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Correlates of Nicotine Dependence Among Current Cigarette Smokers in Nigeria

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Abstract

Background: The level of dependence on nicotine, the main addictive chemical in tobacco, is a substance-related disorder that can be utilized to characterize diverse populations of cigarette smokers and also to determine the effectiveness of individualized smoking cessation intervention programs.

Aim: This study investigates the correlates of nicotine dependence among current established cigarette smokers in Nigeria.

Settings: We conducted a cross-sectional survey among a cohort of current established cigarette smokers (100+ sticks in a lifetime and someday/everyday cigarette smokers) in Lagos, Nigeria.

Methods: The dependent measure was nicotine dependence (ND) using the Fagerstrom scale; independent measures were demographics, harm perception, binge alcohol drinking, and past-year internalizing and externalizing problems. Logistic regression models were used to investigate factors associated with severe nicotine dependence.

Results: The analytic sample was drawn from 487 adults. Within our sample, 69%, 27%, and 3.9% had low, moderate, and severe ND levels, respectively (*p-value*: 0.02); while among daily cigarette smokers, 48.1%, 44.3%, and 7.6% had low, moderate and severe ND levels, respectively (*p-value*: <0.001). In the regression analysis, older age (aOR:1.03; 95% CI:1.01,1.06) and being male (vs, female) (aOR:3.70; 95% CI:1.58,8.15), and reduced cigarette harm perceptions (aOR:2.85; 95% CI: 1.75,4.66) were associated with increased odds of moderate/severe ND.

Conclusion: Older age, males, and those with reduced harm perceptions about cigarette use had increased odds of moderate/severe ND. Our preliminary findings provide baseline results characterizing use behaviors among relatively understudied current established cigarette smokers in Nigeria.

Contributions: All Authors were involved inConceptualization, Data Curation, Formal Analysis, Writing - Review and Editing and Project Administration.

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Introduction

Tobacco use is a public health problem that is the primary cause of avoidable morbidity and mortality globally. About 8 million people are projected to die annually from tobacco related diseases by 2030.[1] Smoking is a substance use disorder related to nicotine in the tobacco, which is characterized by a strong desire to use the substance after repeated and continuous use. Nicotine is a psychoactive drug which activates a cascade of neurobiological events in the reward areas of the brain and all over the body and this reinforces its use. [2] Thus, even though majority of smokers are desirous to quit,[3] there is an inverse relationship between successful quit attempt decreases and level of nicotine dependence.[4][5] Dependence or addiction is characterized by a perceived loss of control, including compulsive use and difficulty abstaining. Research shows that nicotine dependence indicators including the number of cigarettes smoked daily and smoking the first cigarette within 30 minutes after waking up are strongly correlated with the intention and success of quit attempts.[3] Unfortunately, unlike other addictive drug, tobacco is widely available, relatively cheap and legal to use.

To achieve a higher rate of smoking cessation during treatments, an understanding of nicotine dependence and its correlates among smokers is desirable. Transition from experimentation with cigarettes to regular smoking among adolescents, for example, is associated with having poor relationship with parents, poverty, poor academic performance and having friends that smoke.[6] Other correlates of nicotine dependence include alcohol consumption, the use of other addictive substances, exposure to secondhand smoke exposure, genetic predisposition to addiction, and the use of multiple tobacco products.[7][8] Nicotine dependence is also strongly corelated with the age of initiation of and extensiveness of smoking, sensitivity to and metabolism of nicotine, and nicotine metabolism, age at onset of smoking a whole cigarette, a shorter latency between onset and daily smoking as well as mental illness. [9][10]

Clinical studies have constantly documented high rates of cigarette smoking and nicotine dependence among patients with internalizing and externalizing disorders.[11] It is hypothesized that nicotine is used by these patients to self-medicate. It stimulates dopamine release by nicotinic receptors, and addresses cognitive deficits by regularizing P50 auditory gating and to enhance prepulse inhibition.[12] Proxy measures for dependence includes the number of cigarettes smoked daily and a strong craving or urge to smoke and these are often associated with high rates of relapse after treatment.[13] However, a globally accepted normative measure, which is reproducible, accurate and easy to use for evaluating nicotine dependence is the Fagerström test for nicotine dependence (FTND).[14]

At the turn of this century, cigarette smoking reduced by 26% in western Europe which mirrors the pattern in other high-income countries while it increased by about 60% in in African and Middle Eastern countries.[15] Africa and other Low- and middle-income countries (LMIC) have become a key target for tobacco companies due to their weak regulatory oversight over tobacco demand reduction policies and supply-side restrictions.[16] Moreover, many African countries like Nigeria have weak health systems, vulnerable populations and very limited resources to provide necessary assistance such as quit lines to tobacco users. Nigeria is the most populated country in Africa and it has one of the leading tobacco markets in Africa, with over 18 billion cigarettes sold annually costing Nigerians over US$ 931 million.[17] Nicotine replacement therapies and medication to assist cessation efforts are also mainly unavailable and priced beyond the reach of most Nigerians.

To develop and implement effective measures to control tobacco smoking, one must recognize the reasons and risk factors for smoking initiation and dependence. Public health programs are presently being designed to identify and reach subgroups with very higher rates of tobacco use, especially those with mental illness and addiction. It is thus desirable to identify vulnerable populations in the country and to design appropriate preventive intervention for them. The level of dependence on nicotine, the main addictive chemical in tobacco, is a substance-related disorder that can be utilized to characterize diverse populations of cigarette smokers and also to determine the effectiveness of individualized smoking cessation intervention programs. This study investigates the correlates of nicotine dependence among current established cigarette smokers in Nigeria.

Methods

Study design and settings: The study used a cross-sectional design comprised of adult cigarette smokers (18+) in Nigeria. Participants were enrolled from the Smoking Cessation Clinic of the Preventive Dentistry clinic at the Lagos State University Teaching Hospital between February and December 2023.

Data inclusion criteria: Adults aged 18 years and above at the time of enrollment. Our sample was restricted to established users of combustible cigarettes only. Established smokers were individuals who smoked at least 100 cigarettes in their lifetime and currently smoked cigarettes on some days or every day. We excluded respondents who were non-cigarette smokers.

Dependent variable

Nicotine dependence: The Fagerström Test for Nicotine Dependence (FTND) is a validated instrument for assessing nicotine dependence in adult smokers.[18][19] The FTND comprises six question items that assess quantity of cigarette use and compulsion to use. Response options are “yes/no” with scores of 1 and 0 respectively, and multiple-choice items have response options scored 0-3 providing a total score of between 0 and 10. Respondents with a score of 0-4 have low or low-moderate dependence, 5-7 have moderate dependence, and 8 or above have a high level of nicotine dependence. [18][19] Participant nicotine dependence levels were collapsed into a binary variable categorized as low or low-moderate dependence AND moderate/ High nicotine dependence levels.

Independent variables

Harm perception of smoking: All respondents were asked the question *‘What is the effect of cigarettes on your overall health?*’. Response options were on a 4-item Likert scale: very harmful, harmful, harmless, very harmless. The 4-item Likert scale was collapsed into two response options for analyses: very harmful/harmful and harmless/ very harmless.

Binge Alcohol use: Respondents were assessed for binge drinking with a single question: *‘During the past 30, on how many days did you have 4* [5 for males] *or more alcohol drinks on the same occasion? By ‘occasion,’ we mean at the same time or within a couple of hours of each other.*” Respondent were provided the response options: I have not drank alcohol in the past 30 days/ 0-7 days/ 8-14 days/ 15-21 days/ 22-30 days. The measure was adapted from the National Survey on Drug Use and Health (NSDUH).[20]

Internalizing and externalizing problems: Mental distress of participants were our primary outcome variables, and these were measured using the GAIN- Short Screener (GAIN-SS) for internalizing (four questions) and externalizing problems (seven questions).[21] Based on the GAIN-SS scale, severity of internalizing and externalizing problems increases with their respective scores. For every internalizing or externalizing problem reported in the past year the participant’s GAIN-SS score increased by one point. Data on mental distress was treated using a model in a prior study by Kaplan *et al*.[22] Participants with internalizing or externalizing problems were categorized into no/low (0-1 problem) vs moderate/high (2 or more problems). Participants were categorized into two according to their responses to the internalizing and externalizing problem questions on the GAIN-SS: 1) Respondents who indicated at least one internalizing and externalizing problem in the past year, 2) Respondents who did not indicate a problem (internalizing and externalizing) in the past year.

Covariates: Demographic data comprised age; biological sex (male/female); educational attainment (less than high school/high school graduate/college undergraduate/ graduate degree).

Data analyses

Participants’ characteristics were analyzed descriptively using percentages and frequencies. Cigarette smoking status and the severity of nicotine dependence were analyzed using chi-square statistics and presented using percentages. To

determine the association of high nicotine dependence among established cigarette smokers and demographic factors (covariates), past-month binge alcohol use, harm perception, internalizing and externalizing symptoms, bivariate and multivariable logistic regression models were used. The outcome measure “nicotine dependence” was derived from the FTND score treated as a binary variable with low/low-moderate nicotine dependence (0) and moderate/high nicotine dependence (1). In the multivariable logistic regression models, we adjusted for demographic factors (age, sex, and education), binge drinking, harm perception, internalizing and externalizing symptoms and examined the effect of nicotine dependence on these factors. Adjusted odds ratios (aOR), 95% confidence intervals (CIs) were calculated for the logistic regression models. P-values were considered significant at <0.05. Data analyses was conducted using Stata 17 software (StataCorp, 2021).

Ethical approval: Ethical approval was obtained from the Lagos State University Teaching Hospital Health Research Ethics Committee: LREC/06/10/2330

Patient and Public Involvement Statement: During the development, progress and writing of the submitted editorial, Patient and Public Involvement was included at all stages.

Results

The study analytic sample comprised 487 adults. The mean age of participants was 33.8 years (±10.2). Based on sex, there was a higher proportion of males (76.7%) compared to females (23.3%). A majority had binge alcohol use in the past month (84.3%), and more than half (60.2%) of the participants perceived cigarette smoking as harmful to health. Additionally, most participants had severe internalizing (51.7%) or externalizing symptoms (52.3%); while more than two-thirds (73.7%) had low or low-moderate nicotine dependence levels [Table 1].

Table 1. Participant characteristics

Variable	n (%)
Mean Age (±SD)	33.76 (±10.22)
Sex	
Female	112 (23.33)
Male	368 (76.67)
Highest level of education	
Less than high school diploma	100 (20.83)
High School diploma	126 (26.25)
College undergraduate	147 (30.63)
Graduate degree	107 (22.29)
Binge Alcohol use	
I have not drank alcohol in the past 30 days	76 (15.70)
0-7 days	99 (20.45)
8-14 days	148 (30.58)
15-21 days	69 (14.26)
22-30 days	92 (19.01)
Harm perception of smoking	
Very harmful	31 (6.60)
Harmful	252 (53.62)
Harmless	175 (37.23)
Very harmless	12 (2.55)
Internalizing symptoms	
Low/ No	81 (16.88)
Moderate	151 (31.46)
High	248 (51.67)
Externalizing symptoms	
Low/ No	67 (14.02)
Moderate	161 (33.68)
High	250 (52.3)
Nicotine dependence	
Low/ low to moderate	359 (73.72)
Moderate	112 (23.0)
High	16 (3.29)

Low/ low-moderate: score of <4. Moderate: score of 5-7. High: score of ≥8.

When participants' smoking status was stratified by their severity of nicotine dependence, those who reported daily cigarette smoking in the past 30-days had the highest proportion of high nicotine dependence (87.5%), followed by those who smoked on somedays (73.2%) [Figure 1].

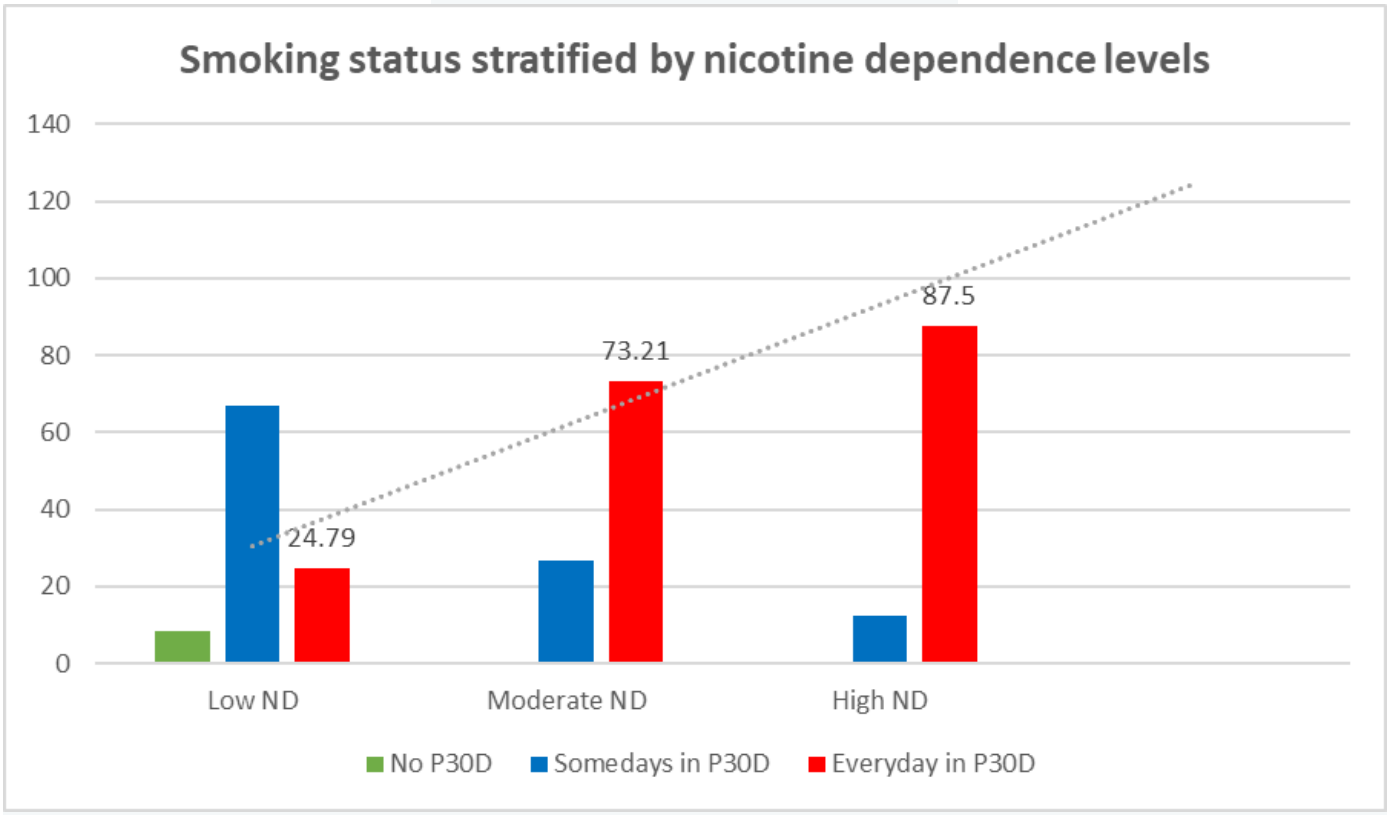

Figure 1. Past 30-day (P30D) smoking status of participants stratified by nicotine dependence levels. p-value: <0.001. **Notes**: P30D: past 30-day cigarette smoking status. ND: Nicotine dependence levels measured using the Fagerstrom Nicotine Dependence Scale (low/low-moderate, moderate, high ND).

On a bivariate regression model (Table 2), older participants had 7% increased odds of having a moderate/high level of nicotine dependence (95% CI: 1.05, 1.09; p:<0.001). Similarly, males had increased odds of a moderate/high level of nicotine dependence compared to females (95% CI: 2.81, 12.67; p: <0.001). Further, participants who perceived the health effect of cigarettes to be harmless or very harmless had significantly increased odds of a moderate/high level of nicotine dependence compared to those who considered cigarettes as harmful or very harmful (95% CI: 2.53, 5.97; p: <0.001). In addition, participants with severe internalizing (95% CI: 2.60, 13.39; p: <0.001) and externalizing symptoms (95% CI: 2.76, 18.41; p: <0.001) suggesting mental disorders had increased odds of moderate/high nicotine dependence.

Table 2. Bivariate regression model of factors associated with moderate/high Nicotine Dependence.

Variables	Odds ratio	*p-value*	95% Confidence Interval
Age in years	1.07	**<0.001**	1.05, 1.09
Sex			
Female	1 (reference)		
Male	5.96	**<0.001**	2.81, 12.67
Education			
Less than high school diploma	1 (reference)		
High School diploma	0.93	0.78	0.54, 1.59
College undergraduate	0.19	**<0.001**	0.10 0.36
Graduate degree	0.37	**0.002**	0.20, 0.70
Binge Alcohol use			
No alcohol use in past month	1 (reference)		
0-17 days	1.71	0.188	0.77, 3.82
8-14 days	2.87	**0.004**	1.39, 5.93
15-21 days	3.17	**0.005**	1.41, 7.13
22-30 days	1.44	0.383	0.64, 3.26
Harm perception of cigarette smoking			
Harmful/ Very harmful	1 (reference)		
Very harmless/ Harmless	3.89	**<0.001**	2.53, 5.97
Internalizing problems			
Low/ No	1 (reference)		
Moderate	2.42	**0.048**	1.01, 5.82
Severe	5.9	**<0.001**	2.60, 13.39
Externalizing problems			
Low/ No	1 (reference)		
Moderate	2.3	0.105	0.84, 6.29
Severe	7.12	**<0.001**	2.76, 18.41

***OR**: odds ratio. P-values <0.05 were in Bold.*

Table 3 shows a multivariable regression model adjusting for age, sex, education, past-month binge alcohol use, harm perception of cigarettes, internalizing and externalizing symptoms. Age, gender, and harm perception were significantly associated with increased odds of moderate/high nicotine dependence levels in the study population. Participants who

believed cigarettes had harmless/ very harmless health effects had 2.8 times increased odds of moderate/high nicotine dependence compared to those who believed cigarettes had harmful/ very harmful health effects (95% CI: 1.75, 4.66; p: <0.001). Likewise, older age and being male remained significantly associated with moderate/high nicotine dependence levels.

Table 3. Full Model showing factors associated with moderate/high Nicotine Dependence.

Variables	aOR	*p-value*	95% Confidence Interval
Age in years	1.03	**0.02**	1.00, 1.06
Sex			
Female	1 (reference)		
Male	3.7	**0.001**	1.65, 8.31
Education			
Less than high school diploma	1 (reference)		
High School diploma	0.94	0.841	0.51, 1.74
College undergraduate	0.46	0.055	0.21, 1.02
Graduate degree	0.61	0.196	0.29, 1.29
Binge Alcohol use			
No alcohol use in past month	1 (reference)		
0-17 days	1.16	0.759	0.46, 2.90
8-14 days	1.28	0.564	0.56, 2.93
15-21 days	1.6	0.318	0.64, 4.04
22-30 days	0.65	0.366	0.25, 1.67
Harm perception of cigarette smoking			
Harmful/ Very harmful	1 (reference)		
Very harmless/ Harmless	2.85	**<0.001**	1.75, 4.66
Internalizing problems			
Moderate	1.69	0.276	0.66, 4.34
Severe	2.37	0.073	0.92, 6.09
Externalizing problems			
Moderate	2.2	0.16	0.73, 6.58
Severe	2.92	0.051	1.00, 8.57

aOR: *adjusted odds ratio. P-values <0.05 were in Bold.*

Discussion

Our findings suggest older age, being male and misperceptions of cigarette harms were associated with moderate to high levels of nicotine dependence. There was a significantly higher proportion of males compared to females among them as previously documented among smokers in Nigeria[23] and this pattern also mirrors that in USA where current cigarette smoking was higher among men than women and was highest among the middle aged and elderly.[24] and also among those with lower educational attainment.[24] While the prevalence of smoking in High Income countries (HICs) continues to decline through the implementation of comprehensive tobacco control policies [25] low-and middle-income countries (LMICs) still have relatively higher smoking prevalence and a less comprehensive and relatively weaker tobacco control environment.[26] Moreover, nicotine replacement therapies and medication to assist cessation efforts are also mainly unavailable and priced beyond the reach of most smoker in LMIC, necessitating the early identification of those who are highly dependent and intervening appropriately.

A majority of the respondents had binge alcohol use in the past month and this further validates findings of an increased odds of alcohol consumption among poly tobacco users in a previous research in Lagos.[27] People who consume alcohol excessively are thrice as likely to smoke and this relationship may be bidirectional.[28]Alcohol dependence and smoking, separately or together, are multifaceted forms of addictive behavior that may be influenced by a variety of genetic, neurobiological, conditioning, and psychosocial mechanisms, and conditioning mechanisms, in which cravings for alcohol or nicotine are elicited by certain environmental cues; and psychosocial factors such as personality characteristics and coexisting psychiatric disorders. Internalizing disorders like depression and anxiety as well as externalizing such as attention-deficit hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), conduct disorder (CD) and antisocial personality disorder (ASPD),[29][30] are significant mental health problems that have been regularly associated with tobacco use.

More than half of the participants perceived cigarette smoking as harmful to health and most of them had severe internalizing or externalizing symptoms. This prevalence is far higher than that documented for mental health disorders among the general population who are not smokers.[31][32] This corroborates previous research that shows that those with mental health conditions, which include externalizing and internalizing disorders, are more likely to smoke,[33] have an earlier age of smoking initiation onset and smoke more heavily than others in the general population. Population-based studies among those with mental health conditions, especially those with past-month mental disorders have also documented higher rates of smoking and nicotine dependence among them.[34][35] Moreover, researchers documented that over a third of cigarettes smoked in England and almost half of that in the United States are by those with mental health conditions, and other substance use disorders.[36] Internalizing disorders and their antecedents, are often associated with fear, contemplation, and emotional distress while externalizing disorders are linked with oppositional, belligerent, impetuous, disorderly, and rule-breaking conduct. Depression, anxiety, and stress, can be partially relieved by a variety of neurotransmitters released after stimulation of nicotinic cholinergic receptors.[37] One of them, dopamine,

signals a pleasurable experience and is critical for the reinforcing effects of nicotine,[38] thus partly explaining the higher levels of nicotine dependence typically found among those with mental health conditions.[39][40]

About one-third of the study respondents had a high level of nicotine dependence levels. Cigarettes and other types of tobacco products are addictive and the development of dependence to smoking progresses through stages which include the experimental stage, regular smoking stage and established or daily smoking stage.[41] At this final stage, cessation efforts usually fail due to the level of dependence on the substance that has been developed. Nicotine dependence is a maladaptive stage in tobacco smoking in which there are withdrawal symptoms comparable that of other addictive disorders and it has been characterized by the fourth edition of the Diagnosis and Statistical Manual of Mental Disorders.[42] Nicotine dependence is associated with an array of withdrawal symptoms such as depression, insomnia, irritability, anxiety, difficulty concentrating, restlessness when an attempt is made to stop smoking. This addiction is the main factor implicated in persistent cigarette smoking, with affected individuals characteristically smoking often during the day and every day. Cohort studies have consistently shown that smoking-related morbidity, especially lung cancer, increases exponentially with cigarette consumption levels and duration of smoking.[43][44] Among established tobacco smokers, cessation results in a considerable reduction in risk, especially among those who cease smoking before 40 years of age.[45] Our findings indicating more than one-third of cigarette smokers had high nicotine dependence levels underscore the importance of public health spending on cessation aids and support.

In addition, participants with severe internalizing and externalizing symptoms suggesting mental disorders had increased odds of moderate/high nicotine dependence, although with marginal statistical significance. Tobacco use can progress to nicotine dependence, which can be highly comorbid with mood, anxiety, and personality disorders [46][47] while quitting smoking has been linked to significant improvements in symptoms of mental health conditions and overall well-being. [48] In the US nicotine dependence severity is high among inpatients with psychosis who smoke cigarettes.[49] A recently proposed bidirectional association suggested that smoking may be causally associated with an elevated risk of mental illness through shared genetic liability to smoking and mental disorders. [50][51] Moreover, people with mental health conditions may seek nicotine to alleviate the symptoms of their illness or the adverse effects of their medications.[51]

Furthermore, age, gender, and harm perception were significantly associated with increased odds of moderate/high nicotine dependence levels in the study population. This aligns with previous research in LMICs and high-income countries (HICs) that have indicated that high dependence is associated with a older age (36-45 years), manual occupations, and lower education.[52][3][6][7][8][9][10][11][12][13][14][15][16][17][18][19][20][21][22][23][24][25][26][27][28][29][30][31][32][33][34][35][36][37][38][39][40][41][42][43][44][45][46][47][48][49][50][51][52][53][54][55][56] Furthermore, other studies have showed that nicotine dependence is more closely linked with the male gender,[54][55] while another study,[57] however reported no difference in nicotine dependence based on sex. Our findings may be explained by social norms in Nigeria, which consider cigarette use, a social habit for older men and less so for women.

In addition, participants who believed cigarettes were harmless on their overall health had harmless health effects had

more than two times increased odds of moderate/high nicotine dependence compared to those who believed cigarettes had very harmful health effects. Perceived risk plays an important role in predicting health behaviors as hypothesized in the Health Belief Model.[58] Perceptions of harm and addictiveness of conventional cigarette smoking are important predictors of smoking behavior, which may differ depending on smoking status and may also influence the transition between tobacco products.[59] Strong *et al.* [60] observed that youth at wave 1 of PATH with lower perceptions of harm or addictiveness of tobacco products were more likely to report trying the product. Other researchers have found that higher perceptions of severity and vulnerability to smoking-related diseases are associated with higher odds of quitting attempts.[61][62] Therefore, interventions such as plain packaging, cigarette stick health warnings, as well as increased access to cessation counselling should be considered by local policy makers, as these might encourage cigarette smokers to attempt quitting.

Our study has some limitations and the results should be interpreted with caution based on these. The use of self-report measures to determine nicotine dependence, internalizing and externalizing disorders could be subject to recall and social desirability bias while our hospital-based cohort also precludes the generalization of our findings to the whole population in Nigeria or similar settings. Further the cross-sectional design of the study indicates association and not causality, as such we cannot establish a causal link between our independent measures like mental health conditions and nicotine dependence. Nonetheless, our study provides findings about nicotine dependence in a cohort of cigarette smokers in a relatively understudied population. We also provide evidence about associated factors (older age, being male, and harm perceptions) of nicotine dependence that can inform local policy.

Conclusion

In conclusion, our findings indicate that older age, males, and those with reduced harm perceptions of cigarette smoking had increased odds of moderate/severe ND. These results validate prior knowledge of nicotine dependence among current established smokers in the literature. Our preliminary findings provide baseline results characterizing use behaviors among relatively understudied current established cigarette smokers in Nigeria, and evidence for further research and targeted cessation interventions within this population.

Statements and Declarations

Competing interests: The authors declare no competing interests.

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