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Factors Associated with Changes in E-Cigarette Use and Tobacco Smoking by Adolescents and Young People in Nigeria during the COVID-19 Pandemic

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Abstract: This study aimed to assess the proportion of adolescents and young people (AYP) in Nigeria who changed their frequency of e-cigarette use and tobacco smoking during the COVID-19 pandemic; and factors associated with the increase, decrease or no change in e-cigarette use and tobacco smoking (including night smoking). This study was a cross-sectional study of AYP recruited from all geopolitical zones in the country. Multivariate logistic regression analyses were conducted to determine if respondents' health HIV and COVID-19 status and anxiety levels were associated with changes in e-cigarette use and tobacco smoking frequency. There were 568 (59.5%) e-cigarette users, of which 188 (33.1%) increased and 70 (12.3%) decreased e-cigarette use and 389 (68.5%) increased night e-cigarette use. There were 787 (82.4%) current tobacco smokers, of which 305 (38.8%) increased and 102 (13.0%) decreased tobacco smoking and 534 (67.9%) increased night tobacco smoking. Having a medical condition was associated with lower odds of increased e-cigarette use (AOR:0.649; $p = 0.031$). High anxiety (AOR:0.437; $p = 0.027$) and having a medical condition (AOR:0.554; $p = 0.044$) were associated with lower odds of decreased e-cigarette use. Having COVID-19 symptoms (AOR:2.108; $p < 0.001$) and moderate anxiety (AOR:2.138; $p = 0.006$) were associated with higher odds of increased night e-cigarette use. We found complex relationships between having a medical condition, experiencing anxiety, changes in tobacco smoking and e-cigarette use among AYP in Nigeria during the COVID-19 pandemic that need to be studied further.

Keywords: tobacco smoking; e-cigarette use; adolescents and young people; COVID-19

1. Introduction

Former and current smokers have higher risks of COVID-19-related hospitalization and death than non-smokers [1]. This is because smokers are more susceptible to bacterial and viral respiratory infections [2] due to impaired mucocilliary oscillation caused by reduced replacement of cells and compromised integrity of intracellular contacts, reduced cough reflex sensitivity and increased ability for colonization and reproduction of pathogens. Tobacco smoking also decreases the nitric oxide synthetase activity and reduces a key early defense against infection [3,4]. Also, smokers' hand-to-mouth action and the sharing of tobacco products are factors that may increase a smoker's vulnerability to contracting COVID-19 [5]. The presence of smoking-induced lung disease increases the risk for worse outcomes in COVID-19 [6,7]. Nicotine upregulates the expression of ACE2 thereby increasing susceptibility to COVID-19 and aggravating the disease [8]. E-cigarettes also seem to have similar impacts on COVID-19 severity. E-cigarette use is associated with a higher risk of intensive care unit admission when patients are hospitalized and a higher risk of death from COVID-19, but the association was not significant [9]. E-cigarettes also induce lung disease [10].

The negative impact of smoking on the risk for COVID-19 may be a motivator to quit smoking. There are, however, few studies on how the pandemic may have affected the decisions of smokers to quit smoking. People who smoke probably had access to information about the higher risk of COVID-19 infection associated with smoking and may have reduced the frequency of smoking or quit smoking. However, evidence from England indicated that smokers' tobacco use remained unchanged during the pandemic [11]. On the contrary, there is evidence that suggests isolation at home had contributed to an increased quantity of tobacco use [8]. Anxiety, poor medical conditions, vulnerability to SARS-CoV-2 infection and HIV status are factors associated with COVID-19 risk-reduction behavior [12–16]. There are, however, no accessible studies on the role these factors may have played in making the decision to reduce smoking frequency or quit smoking during the pandemic. There is also little known about the age-related decisions made about changes in the frequency of smoking during the pandemic.

Although the risk for severe COVID-19 is low in adolescents and young people [16], smoking may increase this risk [17]. Adolescents and young people seem less likely to adopt COVID-19 preventive measures [18] and so may have been less likely to change their smoking habits during the pandemic despite their higher access to information about COVID-19, including the negative impact smoking has on the risk for severe disease among adolescents [19]. They are also more likely to use e-cigarettes than smoke tobacco compared to adults [20]. There is, however, nothing known about the factors that may have made adolescents change (increase or decrease the frequency of smoking) their smoking habits during the COVID-19 pandemic.

Of concern are the adolescents in Nigeria with a high and growing prevalence of tobacco smoking and e-cigarette use. One in five adolescents and young people in Nigeria use e-cigarettes, and one in four adolescents and young people smoke tobacco [21]. There is, however, nothing known about how the pandemic may have caused a change in the tobacco smoking and e-cigarette use of adolescents and young persons in Nigeria. Understanding the factors associated with the changes in the use of e-cigarettes and tobacco smoking and the changes in night smoking may help maximize the opportunities the pandemic presents to institute tobacco cessation strategies for young people.

The aim of this study was to determine the magnitude of the change in the use of e-cigarettes and tobacco smoking by adolescents and young people during the pandemic and to assess the factors associated with the changes in e-cigarette use, tobacco smoking and night use of e-cigarettes during the COVID-19 pandemic by adolescents.

2. Materials and Methods

2.1. Ethics Approval

The Institute of Public Health, Obafemi Awolowo University Health Research Ethics Committee gave ethical approval for the study (IPH/OAU/12/1604). The parents of the participants aged 11–17 years gave written informed consent for the participation of their wards in the study. The respondents aged 18–23 years gave independent informed written consent for study participation. The study participants were informed about the purpose of the study and the freedom to withdraw at any time, and were assured of confidentiality. There was no reimbursement for study participation.

2.2. Study Design, Study Participants and Study Setting

This was a cross-sectional study conducted between the 1st of November to the 30th of December 2021. The study participants were recruited from the 36 States and the Federal Capital Territory in Nigeria. The participants were included if they were aged 11–23 years, consented to study participation, were able to read English and had access to the survey. There were no exclusion criteria.

2.3. Recruitment of Study Participants

YouthRise, a non-governmental organization working with vulnerable populations in Nigeria, worked in partnership with the research team to recruit the study participants. The study participants were recruited using respondent-driven and convenience sampling techniques. The peer educators working with YouthRise in the 36 States of Nigeria and the Federal Capital Territory in Nigeria helped to reach AYP to take the survey. The study investigators and 37 peer educators were trained on the study protocol and how to conduct the online study participants' recruitment to promote the diversity of the study participants recruited. All recruiters received a customized link. The survey links were posted on Facebook, Twitter, WhatsApp and Instagram. Each peer educator was paid \$26.32.

2.4. Sampling Procedure

We increased the diversity of the study participants by diversifying the internet-user community from which the study participants were recruited. First, we had multiple recruiters of varied socio-economic status, age, sex, profession and residential location. This increased the diversity of the networks from where the study participants were recruited. The study investigators were encouraged to recruit 100 participants each, while each peer educator was encouraged to recruit a minimum of 50 study participants.

2.5. Data Collection Instrument

Data were collected using a validated English version of a questionnaire developed for a multi-country study exploring the impact of COVID-19 on smoking and oral health of adolescents and young people [22]. The questions were closed-ended, answered anonymously and took an average of 10 min to complete. The content validity index for the finalized questionnaire was 0.87.

The survey was preceded by an introduction about the study team, study objectives and time needed to complete the questionnaire. The participants were assured that the study was voluntary, and information shared would be kept confidential. Only the participants who responded affirmatively to an informed consent statement that followed could proceed to the survey. Part of the study methodology has been described in prior studies [21,23].

Data were collected through the SurveyMonkey®. The participants could change their answers freely before they submitted their questionnaire. Only one submission was allowed per electronic device.

2.6. Study Variables

2.6.1. Independent Variables

Health status: The respondents were required to tick one or more of a list of 23 health conditions that applied to them. There was also an option to list any health condition they had that was not listed and an option indicating that they had no health condition. These questions were adopted from a validated questionnaire for global use [24]. The participants' responses were dichotomized into those who had no health condition (those who checked the "none" option) and those who had a health condition (ticking any other option).

HIV status: The participants were asked to tick a checkbox to indicate their HIV status (positive, negative or unknown). The respondents with an unknown HIV status were excluded from further analysis.

COVID-19 status: The participants had to identify if they had ever tested positive for COVID-19 (yes/no), had symptoms of COVID-19 (yes/no), and if a family/friend had COVID-19 (yes/no). The responses were dichotomized for analyses.

Anxiety level: The participants' anxiety level was assessed using the Generalized Anxiety Disorder 7-item (GAD-7) scale [25]. This is a seven-item, 4-point scale with responses ranging from not at all (0) to nearly every day (3). The total score ranged from 0 to 21. The cut-off points were 5, 10 and 15 for mild, moderate, and severe anxiety, respectively [26]. The scale had been validated for use in Nigeria [27]. The Cronbach alpha score for the present study was 0.87.

2.6.2. Dependent Variables

Smoking status: The questions on tobacco smoking and the use of e-cigarettes were adopted from the Global Youth Tobacco Survey [28]. The participants were asked if they were current smokers of tobacco (yes/no). The respondents were also asked if they had ever used e-cigarettes (yes/no). Other questions asked current tobacco smokers and users of e-cigarettes whether there was an 'increase', 'decrease' or 'no change' in their tobacco use and e-cigarette use habits, and if there were 'changes in night use' of tobacco and e-cigarettes during the COVID-19 pandemic. For the participants who indicated a change in night use of tobacco and/or e-cigarettes, they had to indicate if this change was an 'increase' or 'decrease' in tobacco smoking or e-cigarette use. The responses on changes in night use of products were dichotomized into either an increase vs. no change in tobacco smoking or an increase vs. no change in e-cigarette use.

2.6.3. Confounders

The confounding variables were age, sex at birth and macro-social vulnerability status. These variables are associated with the dependent and independent variables [29]. The participants were also asked to select the appropriate age group (categorized into 11–17 and 18–23 years), sex at birth (male, female) and vulnerability status (engaged in transactional sex, used illegal/prescription drugs without prescription and injected drugs [30]).

2.7. Statistical Analysis

IBM SPSS for Windows version 22.0 (IBM Corp., Armonk, NY, USA) was used for the statistical analyses. Descriptive analyses were conducted for all variables. Multivariate regression analyses were conducted to determine the associations between the dependent and independent variables after adjusting for the confounding variables. Significance was set at a p value <5%.

3. Results

The response rate was 81%. This study included 954 current e-cigarette users and/or tobacco smokers; these included 568 (59.5%) e-cigarette users and 787 (82.4%) current tobacco smokers. Table 1 shows that, among those who used e-cigarettes, 98 (17.3%) had high anxiety, 268 (47.2%) had a medical condition, 210 (37%) had COVID-19 and 89 (15.7%) were living

with HIV. Among the tobacco smokers, 104 (13.2%) had high anxiety, 326 (41.4%) had a medical condition, 215 (27.3%) had COVID-19 and 97 (12.3) were living with HIV.

Table 1. Characteristics of e-cigarette and tobacco smokers included in the study.

Variables	E-Cigarette Use	Tobacco Smoking
	<i>n</i> = 568	<i>n</i> = 787
Changes in use		
Increase	188 (33.1)	305 (38.8)
Decrease	70 (12.3)	102 (13.0)
No change	310 (54.6)	380 (48.3)
Increase in night e-cigarette use		
Yes	389 (68.5)	534 (67.9)
No	179 (31.5)	253 (32.1)
Age groups		
18 to 23	521 (91.7)	727 (92.4)
11–17	47 (8.3)	60 (7.6)
Sex at birth		
Male	300 (52.8)	427 (54.3)
Female	268 (47.2)	360 (45.7)
Anxiety level		
High	98 (17.3)	104 (13.2)
Moderate	282 (49.6)	463 (58.8)
Low	188 (33.1)	220 (28.0)
Had a medical condition		
Yes	268 (47.2)	326 (41.4)
No	300 (52.8)	461 (58.6)
Tested positive to COVID-19		
Yes	210 (37.0)	215 (27.3)
No	358 (63.0)	572 (72.7)
Had COVID-19 symptoms		
Yes	262 (46.1)	320 (40.7)
No	306 (53.9)	467 (59.3)
Family/friends had COVID-19		
Yes	259 (45.6)	315 (40.0)
No	309 (54.4)	472 (60.0)
Vulnerable group		
Yes	436 (76.8)	599 (76.1)
No	132 (23.2)	188 (23.9)
Living with HIV		
Yes	89 (15.7)	97 (12.3)
No	479 (84.3)	690 (87.7)

Table 2 shows that, among the respondents using e-cigarettes, 188 (33.1%) increased and 70 (12.3%) decreased its use during the COVID-19 pandemic. A greater proportion of the participants with a high anxiety level decreased e-cigarette use during the COVID-19 pandemic ($p = 0.029$). Also, a lower proportion of the participants with a medical condition increased e-cigarette use during the pandemic ($p = 0.009$). In addition, a greater proportion of the participants with low anxiety ($p < 0.001$), with a medical condition ($p < 0.001$), who

tested positive to COVID-19 ($p < 0.001$), had COVID-19 symptoms ($p < 0.001$) or had friends/family member with COVID-19 ($p < 0.001$) increased their night e-cigarette use.

Table 2. Factors associated with changes in e-cigarette use and an increase in night e-cigarette use during the COVID-19 pandemic among adolescents and young people in Nigeria ($n = 568$).

Variables		Changes in E-Cigarette Use <i>n</i> (%)			<i>p</i> Value	Increase in Night E-Cigarette Use <i>n</i> (%)		<i>p</i> Value
		Increased <i>n</i> (%)	Decreased <i>n</i> (%)	No Change <i>n</i> (%)		Yes <i>n</i> (%)	No <i>n</i> (%)	
All		188 (33.1)	70 (12.3)	310 (54.6)		389 (68.5)	179 (31.5)	
Age	18 to 23	173 (33.2)	65 (12.5)	283 (54.3)	0.897	363 (69.8)	158 (30.3)	0.042
	<18	15 (31.9)	5 (10.6)	27 (57.4)		26 (55.3)	21 (44.7)	
Sex	Male	95 (31.7)	41 (13.7)	164 (54.7)	0.516	187 (62.3)	113 (37.7)	<0.001
	Female	93 (34.7)	29 (10.8)	146 (54.5)		202 (75.4)	66 (24.6)	
Anxiety level	High	25 (25.5)	20 (20.4)	53 (54.1)	0.029	53 (54.1)	45 (45.9)	<0.001
	Moderate	104 (36.9)	32 (11.3)	146 (51.8)		213 (75.5)	69 (24.5)	
	Low	59 (31.4)	18 (9.6)	111 (59.0)		123 (65.4)	65 (34.6)	
Medical condition	Yes	78 (29.1)	26 (9.7)	164 (61.2)	0.009	203 (75.7)	65 (24.3)	<0.001
	No	110 (36.7)	44 (14.7)	146 (48.7)		186 (62.0)	114 (38.0)	
Tested positive to COVID-19	Yes	61 (29.0)	28 (13.3)	121 (57.6)	0.288	166 (79.0)	44 (21.0)	<0.001
	No	127 (35.5)	42 (11.7)	189 (52.8)		223 (62.3)	135 (37.7)	
Had COVID-19 symptoms	Yes	89 (37.1)	25 (9.5)	148 (56.5)	0.175	212 (80.9)	50 (19.1)	<0.001
	No	99 (32.4)	45 (14.7)	162 (52.9)		177 (57.8)	129 (42.2)	
Family/friends infected with COVID-19	Yes	79 (30.5)	27 (10.4)	153 (59.1)	0.127	205 (79.2)	54 (20.8)	<0.001
	No	109 (35.3)	43 (13.9)	157 (50.8)		184 (59.5)	125 (40.5)	
Vulnerable group	Yes	143 (32.8)	50 (11.5)	243 (55.7)	0.443	307 (70.4)	129 (29.6)	0.072
	No	45 (34.1)	20 (15.2)	67 (50.8)		82 (62.1)	50 (37.9)	
Living with HIV	Yes	33 (37.1)	10 (11.2)	46 (51.7)	0.681	65 (73.0)	24 (27.0)	0.315
	No	155 (32.4)	60 (12.5)	264 (55.1)		324 (67.6)	155 (32.4)	

Table 3 shows that, among the 787 adolescents and young persons who smoke tobacco, 305 (38.8%) increased and 102 (13.0%) decreased their use of tobacco during the COVID-19 pandemic. A greater proportion of the participants with low anxiety reported an increase in tobacco smoking ($p = 0.001$). Also, a greater proportion of the adolescents and young people who increased their night tobacco use had high anxiety ($p < 0.001$), had no medical conditions ($p < 0.001$), tested positive to COVID-19 ($p < 0.001$), had COVID-19 symptoms ($p < 0.001$) and had friends/family member with COVID-19 ($p < 0.001$).

Table 3. Factors associated with changes in tobacco smoking and an increase in night tobacco smoking during the COVID-19 pandemic among adolescents and young people in Nigeria ($n = 787$).

Variables		Changes in Tobacco Smoking			<i>p</i> Value	Increase in Night Tobacco Smoking		<i>p</i> Value
		Increase <i>n</i> (%)	Decrease <i>n</i> (%)	No Change <i>n</i> (%)		Yes <i>n</i> (%)	No <i>n</i> (%)	
All		305 (38.8)	102 (13.0)	380 (48.3)		534 (67.9)	253 (32.1)	
Age	18 to 23	283 (38.9)	91 (12.5)	353 (48.6)	0.435	505 (69.5)	222 (30.5)	<0.001
	>18	22 (36.7)	11 (18.3)	27 (45.0)		29 (48.3)	31 (51.7)	

Table 3. *Cont.*

Variables		Changes in Tobacco Smoking				Increase in Night Tobacco Smoking		
		Increase <i>n</i> (%)	Decrease <i>n</i> (%)	No Change <i>n</i> (%)	<i>p</i> Value	Yes <i>n</i> (%)	No <i>n</i> (%)	<i>p</i> Value
All		305 (38.8)	102 (13.0)	380 (48.3)		534 (67.9)	253 (32.1)	
Sex	Male	173 (40.5)	58 (13.6)	196 (45.9)	0.346	175 (41.0)	252 (59.0)	<0.001
	Female	132 (36.7)	44 (12.2)	184 (51.1)		78 (21.7)	282 (78.3)	
Anxiety level	High	32 (30.8)	26 (25.0)	46 (44.2)	0.001	65 (62.5)	39 (37.5)	<0.001
	Moderate	179 (38.7)	48 (10.4)	236 (51.0)		357 (77.1)	106 (22.9)	
	Low	94 (42.7)	28 (12.7)	98 (44.5)		112 (50.9)	108 (49.1)	
Medical condition	Yes	117 (35.9)	45 (13.8)	164 (50.3)	0.376	70 (21.5)	256 (78.5)	<0.001
	No	188 (40.8)	57 (12.4)	216 (46.9)		183 (39.7)	278 (60.3)	
Tested positive to COVID-19	Yes	80 (37.2)	24 (11.2)	111 (51.6)	0.448	180 (83.7)	35 (16.3)	<0.001
	No	225 (39.3)	78 (13.6)	269 (47.0)		354 (61.9)	218 (38.1)	
Had COVID-19 symptoms	Yes	121 (37.8)	36 (11.3)	163 (50.9)	0.345	253 (79.1)	67 (20.9)	<0.001
	No	184 (39.4)	66 (14.1)	217 (46.5)		281 (60.2)	186 (39.8)	
Family/friends infected with COVID-19	Yes	119 (37.8)	37 (11.7)	159 (50.5)	0.535	263 (83.5)	52 (16.5)	<0.001
	No	186 (39.4)	65 (13.8)	221 (46.8)		271 (57.4)	201 (42.6)	
Vulnerable group	Yes	222 (37.1)	76 (12.7)	301 (50.3)	0.135	405 (67.6)	194 (32.4)	0.797
	No	83 (44.1)	26 (13.8)	79 (42.0)		129 (68.6)	59 (31.4)	
Living with HIV	Yes	39 (40.2)	13 (13.4)	45 (46.4)	0.924	69 (71.1)	28 (28.9)	0.460
	No	266 (38.6)	89 (12.9)	335 (48.6)		465 (67.4)	225 (32.6)	

Table 4 shows that having a medical condition was associated with significantly lower odds of increased e-cigarette use (AOR:0.649; $p = 0.031$) compared to not having a medical condition. Also, a high level of anxiety (AOR:0.437; $p = 0.027$) and having a medical condition (AOR:0.554; $p = 0.044$) were associated with significantly lower odds of decreased e-cigarette use. In addition, high (AOR:0.516; $p = 0.046$) and moderate anxiety (AOR: 0.373; $p = 0.001$) were associated with significantly lower odds of increased tobacco smoking.

Table 4. Factors associated with increased and decreased e-cigarette use and tobacco smoking during the COVID-19 pandemic.

Variable		E-Cigarette Use			Tobacco Smoking		
		AOR	95% CI	<i>p</i> Value	AOR	95% CI	<i>p</i> Value
Increased Versus no Change during the COVID-19 Pandemic							
Sex	Male	0.918	0.627–1.342	0.658	1.189	0.862–1.641	0.291
	Female	1.000			1.000		
Age	18 to 23	1.160	0.585–2.300	0.672	0.966	0.528–1.766	0.909
	<18	1.000			1.000		
COVID-19 infection	Yes	0.781	0.503–1.214	0.272	0.921	0.625–1.356	0.677
	No	1.000			1.000		
Had COVID-19 symptoms	Yes	1.291	0.825–2.020	0.264	0.996	0.690–1.437	0.982
	No	1.000			1.000		
Family/friends infected with COVID-19	Yes	0.708	0.452–1.109	0.131	0.980	0.681–1.412	0.916
	No	1.000			1.000		

Table 4. *Cont.*

Variable		E-Cigarette Use			Tobacco Smoking			
		AOR	95% CI	<i>p</i> Value	AOR	95% CI	<i>p</i> Value	
Live with HIV	Yes	1.487	0.886–2.497	0.133	1.189	0.735–1.922	0.480	
	No	1.000			1.000			
Vulnerable	Yes	0.888	0.565–1.396	0.607	0.685	0.478–0.983	0.040	
	No	1.000			1.000			
Anxiety level	High	1.236	0.689–2.219	0.478	1.440	0.839–2.471	0.186	
	Moderate	1.722			1.228			0.739–2.042
	Low	1.000			1.000			
Medical condition	Yes	0.649	0.437–0.962	0.031	0.865	0.624–1.199	0.385	
	No	1.000			1.000			
Decreased versus no change than before the COVID-19 Pandemic								
Sex	Male	1.243	0.716–2.156	0.440	1.073	0.671–1.716	0.770	
	Female	1.000			1.000			
Age	18 to 23	1.456	0.520–4.080	0.475	0.610	0.280–1.327	0.213	
	<18	1.000			1.000			
COVID-19 infection	Yes	1.635	0.874–3.058	0.124	0.800	0.447–1.433	0.454	
	No	1.000			1.000			
Had COVID-19 symptoms	Yes	0.631	0.330–1.205	0.163	0.834	0.489–1.424	0.507	
	No	1.000			1.000			
Family/friends infected with COVID-19	Yes	0.833	0.441–1.576	0.575	1.065	0.627–1.811	0.815	
	No	1.000			1.000			
Live with HIV	Yes	0.969	0.444–2.114	0.936	1.031	0.510–2.086	0.932	
	No	1.000			1.000			
Anxiety level	High	0.437	0.210–0.909	0.027	0.516	0.270–0.989	0.046	
	Moderate	0.686			0.373			0.204–0.682
	Low	1.000			1.000			
Vulnerable	Yes	0.845	0.456–1.565	0.592	0.874	0.500–1.433	0.536	
	No	1.000			1.000			
Medical condition	Yes	0.554	0.312–0.984	0.044	1.186	0.739–1.905	0.480	
	No	1.000			1.000			

AOR: adjusted odds ratio, CI: confidence interval. Models were adjusted for age, sex at birth and vulnerability status.

Table 5 shows that moderate anxiety was associated with significantly higher odds of increased night e-cigarette use during the COVID-19 pandemic compared to low anxiety (AOR:2.138; $p = 0.006$). In addition, the respondents with a medical condition (AOR:0.517; $p < 0.001$), those who tested positive to COVID-19 (AOR: 0.493; $p = 0.004$) and those with family/friends infected with COVID-19 (AOR: 0.430, $p < 0.001$) had significantly lower odds of increasing night tobacco use.

Table 5. Factors associated with increased night use of e-cigarettes and tobacco smoking during the COVID-19 pandemic.

Variable		Increased Night E-Cigarette Use			Increased Night Tobacco Smoking		
		AOR	95% CI	p Value	AOR	95% CI	p Value
Sex	Male	0.638	0.443–0.921	0.016	1.913	1.272–2.876	0.002
	Female	1.000			1.000		
Age	18 to 23	2.225	1.019–4.854	0.045	0.225	0.076–0.673	0.008
	<18	1.000			1.000		

Table 5. Cont.

Variable		Increased Night E-Cigarette Use			Increased Night Tobacco Smoking		
		AOR	95% CI	p Value	AOR	95% CI	p Value
Medical condition	Yes	1.446	0.980–2.136	0.063	0.517	0.349–0.765	<0.001
	No	1.000			1.000		
COVID-19 infection	Yes	1.460	0.829–2.572	0.190	0.493	0.306–0.795	0.004
	No	1.000			1.000		
Had COVID-19 symptoms	Yes	2.108	1.428–3.113	<0.001	0.897	0.632–1.273	0.543
	No	1.000			1.000		
Family/friends infected with COVID-19	Yes	1.305	0.873–1.953	0.194	0.430	0.304–0.607	<0.001
	No	1.000			1.000		
Vulnerable	Yes	1.028	0.653–1.618	0.906	1.131	0.786–0.1627	0.507
	No	1.000			1.000		
Anxiety level	High	1.543	0.971–2.450	0.066	1.591	0.848–2.984	0.148
	Moderate	2.138	1.244–3.675	0.006	0.733	0.377–1.426	0.360
	Low	1.000			1.000		
Living with HIV	Yes	1.064	0.829–2.572	0.190	1.036	0.689–1.557	0.865
	No	1.000			1.000		

AOR: adjusted odds ratio, CI: confidence interval.

Table 6 shows the association between e-cigarette/tobacco smoking changes and night e-cigarette use/tobacco smoking during the COVID-19 pandemic among adolescents and young adults. The prevalence of the participants reporting increased e-cigarette use (33.1%) and tobacco smoking (38.8%) was less than those reporting increased night e-cigarette use (68.5%) and tobacco smoking (67.7%). There were no associations between changes in e-cigarette and night e-cigarette use ($p = 0.820$), nor changes in tobacco smoking and night tobacco smoking use ($p = 0.119$).

Table 6. Association between e-cigarette/tobacco smoking changes and night e-cigarette/tobacco smoking use during the COVID-19 pandemic among adolescents and young adults.

Increased Night E-Cigarette Use	Changes in E-Cigarette Use				Total
	Increase <i>n</i> (%)	No Change <i>n</i> (%)	Decrease <i>n</i> (%)	<i>p</i> -Value	
Yes	132 (70.2)	210 (67.7)	47 (67.1)	0.820	389 (68.5)
No	56 (29.8)	100 (32.3)	23 (32.9)		179 (31.5)
Total	188 (100)	310 (100)	70 (100)		568 (100)
Increased Night Tobacco Smoking	Changes in Tobacco Smoking				Total
	Increase <i>n</i> (%)	No Change <i>n</i> (%)	Decrease <i>n</i> (%)	<i>p</i> -Value	
Yes	205 (67.2)	250 (65.8)	78 (76.5)	0.119	533 (67.7)
No	100 (32.8)	130 (34.2)	24 (23.5)		254 (32.3)
Total	305 (100)	380 (100)	102 (100)		787 (100)

4. Discussion

The study findings suggest that the COVID-19 pandemic was associated with both a decrease and an increase in e-cigarette use and tobacco smoking among adolescents and young people in Nigeria. However, the proportion of adolescents and young people who increased e-cigarette use and tobacco smoking during the COVID-19 pandemic was greater than those who decreased the use of these products. In addition, the adolescents and young people with moderate anxiety seemed less likely to have increased tobacco smoking and more likely to have increased night e-cigarette use during the pandemic. Furthermore, those with a medical condition, those who tested positive to COVID-19 and those who had

family/friends infected with COVID-19 were less likely to have increased night tobacco use. Two paradoxes were, however, observed: the adolescents and young people with a medical condition and those with high anxiety seemed less likely to have increased and decreased e-cigarette use, respectively, during the COVID-19 pandemic. It seems that the HIV status of adolescents and young people was not associated with changes in e-cigarette use, tobacco smoking or night smoking during the pandemic.

One of the strengths of the study is its design: We assessed the factors associated with an increase and a decrease in tobacco smoking and e-cigarette use among adolescents rather than assumed the opposite applied. As indicated with the findings of the study, the opposite of the study findings did not always apply. We also provide the first evidence on how the pandemic might have affected e-cigarette use and tobacco smoking habits and the first set of data on night use of e-cigarette and tobacco smoking among adolescents and young persons in Nigeria.

The study, however, has a few limitations. The participants self-reported their health status, which introduces the possibility of a social-desirability bias when reporting stigmatized health conditions, such as smoking, COVID-19 and HIV status [31]. This may lead to the under-reporting of some of these conditions. The use of non-probability sampling for the study participants' recruitment and the use of an online survey may inadvertently have excluded some participants from the survey and skewed data collections to elites with access to the internet and smartphones and an understanding of English [32]. Data collection during the pandemic, however, could only be done using an online survey because of the need to comply with the strict public health measures that limited physical contact [33]. In addition, the use of multiple non-probability sampling techniques also facilitated the recruitment of diverse participants. Another limitation was the use of a cross-sectional study design that makes it difficult to make cause–inference conclusions from the findings. In addition, the increase and decrease in tobacco smoking or use of e-cigarettes were not quantified. Despite these limitations, the study highlights some important findings.

First, we found an overall significant increase in the use of e-cigarettes and tobacco use among adolescents and young people in Nigeria during the pandemic. A prior meta-analysis indicated that there was a relative reduction in the prevalence of smoking during the pandemic. Among people who smoke, 21% smoked less, 27% smoked more, 50% had an unchanged smoking habit and 4% quitted smoking [34]. This current study finding seems to indicate that there may be a context-specific impact of the pandemic on smoking habits. Here, we studied two specific contexts—country and populations. The COVID-19 pandemic may have exacerbated the smoking epidemic for adolescents and young people in Nigeria. More studies are needed to understand how the pandemic affected the smoking habits of different populations in different contexts. The current study, however, suggests the need for designing and implementing tobacco control programs that ensure future COVID-19-like pandemics do not exacerbate the smoking epidemic among adolescents and young people in Nigeria.

Second, we observed in the current study that those with medical conditions who use e-cigarettes could either increase or decrease its use. This may be connected with the concern about their increased risk for severe COVID-19 [35] and emergency hospital visits [35]. An awareness of this risk may have caused high anxiety and a reduction in e-cigarette use, as anxiety increases compliance with COVID-19 prevention measures [36]. On the contrary, high anxiety also causes anxiety sensitivity and an increase in unhealthy behaviors such as increased smoking [37–39]. This postulated link between anxiety and having a medical condition may explain the paradox observed. Further studies are required to explore this observation paradox and understand what may promote the decrease in e-cigarette use.

Moderate anxiety seems to have a different effect: it seems to reduce the likelihood of increased tobacco smoking. This finding suggests that moderate anxiety may likely predispose to a positive change in health behavior, while high anxiety may cause maladaptive changes due to anxiety sensitivity. However, the observed increase in night e-cigarette

smoking raises a new paradox and complexity about the associations between the COVID-19 pandemic, changes in smoking habits and mode of smoking (traditional cigarettes vs. e-cigarettes).

The association between moderate anxiety and the increased likelihood of night e-cigarette use may also be related with the concerns about COVID-19. The experience of anxiety about COVID-19 may cause sleep disturbances. Smoking of tobacco and the use of e-cigarettes are also associated with sleep difficulties [40,41]. Users of e-cigarettes seem to have worse sleep concerns [40] and so may be more prone to smoking e-cigarettes while awake at night. This finding needs to be explored further.

Third, our study of the night use of e-cigarettes and night smoking of tobacco by adolescents and young adults introduces a new measure for mental health and wellness among this population during the pandemic. Recent evidence suggests that night smoking is an indicator of nicotine dependence and a predictor of smoking cessation failure [21], depression [42] and stress [43]. Also, patients with mental health conditions smoke in an effort to regulate the symptoms associated with their disorder [44]. The current study shows that a history of COVID-19 and those with family/friends infected with COVID-19 seem more likely to increase night tobacco use, which may indicate that COVID-19-induced stress may be associated with an increased risk for night smoking. There, however, was no association between increased nighttime tobacco smoking, nighttime e-cigarette use and changes in tobacco smoking and e-cigarette use. These findings call for further studies on the association between COVID-19-induced stress-related night smoking and the failure of success of smoking cessation, as this will inform the intensification of tobacco cessation programs during pandemics to reduce the nighttime smoking.

Finally, we observed some associations with the study confounders, one of which was that adolescents and young people who were vulnerable seemed less likely to increase tobacco smoking. Does this observation suggest that vulnerable adolescents and young people were less prone to risk factors that increased tobacco smoking during the pandemic than those who were not vulnerable? Or do the years of living with vulnerability and stress blunt their response to the stress associated with COVID-19 so that they did not resort to more smoking to cope with their stresses? Our study findings seem to raise more questions than answers. Further studies are needed to find explanation(s) to this finding.

Also, we observed greater odds of increasing nighttime tobacco smoking but lower odds of increasing nighttime e-cigarette use among males than females. This gender difference in the use of e-cigarettes in Nigeria had been reported earlier: significantly more males than females smoke tobacco [45]. Females may choose to de-stress using the more psychosocially acceptable e-cigarette than tobacco [46], and also more likely to use e-cigarettes at night when they are less prone to stigma by the public [47]. These postulations need to be studied further.

5. Conclusions

In conclusion, we found a complex relationship between having a medical condition, having anxiety, tobacco smoking and e-cigarette use among adolescents and young people in Nigeria during the COVID-19 pandemic. The possible link between tobacco smoking and e-cigarettes [36] further complicates this complex relationship. The study raised a lot of paradoxical findings that beg for explanation. Further studies are needed to explore the study findings and postulations.

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Informed Consent Statement: The parents of participants aged 11–17 years gave written informed consent for the participation of their wards in the study. Respondents aged 18–23 years gave independent informed written consent for study participation. Study participants were informed about the purpose of the study, the freedom to withdraw at any time and were assured of confidentiality. There was no reimbursement for study participation.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of Morenike Oluwatoyin Folayan.

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