR 1.626; 95% CI 1.117 to 2.366) or moderate anxiety (AOR 2.500; 95% CI 1.902 to 3.284), an e-cigarette user (AOR 3.201; 95% CI 2.346 to 4.366) and being vulnerable (AOR 2.931; 95% CI 2.307 to 3.724).

The familial variables associated with significantly higher odds of tobacco smoking were: having a father (AOR 3.680; 95% CI 2.635 to 5.140), mother (AOR 1.573; 95% CI 1.074 to 2.304), sibling (AOR 2.199; 95% CI 1.619 to 2.987) or close friends (AOR 4.142; 95% CI 3.260 to 5.264) who smoked cigarettes.

DISCUSSION

The findings of this study suggest about one in five adolescents and young people in Nigeria use e-cigarettes and one in four adolescents and young people smoke tobacco. The risk indicators common to both using e-cigarettes and currently smoking tobacco were being 18–23 years, high anxiety, being vulnerable and having father, mother, siblings or friends who smoked. Smoking tobacco was a risk indicator for the use of e-cigarettes and vice versa. Respondents with a health condition, COVID-19 infection and who were living with HIV were more likely to use e-cigarettes. Respondents who were males, 15–17 years and who had moderate anxiety were more likely to smoke tobacco. Respondents with moderate anxiety were less likely to use e-cigarettes. The study hypothesis was supported by the study findings.

One of the strengths of this study is the large sample size. The study also provides new evidence on the use of e-cigarettes and tobacco smoking by adolescents and young people living with HIV, who had health conditions, had COVID-19 and who considered themselves vulnerable. This new evidence can inform policy formulation and tobacco cessation programme planning in Nigeria and similar settings. The study, however, has some limitations. It is a cross-sectional study, and so a cause-and-effect relationship between the variables cannot be inferred. It was a convenience sample liable to selection bias though the COVID-19 pandemic precluded the use of probability sampling techniques.³⁶ We, however, made efforts to ensure the greatest geographical spread and inclusion of all administrative districts in the recruitment process; and the response to the online survey implied that respondents participated because they were interested and felt comfortable answering the questions.^{37 38} Also, respondents self-reported their oral health and smoking habit which carries a risk of social desirability and recall biases. There is also a probability of a response bias for respondents who needed parental consent for study participation if parents provided oversight for their responses. Despite these limitations, the study provides new insights on adolescents and young people's use of e-cigarettes and tobacco smoking in Nigeria.

First, the findings suggest that a large number of adolescents and young people in Nigeria use e-cigarettes and smoke tobacco, indicating the country may have a

Table 1 Sociodemographic characteristics associated with the use of e-cigarettes and current tobacco smoking among adolescents and young people 11–23 years in Nigeria (n=2870)

Variables	Ever used e-cigarettes N=2870		P value	Current tobacco smoking N=2870		P value	Total N=2870 n (%)
	Yes N=568 n (%)	No N=2302 n (%)		Yes N=787 n (%)	No N=2083 N (%)		
A) Sociodemographic profile of study participants							
Age (years)							
18–23	521 (23.6)	1685 (76.4)	<0.001	727 (33.0)	1479 (67.0)	<0.001	2206 (76.9)
15–17	38 (11.6)	289 (88.4)		52 (15.9)	275 (84.1)		327 (11.4)
11–14	9 (2.7)	328 (97.3)		8 (2.4)	329 (97.7)		337 (11.7)
Sex at birth							
Male	300 (20.7)	1149 (79.3)	<0.001	427 (29.5)	1022 (65.0)	0.013	1449 (50.5)
Female	268 (18.9)	1153 (81.1)		360 (25.3)	1061 (74.7)		1421 (49.5)
Education status							
Secondary school or less	432 (27.4)	1144 (72.6)	<0.001	553 (35.1)	1023 (65.0)	<0.001	1576 (54.9)
University or higher	136 (10.5)	1158 (89.5)		234 (18.1)	1060 (81.9)		1294 (45.1)
B) Other adolescent and young adults characteristics							
Health condition							
Yes	268 (41.8)	373 (58.2)	<0.001	326 (50.9)	315 (49.1)	<0.001	641 (22.3)
No	300 (13.5)	1929 (86.5)		461 (20.7)	1768 (79.3)		2229 (77.7)
Living with HIV							
Yes	89 (51.4)	84 (48.6)	<0.001	97 (56.1)	76 (43.9)	<0.001	173 (6.0)
No	479 (17.8)	2218 (82.2)		690 (25.6)	2007 (74.4)		2697 (94.0)
Vulnerability							
Yes	436 (35.4)	797 (64.6)	<0.001	599 (48.6)	634 (51.4)	<0.001	1233 (43.0)
No	132 (8.0)	1505 (92.0)		188 (11.5)	1449 (88.5)		1637 (57.0)
Infected with COVID-19							
Yes	210 (61.0)	134 (39.0)	<0.001	215 (62.5)	129 (37.5)	<0.001	344 (12.0)
No	358 (14.2)	2168 (85.8)		572 (22.6)	1954 (77.4)		2526 (88.0)
Anxiety status							
Low	188 (11.4)	1464 (88.6)	<0.001	220 (13.3)	1432 (86.6)	<0.001	1652 (57.6)
Moderate	282 (31.2)	623 (68.8)		463 (51.2)	442 (48.8)		905 (31.5)
Severe	98 (31.3)	215 (68.7)		104 (33.2)	209 (66.8)		313 (10.9)
C. Familiar e-cigarettes experience							
Smoker							
Yes	401 (70.6)	167 (29.4)	<0.001	401 (51.0)	167 (21.3)	<0.001	568 (27.4)
No	386 (16.8)	1916 (83.2)		386 (16.8)	1916 (83.2)		2302 (72.6)
Father use e-cigarettes							
Yes	102 (50.7)	99 (49.3)	<0.001	144 (71.6)	57 (28.4)	<0.001	201 (7.0)
No	466 (17.5)	2203 (82.5)		643 (24.1)	2026 (75.9)		2669 (93.0)
Mother use e-cigarettes							
Yes	160 (56.7)	122 (43.3)	<0.001	193 (68.4)	89 (31.6)	<0.001	282 (9.8)
No	408 (15.8)	2180 (84.2)		594 (23.0)	1994 (77.0)		2588 (90.2)
Sibling use e-cigarettes							
Yes	157 (54.9)	129 (45.1)	<0.001	194 (67.8)	92 (32.1)	<0.001	286 (10.0)
No	411 (15.9)	2173 (84.1)		593 (22.9)	1991 (77.1)		2584 (90.0)
Close friends use e-cigarettes							
Yes	252 (43.2)	332 (56.8)	<0.001	338 (57.9)	246 (42.1)	<0.001	584 (20.3)
No	316 (13.8)	1970 (86.2)		449 (19.6)	1837 (80.4)		2286 (79.7)
*Mann-Whitney test.							

**Table 2** Binary regression models to identify risk indicators for e-cigarette and current tobacco smoking by adolescents and young people 11–23 years in Nigeria

Variables	E-cigarettes use AOR (95% CI), p value	Current tobacco smoking AOR (95% CI), p value
Individual factors associated with use of e-cigarettes and tobacco smoking		
Age (years)		
18–23	3.354 (1.507 to 7.465), 0.003	11.335 (5.146 to 24.968), <0.001
15–17	1.767 (0.752 to 4.151), 0.191	6.621 (2.778 to 15.782), <0.001
11–14	1.000	1.000
Sex at birth		
Male	1.221 (0.944 to 1.580), 0.129	1.577 (1.238 to 2.008), <0.001
Female	1.000	1.000
Education		
Primary	1.284 (0.619 to 2.663), 0.502	2.138 (0.902 to 5.066), 0.084
Junior secondary school	1.265 (0.814 to 1.968), 0.296	1.870 (1.217 to 2.872), 0.004
Senior secondary school	2.082 (1.537 to 2.819), <0.001	0.981 (0.731 to 1.315), 0.896
Tertiary	1.000	1.000
Health condition		
Yes	1.514 (1.150 to 1.994), 0.003	1.180 (0.869 to 1.601), 0.289
No	1.000	1.000
COVID-19 infection		
Yes	3.602 (2.199 to 4.263), <0.001	0.926 (0.624 to 1.375), 0.702
No	1.000	1.000
Living with HIV		
Yes	1.898 (1.276 to 2.823), 0.002	1.136 (0.708 to 1.822), 0.597
No	1.000	1.000
Anxiety status		
High	1.872 (1.335 to 2.627), <0.001	1.626 (1.117 to 2.366), 0.011
Moderate	0.627 (0.450 to 0.874), 0.006	2.500 (1.902 to 3.284), <0.001
Low	1.000	1.000
Vulnerability		
Yes	2.000 (1.522 to 2.628), <0.001	2.931 (2.307 to 3.724), <0.001
No	1.000	1.000
Tobacco smoking		
Yes	3.554 (2.625 to 4.812), <0.001	
No	1.000	
E- cigarette use		
Yes		3.201 (2.346 to 4.366), <0.001
No		1.000
Familiar factors associated with use of e-cigarettes and tobacco smoking		
Father		
Yes	1.520 (1.089 to 2.122), 0.014	3.680 (2.635 to 5.140), <0.001
No	1.000	1.000
Mother		
Yes	2.158 (1.519 to 3.065), <0.001	1.573 (1.074 to 2.304), 0.020
No	1.000	1.000
Sibling		
Yes	2.334 (1.731 to 3.148), <0.001	2.199 (1.619 to 2.987), <0.001

Continued

Table 2 Continued

Variables	E-cigarettes use AOR (95% CI), p value	Current tobacco smoking AOR (95% CI), p value
No	1.000	1.000
Close friends		
Yes	2.724 (2.106 to 3.523), <0.001	4.142 (3.260 to 5.264), <0.001
No	1.000	1.000

AOR, adjusted OR.

tobacco and e-cigarette use public health problem that needs strategic planning for effective interventions. The proportion of young people who use e-cigarette in this study is higher than the 7.9% e-cigarette users⁸ reported in a prior study conducted in Nigeria, and the 9.2% current e-cigarette use among youths in a multicountry study.³⁹ Also, the proportion to those smoking tobacco is higher than the 10.4% current tobacco smokers reported in a prior study conducted in Nigeria⁹ and the 19.1% among youths in Africa.⁴⁰ Our study collected data for those with a history of e-cigarette use while the comparative data were those of current e-cigarette use. Nevertheless, the results of this study may indicate a growing prevalence of e-cigarette use and tobacco smoking among the study population of adolescents and young people in Nigeria. A national study on the use of e-cigarettes and tobacco smoking may inform the development of a national strategic plan for effective tobacco use control among adolescents and young adults in Nigeria. Sadly, the country is not taking steps to monitor tobacco and e-cigarette use. In the meantime, programmes working with adolescents and young people in Nigeria should integrate smoking cessation counselling for their clients.

Second, the common familial (father, mother, siblings and close friends who smoked) and individual (age, high anxiety and having a health condition) factors associated with higher risk of using e-cigarettes and smoking tobacco had been reported in previous studies.^{41–43} This may be because of the e-liquid in many e-cigarettes contain nicotine.⁴⁴ The results of the study also reflect the influence that social network has on health behaviours⁴⁵; and agree with prior studies indicating that children of smokers were more likely to smoke, and become habitual smokers⁴⁶; and mothers' smoking had a stronger impact on the transition of adolescents and young persons to habitual smoking than friends who smoke.⁴⁷ The stronger influence of close friends than parents reported in this study may reflect poor parent–child communication on health issues in Nigeria⁴⁸ and the stronger ties that adolescents have with their peers than their parents.⁴⁸ The findings had been reported by an earlier study conducted in Nigeria.¹⁰ The findings emphasise that smoking interventions in Nigeria need to be sensitive to family and social network contexts; and that prevention messages should be tailored to address these influences.⁴⁷

Third, we also observed that young people who identified themselves as vulnerable seemed more likely to smoke tobacco and use e-cigarettes than those who did not perceive themselves as vulnerable. The perception of vulnerability is diverse, complex, dynamic and often, few people self-identify as being vulnerable.⁴⁹ An awareness of one's vulnerability may create stress and anxiety; and may be associated with smoking as a destressor.^{50 51} The multiple health programmes in Nigeria working with populations vulnerable to HIV infection—sex workers, drug users, sexual and gender minority—who face stress because of the conflict between their values and the dominant societal values⁵¹ could include tobacco cessation into their programmes. Also, the National Tobacco Control Act 2015⁵² should focus on vulnerable populations who are often the targets of marketing by the tobacco industry.⁵³

Fourth, though a prior study in Nigeria indicated that e-cigarette use was not associated with anxiety disorder,⁸ we observed that respondents with moderate anxiety were more likely to use e-cigarettes and smoke tobacco. These findings may point to a growing tobacco use problem in Nigeria, a country with the highest level of stress in the world^{54 55} and where tobacco cessation programmes are poorly implemented.⁵⁶ Further studies are needed to understand how anxiety influences decisions related to tobacco use by adolescents and young persons.

Finally, we also observed that respondents with a health condition, COVID-19 infection and living with HIV were more likely to use e-cigarettes than smoke tobacco. The result may reflect a change from tobacco smoking to e-cigarette use by young people with health problems, or that young people with medical problems resort to e-cigarettes as a destressor based on an assumption that e-cigarettes is safer than tobacco smoking. Further studies are needed to explain the reason(s) for this study findings. In the interim, there needs to be more education about the higher risk of heart and lung diseases for users of e-cigarette.^{57 58} Also, e-cigarette use has severe implication for COVID-19 co-infection as it may suppress inflammatory and immune-response in nasal epithelial cells in a similar mechanism to tobacco smoke.⁵⁹ The effectiveness of e-cigarettes as a tobacco cessation tool remains unclear and tobacco smokers should be advised to quit smoking completely rather than switching to e-cigarettes.⁶⁰



In conclusion, the proportion of adolescents and young people who use e-cigarettes and smoke tobacco in this population is high. Though we observed that e-cigarette use and tobacco consumption shared individual and familial risk factors, the study findings point to a complex relationship between factors associated with the use of e-cigarettes and smoking of tobacco that needs to be studied further. In the interim, public health programmes should target these common risk factors for e-cigarette use and tobacco smoking.

Author affiliations

¹Department of Child Oral Health, Obafemi Awolowo University, Ile-Ife, Osun, Nigeria

²Department of Preventive and Community Dentistry, Obafemi Awolowo University, Ile-Ife, Nigeria

³Department of Child Dental Health, Bayero University Kano, Kano, Nigeria

⁴Preventive Dental Sciences, King Abdulaziz University, Jeddah, Saudi Arabia, Jeddah, Saudi Arabia

⁵Dental School, Dundee University, UK

⁶Department of Preventive Dentistry, Lagos State University College of Medicine, Ojo, Nigeria

⁷Department of Child Dental Health, Obafemi Awolowo University, Ile-Ife, Nigeria

⁸Department of Child Oral Health, University of Ibadan, Ibadan, Oyo, Nigeria

⁹Department of Preventive and Community Dentistry, Alexandria University, Alexandria, Egypt

¹⁰Department of Pediatric Dentistry and Dental Public Health, Alexandria University, Alexandria, Egypt

Acknowledgements The authors would like to thank all study participants for the commitment of their time and effort in sharing their information. We also appreciate the contributions of all YouthRise peer educators involved in recruiting participants and implementing the online survey.

Contributors MOF and HJS were involved with the design and planning of the study. OAI and MQ were involved with the management of the logistics of the study implementation. OAF, YA, OAI, EOO and BOP were involved with the recruitment of study participants. HJS and MET conducted the data analysis. MOF and HJS drafted the first edition of the manuscript. MOF, HJS, OAF, MQ, YA, OAI, EOO, BOP and MET read and revised the first edition of the manuscript. HJS accepts full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish. All authors consented to the submission of the final version of the manuscript.

Funding The funding for the implementation of this study was provided by out-of-pocket expenses of the study team.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval Ethical approval was obtained from the Institute of Public Health, Obafemi Awolowo University Health Research Ethics Committee (IPH/OAU/12/1604). The study was carried out according to the National Research Ethics Regulation and the Declaration of Helsinki. Informed consent was obtained from parents of participants who reported they were aged 11 to 17 years old; and assent was also sought from participants 12–17 years before they could continue with the study participation. Respondents aged 18 to 23 years could participate by giving an independent informed consent.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines,

terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Morenike Oluwatoyin Folayan <http://orcid.org/0000-0002-9008-7730>

Bamidele Olubukola Popoola <http://orcid.org/0000-0003-2037-9698>

REFERENCES

- Xavier RF, Ramos D, Ito JT, *et al*. Effects of cigarette smoking intensity on the mucociliary clearance of active smokers. *Respiration* 2013;86:479–85.
- Park S-H. Smoking and adolescent health. *Korean J Pediatr* 2011;54:401–4.
- Pham T, Williams JVA, Bhattarai A, *et al*. Electronic cigarette use and mental health: a Canadian population-based study. *J Affect Disord* 2020;260:646–52.
- Lechner WV, Janssen T, Kahler CW, *et al*. Bi-Directional associations of electronic and combustible cigarette use onset patterns with depressive symptoms in adolescents. *Prev Med* 2017;96:73–8.
- Cummins SE, Zhu S-H, Tedeschi GJ, *et al*. Use of e-cigarettes by individuals with mental health conditions. *Tob Control* 2014;23 Suppl 3:iii48–53.
- Ma C, Xi B, Li Z, *et al*. Prevalence and trends in tobacco use among adolescents aged 13–15 years in 143 countries, 1999–2018: findings from the global youth tobacco surveys. *Lancet Child Adolesc Health* 2021;5:245–55.
- Roble AK, Osman MO, Lathwal OP, *et al*. Prevalence of cigarette smoking and associated factors among adolescents in eastern Ethiopia, 2020. *Subst Abuse Rehabil* 2021;12:73–80.
- 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* 2012;16:e0258850.
- Adeloye D, Auta A, Fawibe A, *et al*. Current prevalence pattern of tobacco smoking in Nigeria: a systematic review and meta-analysis. *BMC Public Health* 2019;19:1719.
- Osibogun O, Odukoya OO, Odusolu YO, *et al*. Knowledge and risk perception of e-cigarettes and hookah amongst youths in Lagos state, Nigeria: an exploratory study. *Niger Postgrad Med J* 2020;27:384–90.
- Tucker JS, Ellickson PL, Klein DJ. Predictors of the transition to regular smoking during adolescence and young adulthood. *J Adolesc Health* 2003;32:314–24.
- Lee GC, Kim YJ, Shin YK. The state of smoking and alcohol use in Korean adolescents. *J Korean Pediatr Soc* 1997;40:307–17.
- Soh JH, Jung YK, Jang GY. Predisposing factors of risk taking behaviors in Korean adolescents. *J Korean Pediatr Soc* 2001;44:1364–73.
- Gaiha SM, Cheng J, Halpern-Felsher B. Association between youth smoking, electronic cigarette use, and COVID-19. *J Adolesc Health* 2020;67:519–23.
- Patanavanich R, Glantz SA. Smoking is associated with worse outcomes of COVID-19 particularly among younger adults: a systematic review and meta-analysis. *BMC Public Health* 2021;21:1554.
- Gao M, Aveyard P, Lindson N, *et al*. Association between smoking, e-cigarette use and severe COVID-19: a cohort study. *Int J Epidemiol* 2022;51:1062–72.
- Gaiha SM, Lempert LK, Halpern-Felsher B. Underage youth and young adult e-cigarette use and access before and during the coronavirus disease 2019 pandemic. *JAMA Netw Open* 2020;3:e2027572.
- Ghadban YA, Zgheib N, Romani M, *et al*. Impact of the COVID-19 pandemic on smoking behavior and beliefs among the American University of Beirut community. *Tob Prev Cessat* 2022;8:1–8.
- Mdege ND, Shah S, Ayo-Yusuf OA, *et al*. Tobacco use among people living with HIV: analysis of data from demographic and health surveys from 28 low-income and middle-income countries. *Lancet Glob Health* 2017;5:e578–92.
- Ajzen I. The theory of planned behavior. *Organ Behav Hum Decis Process* 1991;50:179–211.

- 21 Harakeh Z, Scholte RHJ, Vermulst AA, *et al.* Parental factors and adolescents' smoking behavior: an extension of the theory of planned behavior. *Prev Med* 2004;39:951–61.
- 22 Rogers RW. A protection motivation theory of fear appeals and attitude Change1. *J Psychol* 1975;91:93–114.
- 23 Maddux JE, Rogers RW. Protection motivation and self-efficacy: a revised theory of fear appeals and attitude change. *J Exp Soc Psychol* 1983;19:469–79.
- 24 Rogers R. Cognitive and physiological processes in fear-based attitude change: A revised theory of protection motivation. In: Caccioppo J, Petty R, eds. *Social psychophysiology: a sourcebook*. New York: Guilford, 1983: 153–76.
- 25 Vietor NA. *Understanding smoking relapse from an implicit theories framework*. Houston, TX: University of Houston, 2001.
- 26 World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. *Bull World Health Organ* 2001;79:373–4.
- 27 Sabbagh HJ, Abdelaziz W, Quritum M, *et al.* Cigarettes' use and capabilities-opportunities-motivation-for-behavior model: a multi-country survey of adolescents and young adults. *Front Public Health* 2022;10:875801.
- 28 Yusoff MSB, Yusoff MSB, Yusoff MSB. Abc of content validation and content validity index calculation. *EIMJ* 2019;11:49–54.
- 29 El Tantawi M, Folayan MO, Nguyen AL, *et al.* Validation of a COVID-19 mental health and wellness survey questionnaire. *BMC Public Health* 2022;22:1509.
- 30 Spitzer RL, Kroenke K, Williams JBW, *et al.* A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med* 2006;166:1092–7.
- 31 Löwe B, Decker O, Müller S, *et al.* Validation and standardization of the generalized anxiety disorder screener (GAD-7) in the general population. *Med Care* 2008;46:266–74.
- 32 Islam MS, Rahman ME, Moonajilin MS, *et al.* Prevalence of depression, anxiety and associated factors among school going adolescents in Bangladesh: findings from a cross-sectional study. *PLoS One* 2021;16:e0247898.
- 33 Mossman SA, Luft MJ, Schroeder HK, *et al.* The generalized anxiety disorder 7-item scale in adolescents with generalized anxiety disorder: signal detection and validation. *Ann Clin Psychiatry* 2017;29:227–34.
- 34 Adewuyi AO, Atilola O, Ola BA, *et al.* Current prevalence, comorbidity and associated factors for symptoms of depression and generalised anxiety in the Lagos state mental health survey (LSMHS), Nigeria. *Compr Psychiatry* 2018;81:60–5.
- 35 Centers for Disease Control and Prevention. Global youth tobacco survey (GYTS) — overview. Available: <https://nccd.cdc.gov/GTSS/DataSurveyResources/Ancillary/Documentation.aspx?SUID=1&DOCT=1> [Accessed 10 Apr 2021].
- 36 Hlatshwako TG, Shah SJ, Kosana P, *et al.* Online health survey research during COVID-19. *Lancet Digit Health* 2021;3:e76–7.
- 37 Galloway A. Non-Probability Sampling. In: *Encyclopedia of social measurement*, 2005.
- 38 Yeager DS, Krosnick JA, Chang L, *et al.* Comparing the accuracy of RDD telephone surveys and Internet surveys conducted with probability and Non-Probability samples. *Public Opin Q* 2011;75:709–47.
- 39 Sun J, Xi B, Ma C, *et al.* Prevalence of e-cigarette use and its associated factors among Youths aged 12 to 16 years in 68 countries and territories: global youth tobacco survey, 2012–2019. *Am J Public Health* 2022;112:650–61.
- 40 James PB, Bah AJ, Kabba JA, *et al.* Prevalence and correlates of current tobacco use and non-user susceptibility to using tobacco products among school-going adolescents in 22 African countries: a secondary analysis of the 2013–2018 global youth tobacco surveys. *Arch Public Health* 2022;80:121.
- 41 WHO. *Global report on trends in prevalence of tobacco use 2000–2025, third edition*. Geneva: World Health Organization, 2019.
- 42 Fite PJ, Cushing CC, Poquiz J, *et al.* Family influences on the use of e-cigarettes. *J Subst Use* 2018;23:396–401.
- 43 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;11:55–62.
- 44 Eaton DL, Kwan LY, Stratton K, eds. *Public Health Consequences of E-Cigarettes: Toxicology of E-Cigarette Constituents (chapter 5)*. Washington (DC): National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Population Health and Public Health Practice; Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems; National Academies Press (US), 2018.
- 45 Lewis MA, Rook KS. Social control in personal relationships: impact on health behaviors and psychological distress. *Health Psychol* 1999;18:63–71.
- 46 Wilkinson AV, Shete S, Prokhorov AV. The moderating role of parental smoking on their children's attitudes toward smoking among a predominantly minority sample: a cross-sectional analysis. *Subst Abuse Treat Prev Policy* 2008;3:18.
- 47 Stanton CA, Papandonatos G, Lloyd-Richardson EE, *et al.* How do mothers, fathers, and friends influence stages of adolescent smoking? *Adolesc Fam Health* 2009;4:95–111.
- 48 Mbachu CO, Agu IC, Eze I, *et al.* Exploring issues in caregivers and parent communication of sexual and reproductive health matters with adolescents in Ebonyi state, Nigeria. *BMC Public Health* 2020;20.
- 49 Vulnerability Registration Service. Vulnerability can affect us all. Available: <https://www.vulnerabilityregistrationservice.co.uk/vulnerability-affects-us-all/>
- 50 Parrott AC. Does cigarette smoking cause stress? *Am Psychol* 1999;54:817–20.
- 51 Meyer IH. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: conceptual issues and research evidence. *Psychol Bull* 2003;129:674–97.
- 52 Federal Republic of Nigeria official Gazette. National tobacco control act 2015. 1th June 2015: A179-208. Available: <https://www.tobaccocontrolaws.org/files/live/Nigeria/Nigeria%20-%20TCA%20-%20national.pdf> [Accessed 31 Mar 2021].
- 53 World Health Organization. *Electronic nicotine delivery systems and electronic non-nicotine delivery systems: a report for the conference of parties to the who FCTC (FCTC/COP/7/11)*, 2016.
- 54 The global Economy.com. Nigeria: fragile state index, 2022. Available: https://www.theglobaleconomy.com/Nigeria/fragile_state_index/ [Accessed 31 Mar 2022].
- 55 All Africa. Nigeria: Managing Stress in World's Most Stressful Country. Available: <https://allafrica.com/stories/201709140833.html> [Accessed 31 Mar 2022].
- 56 Oladepo O, Oluwasanu M, Abiona O. Analysis of tobacco control policies in Nigeria: historical development and application of multi-sectoral action. *BMC Public Health* 2018;18:959.
- 57 Alzahrani T, Pena I, Temesgen N, *et al.* Association between electronic cigarette use and myocardial infarction. *Am J Prev Med* 2018;55:455–61.
- 58 Wills TA, Pagano I, Williams RJ, *et al.* E-Cigarette use and respiratory disorder in an adult sample. *Drug Alcohol Depend* 2019;194:363–70.
- 59 Martin EM, Clapp PW, Rebuli ME, *et al.* E-Cigarette use results in suppression of immune and inflammatory-response genes in nasal epithelial cells similar to cigarette smoke. *Am J Physiol Lung Cell Mol Physiol* 2016;311:135–44.
- 60 Ghebreyesus TA. Progress in beating the tobacco epidemic. *Lancet* 2019;394:548–9.