ISSN: 2476-8642 (Print)
ISSN: 2536-6149 (Online)
www.annalsofhealthresearch.com
African Index Medicus, Crossref, African Journals Online, Scopus, C.O.P.E & Directory of Open Access Journals

Annals of HEALTH RESEARCH

(The Journal of the Medical and Dental Consultants' Association of Nigeria, OOUTH, Sagamu, Nigeria)

Volume 11 | No. 4 | Oct. - Dec., 2025

IN THIS ISSUE

PUBLISHED BY THE MEDICAL AND DENTAL CONSULTANTS ASSOCIATION OF NIGERIA, OOUTH, SAGAMU, NIGERIA.
www.mdcan.oouth.org.ng

Annals of Health Research
(The Journal of the Medical and Dental Consultants' Association of Nigeria, OOUTH, Sagamu, Nigeria)

Volume 11, Issue 4: 341-366
December 2025
doi:10.30442/ahr.1104-01-299

SYSTEMATIC REVIEW

Tobacco Product Use (Smoking, Shisha and Electronic Cigarettes) as Risk Factors for Breast Cancer in Nigeria: A Systematic Review

Olumide Yetunde M, Ayanlowo Olusola O, Akinkugbe Ayesha O, Otrofanowei Erereoghor

Department of Medicine, College of Medicine of the University of Lagos, Lagos.

***Correspondence: Professor YM Olumide (Emeritus Professor of Medicine), Department of Medicine, College of Medicine of the University of Lagos, Surulere, Idi-Araba, Lagos, Nigeria.**
E-mail: mercyolumide2004@yahoo.co.uk ; ORCID – https://orcid.org/0000-0001-5760-6300.

Citation: Olumide YM, Ayanlowo OO, Akinkugbe AO, Otrofanowei E. Tobacco Product Use (Smoking, Shisha and Electronic Cigarettes) as Risk Factors for Breast Cancer in Nigeria: A Systematic Review. Ann Health Res 2025;11:341-366. https://doi.org/10.30442/ahr.1104-01-299.

Abstract

Background: The use of tobacco products, including cigarettes, Shisha, and electronic cigarettes (e-cigs), contributes to breast cancer risk due to the presence of carcinogenic compounds such as polycyclic aromatic hydrocarbons (PAHs), formaldehyde, benzene, and nitrosamines. While the health risks of conventional smoking are well-documented, emerging evidence highlights similar risks associated with Shisha and e-cigs, especially among younger populations.
Objectives: To explore the association between tobacco product use and breast cancer in Nigeria. It also examines exposure trends and suggests culturally appropriate measures to address modifiable risk factors.
Methods: A systematic review of the literature was conducted using databases like PubMed, Google Scholar, and African Journals Online. Studies published between January 2000 and December 2024 were analysed, with a focus on the Nigerian context. Relevant data from global and local studies, government reports, and surveys were incorporated.
Results: Tobacco smoke contains numerous carcinogens, with PAHs, *N*-Nitrosamines, Aromatic amines, Aldehydes, Phenols, Volatile hydrocarbons, and formaldehyde strongly linked to breast cancer. Shisha exposes users to toxins equivalent to smoking approximately 100 cigarettes in a single session, while e-cig aerosols contain harmful substances such as glycols, formaldehyde, and heavy metals. The popularity of these products is increasing among Nigerian youths, driven by cultural shifts and media influences.
Conclusions: The consumption of cigarettes, Shisha, and e-cigs poses significant breast cancer risks. Effective tobacco control measures must extend beyond traditional products to include Shisha and e-cigs. Awareness campaigns, stringent regulations, and culturally informed interventions are essential to curb usage and mitigate associated health risks.

Keywords: Breast Cancer, Carcinogens, E-cigs, Shisha, Tobacco, Tobacco Control Program.

Introduction

Cigarette smoking is a significant health concern, often contributing to tobacco-related cancers and potentially leading to death. [1] Tobacco use is an epidemic and a global public health concern. There is now substantial literature indicating that past and current active cigarette smoking is associated with a higher risk of developing breast cancer. [2] For women who are smokers at the time of diagnosis, there is also an increased risk of mortality from breast cancer. Awareness of this notorious environmental pollutant is even more dangerous because exposures are often involuntary. Smokers are exposed to tobacco products primarily by smoking manufactured cigarettes or other tobacco products.[3] Smoked forms of tobacco include various kinds of cigarettes (manufactured, hand-rolled, filtered, unfiltered, and flavoured), cigars, and pipes such as Shisha; exposure to tobacco chemicals also occurs through snuffing/chewing tobacco (smokeless tobacco). [4] Non-smokers are exposed to tobacco smoke from the environment where cigarette smoking occurs. This indirect exposure type is second-hand, involuntary, passive, or environmental. The impact of tobacco on health varies depending on the types of tobacco products used and the duration of lifetime exposure. [4] Due to strict tobacco legislation in the Western hemisphere, many African nations, like Nigeria, have shifted from being tobacco-producing nations to tobacco-consuming ones.[5] Since smoking is a modifiable risk factor for breast cancer, the possible impact of smoking on breast cancer and the long latency of the disease make it compelling to scientifically evaluate current knowledge on the state of the evidence regarding the association of tobacco with breast cancer risk.

Objectives

The primary objective is to examine the association between smoking and its role as a risk factor for breast cancer. The secondary aim is to investigate the pattern of tobacco product exposure in Nigeria and propose culturally tailored, actionable strategies to mitigate this modifiable lifestyle risk.

Methods

Search strategy

A comprehensive search of studies investigating the association between smoking and breast cancer was carried out in electronic databases of PubMed, Google Scholar, African Journals Online, and other documents, including reports from the Nigerian government and the Global Youth Tobacco Survey. We searched publications between January 2000 and December 2024. A total of 30 studies were included in the systematic review. The inclusion criteria comprised publications that examined the association between smoking (including Shisha and electronic cigarettes, e-cigs) and breast cancer, as well as studies that investigated tobacco use within the Nigerian context or provided relevant global findings applicable to Nigeria. The comprehensive search strategy employed to locate relevant studies involved the terms: "breast cancer" or "breast neoplasms" in combination with "smoking" or "tobacco smoke pollution", or "tobacco use", or "tobacco products", or "active smoking" or "passive smoking" or "second-hand smoking" or "tobacco."

The reference lists of retrieved studies and conference records were also reviewed for potentially inclusive studies. Similar search strategies were used for Shisha and E-cigs. We studied the articles with the primary objective of identifying their relevance to the Nigerian environment. We further searched for relevant articles on any of the chemicals by local Nigerian scientists. This latter group of databases included relevant scientific studies conducted in Nigeria, even when the issue of female breast cancer was not on the radar of the context for the research.

The review's exclusion criteria encompassed studies that were not directly relevant to breast cancer or tobacco use in Nigeria, research with insufficient data or a lack of methodological rigour, and studies that focused exclusively on medical conditions unrelated to tobacco or breast cancer. No librarian service was included in the search.

Tobacco Carcinogenicity: The Relevance of Tobacco to Breast Cancer

How tobacco causes diseases has been comprehensively documented.[6] The approximate composition of mainstream smoke of a plain cigarette is summarised in Table I.[7] Over 5,300 compounds have been identified in tobacco smoke.[8] Classes of compounds include but are not limited to neutral gases, carbon and nitrogen oxides, amides, imides, lactams, carboxylic acids, lactones, esters, aldehydes, ketones, alcohols, phenols, amines, *N*-nitrosamines, *N*-heterocyclics, aliphatic hydrocarbons, monocyclic and polycyclic aromatic hydrocarbons (PAHs), nitriles, anhydrides, carbohydrates, ethers, nitro compounds and metals. [8] The addictive properties of tobacco smoke are attributed to nicotine, the principal tobacco alkaloid in smoke. [9] There are over 70 carcinogens in tobacco smoke that the *IARC Monographs* programme has evaluated as having sufficient evidence for carcinogenicity in either laboratory animals or humans. The different chemical classes of carcinogens and their representatives are presented in Table II. [8,10] Sixteen of these – Benzo [*a*] pyrene (BaP), 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK) and *N′*-nitrosonornicotine (NNN), 2-naphthylamine, 4-aminobiphenyl, formaldehyde, 1,3-butadiene, 4-aminobiphenyl, formaldehyde, 1,3-butadiene, benzene, vinyl chloride, ethylene oxide, arsenic, beryllium, nickel compounds, chromium VI, cadmium, and polonium-210 – are classified as carcinogenic to humans (Group 1).

Table I: Approximate chemical composition of mainstream smoke generated by a plain cigarette [7]

Compound or class of components	*Relative amount w/w 9%*
Nitrogen	58
Oxygen	12
Carbon dioxide	13
Carbon monoxide	3.5
Hydrogen, argon	0.5
Water	1
Volatile organic substances	5
Particulate phase	8

Studies on the relationship between smoking and breast cancer risk have yielded inconsistent results and conclusions, potentially due to modification by other factors or confounding. In 2009, the Canadian Expert Panel on Tobacco Smoke and Breast Cancer Risk concluded that the relationship between active smoking and breast cancer is consistent with causality. [11] Tobacco carcinogens are also linked to the development of mammary gland disease and an elevated risk of various cancers, including breast cancer. In addition, the International Agency for Research on Cancer (IARC), after reviewing over 150 epidemiological studies, concluded that evidence exists for tobacco smoke carcinogenicity in breast cancer. [4]

Tobacco smoke contains polycyclic aromatic hydrocarbons (PAHs), including three known human carcinogens—polonium-210 (a radioactive element), benzene and vinyl chloride, as well as 1,3-butadiene and nicotine-derived nitrosamine (NNK), all of which are known to cause mammary tumours in animals. NNK is a tobacco-specific carcinogen that has been shown to increase tumour cell proliferation and the transformation of healthy breast epithelial cells into cancer cells [11-13] at least in part via the nicotine acetylcholine receptor. [14] The other chemicals, viz, PAH, Benzene, Vinyl chloride and 1,3-butadiene, have been discussed in further detail individually in this study on

Environmental Chemical Risk Factors of breast cancer in the appropriate section titled: Non-EDC Industrial chemical risk factors for breast cancer.[15] PAHs do not naturally occur in the tobacco plant but are formed primarily by the incomplete combustion of tobacco and other organic components during smoking. [16] There are more than five hundred different PAHs in tobacco smoke. [17] The IARC lists Benzo [*a*]pyrene (BaP) as a Group 1 carcinogen, classifying it as the most potent carcinogen among the PAHs. [8]

Table II: Tobacco smoke carcinogens evaluated in the IARC Monographs [8,10]

Chemical Class	*Number of Carcinogens*	*Representative Carcinogens*
Polycyclic aromatic hydrocarbons (PAHs) and their heterocyclic analogues	15	Benzo[*a*]pyrene (BaP) Dibenz[*a,h*]anthracene
N-Nitrosamines	8	4-(Methy1nitrosamino)-1-(3-pyridyl)-1-butanone (NNK) *N'*-Nitrosonornicotine (NNN)
Aromatic amines	12	4-Aminobiphenyl 2-Naphthylamine
Aldehydes	2	Formaldehyde Acetaldehyde
Phenols	2	Catechol Caffeic acid
Volatile hydrocarbons	3	Benzene 1,3-Butadiene Isoprene
Other organics	12	Ethylene oxide Acrylonitrile
Inorganic compounds	8	Cadmium Polonium-210

Many other carcinogens in cigarette smoke have not been evaluated in an International Agency for Research on Cancer (IARC) Monograph.

Exposure and consumption of tobacco products are causally associated with various types of cancer. [18,19] Nicotine is the principal property of all kinds of tobacco products and smoke. Nicotine is addictive but non-carcinogenic; [20] however, it is capable of activating various signalling pathways related to tumour promotion. [18] Nicotine and nitrosamines form a catastrophic and fatal alliance. Nicotine activates the brain's reward system, eliciting cravings for continued tobacco consumption, and it is often accompanied by carcinogens, which induce tumour initiation and progression.

Components of cigarette smoke have been found in the nipple aspirate of female smokers. [1] In addition, the presence of smoking-related DNA adduct in epithelial cells of breast milk demonstrates that cigarette components access breast tissue. [21,22] Several mechanisms have been proposed for the development of cigarette smoke-induced breast cancer. Carcinogens found in cigarette smoke have caused mammary tumours in rodents, including Benzo [*a*] pyrene, isoprene, and ethylene oxide. [23] The formation of DNA adducts has been proven to be a widespread mechanism for tumour development as a result of cigarette smoking. [24]

Recent epidemiological research indicates that exposure to tobacco smoke, whether through active smoking or second-hand inhalation, elevates the risk of developing breast cancer. Breast epithelial cells, including non-tumorigenic

types such as MCF10A and MCF12A, and tumorigenic cells such as MCF7, exhibit mesenchymal traits after exposure to cigarette smoke. These traits include a fibroblast-like appearance, enhanced anchorage-independent growth, and greater motility and invasiveness. Perhaps the most notable and studied carcinogens include polycyclic aromatic hydrocarbons and tobacco-specific nitrosamines. [24] These carcinogens are metabolically activated and form DNA adducts that can evade cellular repair mechanisms, allowing permanent mutations of replicate. [25] Increased cell proliferation following cigarette smoke component exposure has been seen in oesophageal, breast, and lung cancer cells. [25,26] In addition to cell proliferation, cigarette smoke can induce migration in cancer cells, a hallmark of tumour progression. [27] Immunomodulation has also been affected by cigarette smoke exposure in cancer cells. [27]

In support, another recent study showed that smoking 40 or more cigarettes per day had the strongest association with the risk of breast cancer (HR 1.17, 95% CI). [28] According to the Surgeon General's report, which included a meta-analysis of 22 cohort and case-control studies, it did not conclusively determine whether starting to smoke at a younger age increases the risk of developing the habit than starting at an older age. [28] However, a recent pooled analysis by Gaudet *et al.,* which included 934,681 participants, concluded that there was an 18% higher risk of breast cancer for women who smoked for more than 10 years before their first birth. [28] Several studies investigated patients who have already developed breast cancer. Pierce *et al*. found that breast cancer patients who were former smokers with more than a 30-pack-year history had a 37% increased risk of breast cancer recurrence and a 54% increased risk of overall breast cancer mortality when compared with non-smoking patients. [29] The overall mortality rate from any cause was increased by 60% for these heavy smokers. [29]

In addition to active smoking, several studies have looked at passive smoking. A 2004 IARC report stated that passive smoke (second-hand smoke) contains higher levels of several carcinogens, including benzene, formaldehyde, and N-nitrosamines. [30] The European Prospective Investigation into Cancer and Nutrition, which carried out the most extensive cohort study on smoking and breast cancer to date, discovered an increased risk of breast cancer in women who were current or former smokers, as well as those currently exposed to second-hand smoke, compared to women who had never smoked and were not exposed to passive smoke. [31] Despite the results from numerous cohort studies, several confounding factors have contributed to the controversial standing on cigarette smoking and breast cancer. [30,32] Alcohol consumption, an identified risk factor for breast cancer, is positively correlated with cigarette smoking. [33]

Yujing *et al.* [1] recently conducted a thorough systematic review and meta-analysis of observational studies. Critical parameters considered in the study were (1) smoking duration in years, (2) smoking intensity-cigarettes per day, (3) pack-years smoked (defined as the product of the number of cigarettes smoked per day and the number of years of smoking, (4) age at the onset of smoking, (5) years since quitting, (6) fertility status, (7) active smoking before/after the first birth, (8) breast cancer subtypes, (9) breast cancer subtypes and smoking duration, (10) menopausal status, (11) places exposed to passive smoking, (12) age stage exposure to passive smoking, and (13) years of passive smoking. [1] The meta-analysis found that smoking (active and passive smoking) increases the risk of BC in the female population, especially pre-menopausal BC and ER^+ BC, but did not affect postmenopausal BC and ER^- BC.

The likelihood of BC was found to be higher with increased smoking duration and intensity, and lower with a longer period of smoking cessation. While smoking elevates the risk of BC in women who have had multiple pregnancies, it does not appear to affect the risk in women who have not given birth. Additionally, smoking before the first childbirth has a greater impact on BC risk compared to smoking after the first childbirth.

Tobacco Smoking Scenario in Nigeria

Tobacco use is rising faster in Africa than anywhere else.[34] The prevalence of smoking in the general population is reported to be 8·9% in Nigeria, [35] however, the pattern of tobacco smoking varies among different social strata. It ranges from 7·7% among female secondary school students [36], 17·1% among secondary school students [37], 17·7% among physicians [38], 20.3% among soldiers [39], to 37·9% among the general population in the northern part of the country. [40] In 2015, the WHO reported a current smoking prevalence of about 9% among persons aged 15 years or more (17% among men and 1% among women) in Nigeria. [41]

Culturally, in Nigeria, women are not expected to smoke cigarettes. Such is the aversion to female smoking that any woman who smokes a cigarette is not likely to find a spouse. Women who smoke are in the minority. Some are commercial sex workers, and some are women who were born in temperate countries and have imbibed the Western lifestyle when they returned home to Nigeria in adulthood. Indeed, the latter group is not usually "bold" enough to smoke in public spaces until they are eventually forced to wean themselves off the habit, particularly when they experience successive failed relationships with men who do not regard them as 'marriageable' because of their socially unacceptable "over sophistication" with the western lifestyle. However, the inevitable plight of women and their children in Nigeria is the "bystander effect" from a husband who is addicted to smoking. Wives of such men are condemned to a life of involuntary exposure to tobacco smoke through passive (second-hand) smoking at home. Nigeria is essentially a patriarchal society where a husband can smoke inexorably with impunity at home until a "spiritual" conviction occurs when he sees the habit as a 'vice' akin to recreational drug addiction, not compatible with his faith if he is a Christian. It is, therefore, imperative that men are also invited to fora where public enlightenment and educational breast cancer preventive strategies are discussed. Usually, such talks are reserved for women only. The modern-day female gender smoking habit in Nigeria is one of the fallouts of westernisation, globalisation and saturated media space.[42]

It is critical to note that since second-hand smoke is just as dangerous or even more dangerous, particularly as regards breast cancer risk, it makes no difference whether the man or the woman is the smoker within a household or an enclosed space. Irrespective of who is the smoker, women, daughters, and fetuses are at risk in the household where a family member is a smoker. The various ways of tobacco consumption in Nigeria include cigarette smoking, snuffing, smoking pipes, and chewing.

Adolescents aged 10 to 19 years are particularly vulnerable to high-risk behaviours like tobacco use.[43] Tobacco use during adolescence increases the risk of addiction, [44,45] and most adult smokers become addicted to nicotine during adolescence. [46 - 48] The tobacco industry explicitly targets the youth, especially in developing countries, to retain them as lifetime users [49] who will experience prolonged exposure to tobacco and its associated health risks. In Nigeria, the issue of tobacco use among adolescents is considerable. According to the 2008 Global Youth Tobacco Survey (GYTS), approximately 20% of students aged 13 to 15 years had tried smoking cigarettes at some point, while around 10% of them were current cigarette

smokers. [50] Studies in other parts of Nigeria showed tobacco smoking prevalence among school-going adolescents to range from 3.4% in Ibadan in the southwest [51] to 34.8% in Akwa Ibom State in the south-south region. [52]

Aniwada *et al.* [53] analysed tobacco use data from the 2013 Nigerian Demographic and Health Survey (NDHS) to assess the prevalence, pattern, and socio-demographic correlates of tobacco use among Nigerians aged 15-49 years. Data on 17,322 were extracted from 36,800 participants. On average, 6.6% of participants smoked cigarettes, 1.7% used snuff, 0.4% smoked a pipe, and 0.2% chewed tobacco. Based on gender, 6.6% of males and 6.3% of females smoked cigarettes, while 0.3% of males and 0.4% of females smoked cigarettes and used snuff. The predictors of cigarette use included being in the 25-34 age group.

Oyewole *et al.* [54] conducted a systematic review of tobacco use in Nigerian youths (aged 10-24) and excluded evaluations of tobacco-related medical conditions. The review was conducted on 30 studies involving a combined total of 26,709 participants. Prevalence rates of tobacco smoking ranged from 0·2% to 32·5%. Among the gender-specific studies, the prevalence of smoking among females ranged from 2·2% to 10% while that of males ranged from 1% to 32·5%. Gender distribution among these studies was mixed (80·0%), with males only (13·3%) and females only (6·7%). Smoking prevalence was higher among males than among females. Over one-third (36·7%) of the studies reviewed did not measure the risk factors for tobacco smoking in young people. [54] The most common risk factors included peer influence, male gender, family conditions, such as low parental education, not living with parents, having a parent who smokes and having divorced or separated parents, and psychosocial factors such as belonging to a polygamous home and low level of father's education. Loneliness, depressive symptoms, and a sign of emancipation to manhood were found to contribute significantly to the prevalence of smoking among street children. Other risk factors included concurrent substance abuse, media advertising, and advancing age. The researchers concluded that all stakeholders should engage in concerted efforts to target both in-school and out-of-school youths in tobacco control strategies. [54]

Gana *et al.* [55] examined the prevalence and perceptions of cigarette smoking among out-of-school adolescents aged 10-19 years who had never been to school or had been out of school for at least six months before the survey and resided in the Birnin Kebbi metropolis. This group of young boys are called "Almajiris." The study area (setting) is a classical "Built-in" environment. Although the inhabitants' main occupation is farming and fishing, adolescents are found in their numbers at market areas, motor parks, construction sites, and on busy streets, hawking goods and roaming around, waiting to be beckoned to do one menial job or the other. Cigarettes are sold at corner shops on busy roads, motor parks, shops/stalls at entrances to marketplaces, shops serving the state secretariat office complex and other busy areas. Birnin Kebbi lacks a health facility that provides services specifically for adolescents and a functional, youth-friendly centre. The respondents were aged 15-19 years (mean age of 15·9±2·4 years), with 88·6% males, 85 · 4% of the Hausa/Fulani ethnic group, 94·7% Muslims, and 98·8% unmarried. Close to one-fifth (17·3%) started smoking before the age of 10 years, and 23·6% smoked for more than five days in the last month, while 6·4% used more than five sticks of cigarettes daily. About a third (30%) bought their cigarettes, while 18·2% got theirs from friends. Close to half (49·6%) had never been refused cigarettes by vendors on account of their age, and 19·5% smoked or felt like smoking cigarettes first thing in the morning. The majority of the respondents saw nothing wrong with cigarette

smoking, but rather as an attitude that every "real man" should imbibe. The researchers concluded that the prevalence of cigarette smoking was very high among out-of-school adolescents, much higher than is suggested by studies conducted among secondary school adolescents. Secondly, most out-of-school adolescents who smoked cigarettes became aware of the harmful effects of smoking after tobacco initiation. At the same time, they also believed that the benefits of smoking outweigh the damaging effects.

Adeloye *et al.* [56] in 2019, conducted a review of publicly available studies as part of the series on the epidemiology of non-communicable diseases (NCDs) in Nigeria. The crude prevalence of current smokers in Nigeria was 10·4% and 17·9% for ever smokers. The rates were greater among men than women in both groups. There was considerable variation across geopolitical zones, ranging from 5·4% (North-west) to 32·1% (North-east) for current smokers, and 10·5% (South-east) to 43·6% (North-east) for ever smokers. Urban and rural dwellers had relatively similar rates of current smokers (10·7% and 9·1%) and ever smokers (18·1% and 17·0%%). The pooled mean number of cigarettes consumed per person per day was 10.1 (6·1-14·2), accounting for 110 million sticks of cigarettes per day and over 40 billion cigarette sticks consumed in Nigeria in 2015.

The study by Adeloye *et al.* [56] reported that the prevalence of smoking in some countries in sub-Saharan Africa was increasing due to changing socioeconomic status, rural-urban migration and increased cigarette affordability. [57] Davies *et al.* noted a decreasing smoking rate in Nigeria and attributed this to increased health risk awareness and better overall measures to help smokers quit in the country. For example, in a national survey, Kale and colleagues [58] reported that in the 12 months preceding their study, almost half of current smokers attempted to quit, with over 66% of these individuals receiving guidance from healthcare providers and counsellors. For instance, Adeloye *et al.* [56] estimate that rural dwellers smoked at nearly the same rate as urban dwellers, suggesting that smoking, which is traditionally linked to urbanisation, has increasingly spread to remote areas. Further, the researchers estimated that current smokers consumed an average of 10 cigarette sticks per person per day, accounting for about 110 million cigarettes per day and over 40 billion cigarettes in 2015 alone. Vellios *et al.* [59] noted that cigarette demand increased by 44% across many African countries between 1990 and 2012, leading to an over 100% increase in cigarette production during the same period. An expanding tobacco industry poses significant public health challenges, especially for a nation with a comparatively underdeveloped health system. Tobacco companies see these countries as emerging markets due to weak tobacco control regulations and several vulnerable populations. [60,61]

The prevalence of smoking was markedly elevated in northeast Nigeria, a trend that can be attributed to the protracted armed conflict that has been enduring for over a decade in the region. Although the evidence of the association between smoking and conflict is limited and inconclusive,[62] varying social situations among vulnerable populations are known to precipitate substance use.[63] Given the displacement of numerous individuals, the interruption of education for children and adolescents, and the lack of employment opportunities for young people, there is an increased likelihood of rising substance use, including tobacco products, in these environments. The researchers concluded that while the prevalence of smokers may be declining in Nigeria, one out of ten Nigerians still smokes daily. They recommended comprehensive measures and strict anti-tobacco laws targeting tobacco production and marketing.

Odiase[64] of the Women Action Initiative against Tobacco, Smoke-Free Foundation, Abuja, Nigeria, examined the effect of smoking on breast cancer risk in women who started smoking as teenagers. The study was conducted among Kenyan and Nigerian women. The number of women used for the study included 102,098 women who completed a mailed questionnaire at recruitment over a period of 9 years (1996 to 2004). All Kenyan-Nigerian women were aged from 30 to 50. The researchers estimated the relative risk (RR) of breast cancer associated with different measures of smoking initiation, the duration of smoking, which is a strong determinant of the risk, and intensity, the number of cigarettes that were smoked during the period.

Cox proportional-hazards regression models were used to estimate these risks and to adjust for confounding variables. The researchers conducted analyses on the entire study population, among women who had smoked for at least 20 years, among non-drinkers, and separately for each country. A total of 1,240 women were diagnosed with invasive breast cancer. Compared with women who had never smoked, women who smoked for at least 20 years and who smoked 10 cigarettes or more daily had an RR of 90%. In contrast, women who had smoked for at least 20 years but started after their first childbirth did not experience an increased breast cancer risk. The results support the notion that women who start smoking as teenagers and continue to smoke for at least 20 years may increase their breast cancer risk. The researchers concluded that more cigarettes per day and more years of smoking led to a higher chance of breast cancer and that smoking prevention should be reinforced among adolescents.

What Intervention Strategies Has Nigeria Introduced

Intervention and Policy Implication [65]

To promote future reductions in tobacco use in Nigeria, it is essential to develop and implement new tobacco control strategies and strengthen existing measures. These efforts should focus on encouraging smoking cessation, preventing exposure to second-hand smoke (SHS), and discouraging individuals from starting to use tobacco. Nigeria became a signatory to the WHO Framework Convention on Tobacco Control (FCTC) [66] in June 2004 and ratified it in October 2005 as part of its national tobacco control strategies. In June 2006, the esteemed Minister of Health established a multisectoral committee on tobacco control in Nigeria. At the State level, Cross River State passed a law in 2001 prohibiting the advertisement of tobacco products in the media [67], while the Federal Capital Territory, Abuja, banned smoking in public spaces starting from May 31, 2008. In 2008, several non-governmental organisations (NGOs), including the Nigerian Heart Foundation (NHF), Environmental Rights Action (ERA), and Nigerian Cancer Society (NCS), among others, came together to form an Anti-Tobacco Control Alliance (ATCA). By doing so, a robust advocacy organisation has been established to collaborate with the government in its tobacco control initiatives. Most of these organisations already carry out activities during World No Tobacco Day (WNTD) on May 31 each year to raise public awareness of tobacco's serious health, environmental and economic hazards. [65]

In 1999, the Global Youth Tobacco Survey (GYTS) was launched by the World Health Organisation (WHO), the Centres for Disease Control and Prevention (CDC), and the Canadian Public Health Association (CPHA) to assess tobacco consumption, perceptions regarding tobacco use, and exposure to second-hand smoke (SHS) among adolescents aged 13 to 15 years. Since 1999, the survey has been conducted in 140 countries and 11 territories and across all six

WHO regions. [68] A key goal of GYTS is for countries to repeat the survey every 4 years.

GYTS is a school-based anonymous questionnaire survey that collects data on students aged 13-15 years using a standardised methodology for constructing the sample frame, selecting schools and classes, and processing data. In all centres, exposure to second-hand tobacco smoke is a problem. The exposure rate ranges from 14·5% in Ibadan to 31·3% in Cross State at home and 35% in Ibadan to 55·8% in Kano in public areas. Approximately 70% of students from Kano, Cross River, and Ibadan support the prohibition of smoking in public spaces. However, fewer students in Lagos (about 1 in 2) and in Abuja (over 1 in 2) are in favour of the ban. On the whole, over 50% of the youths favour the ban on smoking.[68]

The main goal of a comprehensive tobacco control programme is to improve the health of the population by encouraging smokers to quit, eliminating exposure to second-hand smoke, and encouraging people not to initiate tobacco use. The MPOWER [69,70] report focuses on the following:
M – Monitor tobacco use
P – Protect people from tobacco smoke
O – Offer help to quit tobacco use
W – Warn about the dangers of tobacco
E – Enforce bans on tobacco advertising and promotion
R – Raise taxes on tobacco products

Nigeria has laws banning smoking in health care facilities, education facilities, and government facilities' indoor offices; however, enforcement is very weak, and none exists for restaurants, pubs, or bars. GYTS data on exposure to SHS in Nigeria shows in Abuja 39·7%, Cross-River 46·9%, Ibadan 35%, Kano 55·8%, and Lagos 43·1.0% of the students report being exposed in public during the past week, while between 14·5% and 31·3% live in homes where others smoke, and between 2·1% and 11·1% of their parents smoke.

Research on the efficacy of school-based smoking prevention programs has yielded inconsistent results. Results from the GYTS show that between 44% and 59% of students reported being taught in class within the past school year about the dangers of tobacco. Studies have found that some programmes result in short-term decreases, but others have examined long-term programme outcomes and found none to be effective.[71] WHO recognises that school- and community-based tobacco control programmes are essential. Still, they are most likely to be successful after a favourable policy environment has been created, including tax and price policies, 100% smoke-free public places and indoor workplaces, and a comprehensive ban on all tobacco advertising, promotion, and sponsorship.[72]

Although Nigeria ratified the WHO FCTC on October 20, 2005, the findings in this report suggest that the tobacco control programme should focus on implementing and enforcing existing policies and expanding into new programmatic initiatives. The tobacco control effort needs to be comprehensive, broad-based, and focused on boys and girls and tobacco products other than cigarettes. If Nigeria does not address these issues soon, future morbidity and mortality attributed to tobacco will increase. The WHO FCTC provides practical frameworks for implementing such a comprehensive approach. The synergy between countries that pass tobacco control laws, regulations, or decrees ratifying the WHO FCTC and conduct initial and repeat GYTS offers countries a unique opportunity to develop, implement, and evaluate comprehensive tobacco control policies tailored to each country.

Although the rate of current smokers in Nigeria may be decreasing, the total number of active smokers continues to be among the highest in Africa. Economic growth, improved

socioeconomic status, rapid migration, and increased cigarette affordability are key factors. As rural dwellers are almost as affected as urban dwellers, careful consideration is required during programming. Robust measures and stringent anti-tobacco regulations to control tobacco production and marketing should be implemented at all levels of the country.

Conclusion and Recommendations on Tobacco Smoking

While cigarette smoke contains a range of carcinogenic substances, polycyclic aromatic hydrocarbons (PAHs), N-nitrosamines, aromatic amines, 1,3-butadiene, benzene, aldehydes, and ethylene oxide are particularly significant due to their high carcinogenic potency and their prevalence in cigarette smoke.

Based on cancer studies in experimental animals, epidemiological human studies, and mechanistic studies, smoking (active and passive smoking) increases the risk of breast cancer in the female population, especially pre-menopausal BC and ER^+ BC. The risk of breast cancer was found to be positively correlated with both the duration of smoking and the intensity of smoking. Smoking before the first birth had a larger adverse effect on BC risk than smoking after the first birth.

Current scientific evidence strongly supports that effective remedial actions should encompass ensuring comprehensive protection from second-hand smoke exposure for the entire population, progressively increasing the cost of all tobacco products, and enhancing access to cessation resources to proven cessation treatments and services; taking actions at the federal, state, and local levels to counteract the influence of tobacco advertising, promotions, and sponsorship; and ensuring that all adults and children clearly understand that the result of tobacco use is addiction, suffering, reduced quality of life, and all too often, early death from breast cancer among other types of cancer.

Although the NTC Act was signed into law in 2015 and Nigeria has been a party to the WHO FCTC since 2005,[67] the country is not yet on track to achieve tobacco control targets.[6] Careful incorporation of the WHO MPOWER package (targeted at reversing the tobacco epidemic) [67] beyond the national level to state and local levels may complement successful measures such as smoke-free legislation, taxes, health education, and media campaigns.[8,61] Nigeria also needs to develop comprehensive surveillance systems to monitor cigarette production, sales, and consumption to achieve control targets effectively.[60]

Although paid advertisements for tobacco products are prohibited on most social media sites, social media influencers promoting tobacco products are often permitted.[73] Today's youth spend more time online; therefore, surveillance of online pro-tobacco messaging exposures among young people is crucial.[74] Implementation of counter-marketing campaigns targeted to young people—deployed online and via other media—could dampen the effects of pro-tobacco messaging exposure in this vulnerable population. [75]

Shisha

Shisha is also known as Narghile, hookah, Hubble bubble, and water pipe in different cultures and countries.[76] Shisha is a method of smoking tobacco invented in the 16th century by an Indian physician named Hakim Abul-Fath Gilani.[77] The device's purpose was to pass smoke through water to 'purify' the smoke, an unproven concept that the medical community has repeatedly questioned.[78] The practice of Shisha has changed in multiple ways. For example, the substance smoked has evolved from simple tobacco to the addition of flavourings (such as apple, grape, and mint), a marketing strategy to increase popularity, particularly among the youth. Shisha has surged in popularity in the last decade, especially in the

UK.[79] Present-day Shisha smoking masses include the youth, mainly university and college students, and also high school children.[80] Recently, Shisha has been considered a global threat and given the status of an epidemic by public health officials. According to the WHO, Shisha has been used to smoke tobacco and other substances by the indigenous people of Africa and Asia for at least four centuries.[81] But there is growing evidence to show that Shisha is gaining popularity globally and is fast becoming a serious threat to public health. [81,82]

Attitudes and Beliefs Regarding Shisha Use

A recent study found a disparity among general practitioners (GPs) in their knowledge of Shisha and its effects.[83] 36% of GPs described smoking shisha as equivalent to 16-20 cigarettes, while 20% of GPs believed smoking shisha was equivalent to 0-5 cigarettes.[83] There is, therefore, a clear need for more research regarding the health effects of shisha smoking to provide an accurate evidence base. The prevailing attitude towards smoking shisha is notably more lenient in comparison to the attitudes towards cigarette smoking. There is a widespread misconception that Shisha is a safe alternative to smoking cigarettes, particularly among medical students, young adults, and the teenage population in the UK, the US, Pakistan, Saudi Arabia, and Malaysia, where there has been an exponential rise in shisha popularity. [84-88] These lay beliefs have unfortunately maintained themselves despite the campaigns against shisha smoking and action by local councils in the UK. A comprehensive program is needed to enhance awareness of the health risks associated with smoking shisha, particularly among adolescents and young adults.

Markets, even in developed countries, promote the fallacy that Shisha is less hazardous than smoking cigarettes, and it is the main driving factor behind its current popularity. However, research has proven otherwise, suggesting three additional risks to the health of water pipe smoking over cigarette smoking. Firstly, as Shisha is smoked over coal, this adds to the already many harmful toxins that the smoke possesses. Secondly, a shisha smoker inhales up to 200 times more smoke in a single session than a cigarette smoker. Thirdly, it is linked to high rates of second-hand smoking due to its high social acceptance.[76] The World Health Organisation has also warned that smoking Shisha for an hour is equivalent to smoking 100 cigarettes.[81] The greater the exposure in terms of duration and amount smoked, the greater the health risk.[89]

The common misconception that water in a shisha filter reduces its harmful effects is widely held, with many believing that the water filtration process makes it less detrimental. However, it is well established that passing air bubbles through water does not alter their content. Consequently, the volatile carcinogens and other particles in tobacco smoke remain in the air bubbles as they travel through the water, meaning that Shisha is no less harmful than cigarettes.[90] Shisha smokers are exposed to hundreds of potentially dangerous materials at one time. Major smoke constituents are carbon monoxide and nicotine.[91] Shisha smokers may absorb large amounts of these substances because of the mode of smoking, depth of inhalation, length of smoking session, and frequency of puffing.[92] The hazards of tar and its carcinogenicity were directly related to working temperature, not only to combustion and pyrolysis.[93,94] Hookah smoking is associated with an increased risk of lung cancer in the ethnic Kashmiri population, with the risk being six times higher than that of non-smokers. [95,96]

Constituents of Shisha Smoke and Carcinogenesis

In shisha smoking, flavoured tobacco or molasses is combusted with coal. When a person inhales through the mouthpiece, the air is drawn through

the device, passing over the tobacco and heated by the coal to generate smoke. Consequently, the resulting smoke contains elements from both the tobacco and the coal. Both tobacco-containing and tobacco-free molasses contain high levels of polycyclic aromatic hydrocarbons (PAH), a carcinogenic compound.[97] These high levels are primarily due of coal combustion.[96] Coal is generally found either in lumps or briquettes.[97] Lump coal comes in various forms and sizes and is derived from biomass. The briquette form can be seen as either 'easy-light', which contains an ignition agent, or as a coconut-shell-based product.[97] All these forms of coal contain high levels of PAH residues, especially Benzo (a)pyrene, a potent carcinogen.[97] Curiously, in one study, coconut-shell-based coal contained approximately six times more PAH products than any other type of coal.[90] Lump coal was shown to contain the least amount of PAH.[97] This significant exposure to PAH may be causal in the development of various malignancies after smoking.[97] The presence of volatile aldehydes has also been reported in shisha smoke, including formaldehyde, acrolein, propionaldehyde, and methacrolein.[98] Formaldehyde and acrolein are both potent carcinogens that may promote the development of leukaemia.[98] Research indicates that the concentrations of volatile aldehydes in shisha smoke are considerably elevated compared to those found in cigarette smoke. This suggests that shisha use may be associated with an increased risk of diseases linked to aldehyde exposure.

Notable chemicals relevant to breast cancer in Shisha include polycyclic aromatic hydrocarbons (PAHs), Benzo[*a*]pyrene, and volatile aldehydes, including formaldehyde, acrolein, propionaldehyde, and methacrolein. The relationship between the chemicals in tobacco, formaldehyde, and PAH as breast cancer risk factors has been discussed individually in this series of studies on Environmental Chemical Risk Factors of Breast Cancer. Similar to cigarette smoking, shisha smoking introduces numerous harmful chemicals and free radicals into the body, many of which have been associated with the development of cancer. For example, one study revealed that smoking Shisha quadruples the risk of lung cancer.[98] Further study is necessary to clarify and define the pathophysiological mechanisms whereby shisha smoking may produce disease. In light of the evidence already available, public awareness of the potential effects of shisha smoking is required, particularly as regards breast cancer risk.

Shisha Use Scenario in Nigeria

The hookah culture started in Nigeria circa 2012, around the same time when many wealthy Nigerians made Dubai their new recreational destination. They picked up the hookah lifestyle during numerous visits to the famous capital city and brought it back to Nigeria. Shisha is perceived as an exotic culture by Nigerian millennials and is promoted on Instagram and Snapchat with hookah clouds hovering over them. Shisha smoking is so common now in the metropolis similar to what obtains in places such as swanky nightclub on Dubai island [99]

Lasebikan *et al*. [100] studied the prevalence, correlates, and predictors of shisha smoking in some nightclubs in Ibadan. Among a sample population of 633, the prevalence rate of smoking was 7·1%, and out of this number, 7·2% were men, and 6·6% were women. The age of initiation into shisha smoking was lower among women, but men were significantly more likely to be more frequent users. There was no significant gender variability in the stage of readiness to quit. The researchers concluded that Shisha has emerged as a prevalent public health issue in Nigeria and that there is a need for an immediate response from policy providers towards shisha smoking intervention in Nigeria.

Osibogun *et al.* [101] explored the knowledge and risk perception of e-cigarettes and hookah amongst young people in Lagos in a focus group discussion. The users of e-cigarettes and hookah continue to use these products, though they are aware of some associated adverse health effects. The users claimed they primarily use the products to relieve stress and gain social acceptance. The researchers recommend raising awareness of the risks associated with the use of these products to reduce their acceptability among youths.

Nwafor *et al.* [102] conducted a study among doctors in Kebbi State to explore their attitudes and willingness towards clinical counselling of shisha smokers on tobacco cessation. They found that about 80% of the doctors were aware of shisha smoking but had inadequate knowledge of Shisha to equip them for counselling.

Abraham *et al.* [103] evaluated media coverage of Shisha in Nigeria between 2014 and 2018. They found 30 relevant publications about Shisha in newspapers. The findings were as follows (1) shisha is gaining popularity among youths, particularly in tertiary institutions across the country; (2) the increasing popularity was driven by the attractive flavours and the misperception that it is safer than traditional cigarettes; (3) many shisha users were no longer satisfied with just visiting night clubs and shisha cafes but now own the shisha paraphernalia; (4) in some instances the tobacco in Shisha was being replaced or mixed with other hard drugs like marijuana; (5) there exists subtle advertisement of shisha lounges, which constitutes a breach of the Nigerian National Tobacco Control Act. The researchers conclude that there is a need for increased sensitisation of the public through the media on the dangers of shisha smoking and other tobacco product use. They also advocate for the implementation of a national survey to assess the prevalence of shisha use in Nigeria.

In May 2015, the Tobacco Control Bill, which prohibits tobacco smoking in public places in Nigeria, was passed into law by the Federal Government of Nigeria. [100,104] Unfortunately, many public shisha smoking places have opened in major cities across Nigeria, even after the enactment of the Tobacco Control Law.[100] In a 2015 technical report by the World Health Organisation (WHO) Study Group on Tobacco Product Regulation (TobReg), it was reported that many countries, including Nigeria, lack specific policies regulating shisha smoking among their populace. [103,105] It is also noteworthy that most of the existing public health education programmes on tobacco in Nigeria have focused only on cigarettes, with little or no attention on Shisha. Furthermore, many shisha smokers in Nigeria lack adequate knowledge of the health risks associated with shisha smoking.[106] Kanmodi *et al.* [107] assessed how to combat the silent shisha epidemic in Nigeria. They recognised that enacting a law by the Federal Government of Nigeria would be insufficient to combat the outbreak. They, therefore, recommend the use of public health education interventions, which should focus on positively changing people's attitudes towards Shisha, on how to resist peer pressure to smoke, and the adverse health and socioeconomic consequences of Shisha use to make Shisha smoking a socially unacceptable habit.[108]

Electronic cigarettes

Electronic cigarettes are known by many different names, including E-cigarettes, ECs, e-cigs, vape pens, electronic nicotine delivery systems (ENDS), alternative nicotine delivery systems (ANDS), e-hookahs, mods, vaporisers, vapes, and tank systems; JUUL is one popular brand of e-cigarette.[109] Electronic cigarettes are a diverse range of battery-operated devices that vaporise nicotine for inhalation. Electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems (ENNDS) exist.[110] The use of e-cigarettes is often referred to as

"vaping" because many people believe e-cigarettes create a vapour, which is then inhaled. However, e-cigarettes produce an aerosol of tiny particles, rather than vapour. [111] They have been purchased and used by millions of people since their introduction in 2004.[110] However, the place of ECs in tobacco control is controversial and ethically debatable. [112,113] smoke from e-cigarettes is different from cigarette smoke. While cigarette smoke results from the burning of tobacco and other cigarette additives, e-cigs create "smoke" by heating a liquid, creating a chemical-filled aerosol which is then inhaled. Since they don't contain tobacco combustion byproducts (many of which are carcinogenic), e-cigarettes are expected to offer an improvement over traditional cigarettes in this area under *typical* conditions of use. [114]

What exactly are the chemicals/ingredients in the e-vapour smoke?

It is hard to know exactly what chemicals are in an e-cigarette because most products do not list all the harmful or potentially harmful substances contained in them. Some products are also mislabeled.[112] There are a vast number of vaping devices on the market, and an even larger number of other chemicals (in the form of e-juice formulations) that can be used in these devices, including those users may occasionally add independently. To make matters worse, many retailers of e-cigarettes also mix custom "e-liquids," making ingredients difficult to track and regulate.[112]

All ENDS/ENNDS devices heat a solution (e-liquid) to produce an aerosol, often including flavourings typically dissolved in Propylene Glycol and/or Glycerin. All ENDS (but not ENDS) contain nicotine. [109] The typical use of unadulterated ENDS/ENNDS produces an aerosol that *ordinarily* includes glycols, aldehydes, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), tobacco-specific nitrosamines (TSNAs), metals, silicate particles, and other elements. Dicarbonyls (glyoxal, methylglyoxal, diacetyl) and hydroxycarbonyls (acetol) are also possible important aerosol compounds.[109] Metals identified in some ENDS/ENNDS aerosols include lead, chromium, and nickel. Other ingredients include acetaldehyde and formaldehyde. [115-118] Some of the metals and aldehydes have been found in the aerosol of some ENDS/ENNDS at concentrations equal to or greater than those of traditional cigarettes under standard experimental conditions of use. [109,117,118] The number and level of known toxicants generated by the typical use of unadulterated ENDS/ENNDS are lower than in cigarette smoke, with a few new toxicants specific to ENDS, such as glyoxal. However, the levels of toxicants can vary enormously across and within brands and sometimes reach higher levels than in tobacco smoke. [118]

E-cigarette and Cancer

Researchers have found that E-cigarette smoke causes DNA damage in mice and creates mutations in the lungs, bladders, and hearts of mice.[119] Although the study is preliminary, the researchers suggest the findings may indicate similar effects in humans. However, nicotine is a chemical that cigarettes and vaping tools seem to universally have in common. Nicotine is also capable of transferring directly to breast tissue. The chemical nicotine is linked to resistance to cancer treatment drugs, and tobacco, from which nicotine is derived, is a known carcinogen.[120] Multiple samples of e-cigarette vapour contained formaldehyde-releasing agents, which are thought to be byproducts of the vaporisation of the propylene glycol e-liquid base. Formaldehyde is a cancer-causing substance that may form if e-liquid overheats or if not enough liquid reaches the heating element (known as "dry puff").[110] Assuming that the risk per unit of formaldehyde from inhaling formaldehyde-releasing agents is equivalent to the risk associated with inhaling gaseous formaldehyde,

it follows that long-term use of vaping products could result in a lifetime cancer risk that is five to fifteen times greater compared to the risk associated with long-term smoking.[120] Formaldehyde as a risk factor for breast cancer has already been discussed in this study. Other chemical breast cancer risk factors which have been identified in e-cigs at unsafe levels are lead, chromium, manganese, nickel, and volatile organic chemicals (VOCs). These have all been discussed under the relevant headings in this study.

However, there is as yet not enough research to quantify the relative risk of ENDS/ENNDS compared to smoking because (a) complex mixtures, such as in ENDS liquids and aerosol, have the potential for toxicological effects even if toxicants are at low or very low concentrations; [121] (b) predicting adverse health effects of these complex mixtures solely based on aerosol composition might prove futile without solid evidence from the coordinated use of chemical, in vitro, clinical [121] and epidemiological methods; and (c) simple comparisons of toxicant levels in ENDS/ENNDS aerosol to high levels in tobacco smoke, may be of little value given the absence of science on safe tolerance limits for smoke constituents or their specific effects on the multiple diseases caused by smoking.

Health risks to bystanders from exposure to exhaled aerosol from ENDS/ENNDS USERS

A recent systematic review of the health risks associated with passive exposure to exhaled aerosol from electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems (ENNDS), commonly referred to as second-hand aerosol (SHA), determined that such exposure could potentially result in adverse health effects. This finding is further supported by a review commissioned by the World Health Organisation (WHO). It has been established that bystanders are also at risk from the harmful toxins present in e-cigarette emissions.

E-cigarettes and the youth

Among youth, e-cigarettes are more popular than any traditional tobacco product. In 2015, the US Surgeon General reported that e-cigarette use among high school students had increased by 900%, and 40% of young e-cigarette users had never smoked regular tobacco.[114] E-cigarettes are available in a range of designs, including forms resembling pens, bracelets, USB drives, and other everyday objects. These discreet designs enable young individuals to use these products covertly, thereby minimising potential disapproval from those who might object to adolescent smoking behaviours. JUUL or 'JUULing' refers to using one brand of e-cigarette called JUUL, which is very popular among kids, teenagers, and young adults. All JUULs contain nicotine. JUULs and similar devices are typically small, sleek, high-tech-looking, and easy to hide. They are designed to resemble USB flash drives and can be recharged using a computer. They can be hidden in the palm and are hard to detect because they give off little vapour or smell. Kids and teenagers are known to use them in school restrooms and even in the classroom.[110]

There are three reasons e-cigarettes may be particularly enticing to young people.[114] First, many teens believe that vaping is less harmful than smoking. Second, e-cigarettes have a lower per-use cost than traditional cigarettes. Finally, vape cartridges are often formulated with flavourings such as apple pie and watermelon that appeal to younger users. The absence of smoke is appealing to both adolescents and adults. With no smell, e-cigarettes reduce the stigma of smoking. Adolescents are more inclined to use e-cigarettes rather than traditional cigarettes.

Although e-cigs have been marketed as an aid to help quit tobacco smoking, e-cigs have not received Food and Drug Administration approval as smoking cessation devices. Many individuals who initially aimed to quit nicotine

by using e-cigarettes ultimately continued to use both traditional cigarettes and e-cigarettes. [114,123] In light of the known and yet unknown adverse health effects of e-cigs, there is as yet no substitute for approved smoking cessation options.

Prevention of the use of e-cigs

Identifying the drivers/facilitators of e-cig use and the regulatory options is critical if meaningful intervention strategies are to be implemented.

Some other drivers/facilitators of e-cig use

The marketing of e-cigs uses diverse channels such as point-of-sale, audiovisual, print, mass media, and online,[123] and uses deceptive claims. Some e-cigs also have lower per-use costs than traditional cigarettes. Product characteristics also favour e-cigs. Certain flavours, such as fruit and confectionery or candy-like aromas, appeal to children, younger never-smokers and young ENDS/ENNDS beginners, [123-127] and, therefore, motivate experimentation among them. Product placement also facilitates the use of e-cigs. Internet sales, unlike those in retail stores, allow e-cigs to of purchased with a single click of the mouse.

Regulatory options

The following objectives have been identified by the WHO FCTC for consideration by Parties with national law. [109]

- Prevent the initiation of ENDS/ENNDS by non-smokers and youth with special attention to vulnerable groups.
- Minimise potential health risks to ENDS/ENNDS users as much as possible and protect non-users from exposure to their emissions.
- Prevent unproven health claims being made about ENDS/ENNDS
- Protect tobacco control activities from all commercial and other vested interests related to ENDS/ENNDS, including the interests of the tobacco industry

Prevention of initiation of ENDS/ENNDS may be promoted by (a) school visits on breast health programs should aim to educate students against vaping and encourage healthier lifestyle choices. (b) banning the sale and distribution of e-cigs to minors; (c) prohibiting or restricting advertising, promotion and sponsorship of e-cigs; (d) taxing e-cigs at a level that makes e-cigs unaffordable to minors; (e) prohibiting or limiting the use of flavours that appeal to minors; (f) regulating places, density and channels of sales; and (g) taking measures to combat illicit trade in e-cigs.

Minimising potential health risks to users and exposed non-users may be facilitated by (a) testing heated and inhaled flavourings for safety and banning or restricting the amount of those found to be of serious toxicological concerns, e.g. diacetyl, acetyl propionyl, the aldehydes and metals; (b) requiring the use of ingredients, not a health risk; (c) regulating electrical and fire safety standards of e-cigs devices; (d) regulating the e-cig products like drugs e.g as regards ingredient labelling, report of adverse effects; and removal of sub-standard products.

Parties that have not banned the importation, sale, and distribution of e-cigs may consider the following options to minimise health risks to non-users: (i) Prohibit the use of e-cigs in indoor spaces; (ii) publish health warnings as regards risks of e-cigs to increase awareness; (iii) reduce the risk of accidental acute nicotine intoxication by (a) requiring tamper-evident/child-resistant packaging for e-liquids and leak-proof containers for devices and e-liquids and (b) limiting the nicotine concentration and total nicotine amount in devices and e-liquids.

Prevention of unproven health claims being made about e-cigs involves prohibiting implicit or explicit claims about the effectiveness of e-cigs as smoking cessation aids, as innocuous, or not as

addictive. Protecting tobacco control activities from all commercial and other vested interests related to e-cigs, including interests of the tobacco industry, involves stringent steps which include (a) Raising awareness about potential industry interference with Parties tobacco control policies; (b) Establishing measures to limit interactions with the industry and to ensure transparency in those interactions that do take place; (c) rejecting partnerships with the industry; (d) taking measures to prevent conflicts of interest for government officials and employees; (e) requiring that information provided by the industry be transparent and accurate; (f) banning activities described as "socially responsible" by the industry, including but not limited to activities described as "corporate social responsibility;" (g) refusing to give preferential treatment to industry; and (h) treating state-owned industry in the same way as any other industry.

There is an ongoing debate regarding whether e-cigarettes save smokers or create new addicts. [128] The US is cracking down on vaping, while the UK is promoting e-cigarettes as an aid to giving up smoking. In the storm over child users, the FDA has instructed manufacturers of e-cigs to apply for the right to trade by May 2020. The WHO has advised countries to control vaping, warning about the unknown impact on health and stating that e-cigs are risky for teenage brains, as well as for the foetus. [129,130] The revelation of breast cancer risk factors makes it immediately compelling to eliminate e-cigs from the market and intensify awareness programs in schools and in every religious institution where parents and children can be reached.

E-cigarette use in Nigeria

Kanmodi *et al.* [131] found a paucity of scientific literature on e-cigarette use (vaping) in sub-Saharan Africa. This indicates that limited research has been conducted on this emerging public health concern. They recommend multidisciplinary, collaborative research across relevant academic disciplines to conduct robust studies on e-cigarette use in sub-Saharan Africa. Osibogun *et al.* [132] investigated the understanding and risk perceptions of e-cigarettes and hookah among adolescents in Lagos State, Nigeria. An essential element of their findings was that the majority of the participants reported that they were aware of some adverse health effects associated with e-cigarette or hookah use. Although some participants felt that the use of e-cigarettes or hookahs could transform into cigarette smoking, many felt that e-cigarette was a harm-reduction tool. They found that the products are primarily used to relieve stress and for social reasons. They concluded that raising awareness of the risks associated with using these products may help reduce the acceptability of these products among youths.

Intervention strategies

Regarding the regulations to protect Nigerian citizens, the following guidelines, as informed by the Standards Organisation of Nigeria (SON), are relevant to the importation of e-cigarettes into Nigeria.

i. Importers of e-cigarettes into Nigeria should be aware of the following requirements, as defined by SON: E-cigarette importers shall register with SON and obtain a SON approval letter before proceeding with the SON Conformity Assessment Programme (SONCAP) certification process.
ii. Only e-cigarettes with Zero Nicotine can be registered and processed by SONCAP.
iii. E-cigarettes with zero nicotine must not contain propylene glycol.
iv. All e-cigarette imports must be registered with SON before being processed to obtain the SONCAP Certificate.

v. A letter of responsibility/commitment for any health-related side effect observed as a result of the use of the product must be written by e-cigarette manufacturers before clauses i-iii are allowed.

Tobacco cigarettes, Shisha, and e-cigarettes contain nicotine and propylene Glycol.

It becomes clear that, as far as Nigeria is concerned, laws are enacted by regulatory bodies to fulfil all righteousness, "just to be seen doing something, not for implementation. Therefore, the most critical intervention strategy in Nigeria regarding smoking is *increased awareness.* Only when adolescents hear, believe, and see the serious consequences of these chemicals on themselves and their loved ones would they have the motivation to stop smoking. The long latency of breast cancer and the plurality of risk factors make interventions difficult to implement, but this should not discourage sustained intervention strategies regarding modifiable factors.

Conclusion and Recommendations

Vaping is considered a harmful habit for non-smokers for several reasons. It increases secondhand exposure to particulates and nicotine, elevating bystanders' risk. Furthermore, it heightens the likelihood of fatal poisonings and increases the chances of transitioning to conventional cigarette smoking. Dependency on e-cigarettes is another significant concern, along with exposure to numerous toxic substances found in vaping aerosols. Vaping can also exacerbate respiratory issues such as coughing and wheezing, and worsen asthma symptoms. Additionally, the presence of cancer-causing substances in e-cigarettes gives users a misleading sense of security compared to the well-known health risks associated with conventional tobacco cigarettes.

The Centres for Disease Control and Prevention (CDC) advises against using e-cigarettes or vaping products that contain THC. It also discourages obtaining vaping devices from informal sources, such as friends, family, or online dealers. Modifying or adding substances to a vaping device that the manufacturer does not intend is strongly discouraged to prevent adverse health effects.

Authors' Contributions: OYM conceived and designed the study and did the literature review. OYM did data analysis and interpretation and also drafted the manuscript. AOO participated in designing the study. AOO, AAO and OE revised the draft for sound intellectual content. All the authors approved the final version of the manuscript.

Conflict of Interest: None.

Funding: The authors received funding from FAMFA Oil Limited for the research.

Publication History: Submitted 25 October 2024**; Accepted** 21 August 2025**.**

References

1. He Yujing, Si Yuexiu, Li Xiangyan, Hong Jiaze, Yu Chiyuan, He Ning. The relationship between tobacco and breast cancer incidence: A systematic review and meta-analysis of observational studies. Front Oncol 2022;12:961970. https://doi.org/10.3389/fonc.2022.961970.
2. Goldvaser Hadar, Gal Omer, Rizel Shulamith, Hendler Daniel, Neiman Victoria, Shochat Tzippy, Sulkes Aaron, Brenner Baruch, Yerushalmi Rinat. The association between smoking and breast cancer characteristics and outcome. BMC Cancer 2017;17:624. https://doi.org/10.1186/s12885-017-3611-z.
3. Kispert Shannon, McHowat Jane. Recent insights into cigarette smoking as a lifestyle risk factor for breast cancer. Breast Cancer (Dove Med Press). 2017;9:127-132. https://doi.org/10.2147/BCTT.S129746.
4. IARC. Tobacco smoke and involuntary smoking. IARC Monogr Eval Carcinog Risks Hum 2004a; 83: 1–1438.
5. Oyewole BK, Animasahun VJ, Chapman HJ.

Tobacco use in Nigerian youth: A systematic review. PLosONE 13(5):e0196362. https://doi.org/10.1371/journal.pone.0196362

6. Centers for Disease Control and Prevention (US); National Center for Chronic Disease Prevention and Health Promotion (US); Office on Smoking and Health (US). How Tobacco Smoke Causes Disease: The Biology and Behavioral Basis for Smoking-Attributable Disease: A Report of the Surgeon General. Atlanta (GA): Centers for Disease Control and Prevention (US); 2010. Available from: https://www.ncbi.nlm.nih.gov/books/NBK53017/
7. Borgerding M, Klus H. Analysis of complex mixtures--cigarette smoke. Exp Toxicol Pathol 2005;57 Suppl 1:43-73. https://doi.org/10.1016/j.etp.2005.05.010.
8. Rodgman A, Perfetti TA. The Chemical Components of Tobacco and Tobacco Smoke. Boca Raton (FL): CRC Press Taylor & Francis Group; 2009. https://www.scirp.org/reference/referencespapers?referenceid=2465525
9. Hukkanen J, Jacob P 3rd, Benowitz NL. Metabolism and disposition kinetics of nicotine. Pharmacol Rev 2005;57:79-115. https://doi.org/10.1124/pr.57.1.3. PMID: 15734728.
10. IARC. Tobacco smoke and involuntary smoking. IARC Monogr Eval Carcinog Risks Hum, 2004a; 83:1-1438.
11. Chen Z, An Y, Wang Z, Zhang B, Liu L. Tobacco-specific carcinogen4-(Methylnitrosoamino)-1-(3-pyridyl)-1-butanone (NNK) activating ERK1/2 MAP kinases and stimulating proliferation of human mammary epithelial cells. Chem Res Chin Univ 2007;23:76–80.
12. California Environmental Protection Agency. Air Resources Board: Proposed identification of environmental tobacco smoke as a toxic air contaminant. 2005. www.oehha.ca.gov/media/downloads/crnr/app3partb2005.pdf. (Accessed 26 October 2016).
13. Mei J, Hu H, McEntee M, Plummer H, Song P, Wang H-CR. Transformation of non-cancerous human breast epithelial cell line MCF10A by the tobacco-specific carcinogen NNK. Breast Cancer Res Treat 2003;79:95–105.
14. Siriwardhana N, Choudhary S, Wang H-CR. Precancerous model of human breast epithelial cells induced by NNK for prevention. Breast Cancer Res Treat 2008;109:427–41.
15. Olumide YM, Ayanlowo OO, Akinkugbe AO, Otrofanowei E. Environmental chemical risk factors of breast cancer in Nigeria I: Broad overview. *NAS J* 2022;15:17-38. Retrieved from https://nasjournal.org.ng/site/index.php/pnas/article/view/449.
16. Ghosal, D, Ghosh S, Dutta TK, Ahn Y. Current state of knowledge in microbial degradation of polycyclic aromatic hydrocarbons (PAHs): a review. Front. Microbiol. 2016; 7:1369. https://doi.org/10.3389/fmicb.2016.01369.
17. Vu AT, Taylor KM, Holman MR, Ding YS, Hearn B, Watson CH. Polycyclic Aromatic Hydrocarbons in the Mainstream Smoke of Popular US Cigarettes. Chem Res Toxicol 2015;17;28:1616-1626. https://doi.org/10.1021/acs.chemrestox.5b00190.
18. International Agency for Research on Cancer. Some Non-heterocyclic Polycyclic Aromatic Hydrocarbons and Some Related Exposures; IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Lyon, France: IARC 2010;92: 773.
19. Warren G.W., Singh A.K. Nicotine and lung cancer. J Carcinog 2013. https://doi.org/10.4103/1477-3163.106680.
20. Doll R, Peto R. The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. *J Natl Cancer Institute* 2005;95:1177–1184. https://doi.org/10.1093/jnci/dji197
21. Takahashi H., Ogata H., Nishigaki R., Broide D.H., Karin M. Tobacco smoke promotes lung tumorigenesis by triggering IKKbeta- and JNK1-dependent inflammation. Cancer Cell. 2010;17:89–97. https://doi.org/10.1016/j.ccr.2009.12.008.
22. Petrakis NL, Gruenke LD, Beelen TC, Castagnoli N Jr, Craig JC. Nicotine in breast fluid of nonlactating women. Science. 1978;199:303-5. https://doi.org/10.1126/science.619458.
23. Thompson PA, DeMarini DM, Kadlubar FF, McClure GY, Brooks LR, Green BL, *et al.* Evidence for the presence of mutagenic arylamines in human breast milk and DNA

adducts in exfoliated breast ductal epithelial cells. Environ Mol Mutagen. 2002;39:134–142.
24. Hecht SS. Tobacco smoke carcinogens and breast cancer. Environ Mol Mutagen 2002;39:119–126.
25. Kispert S, McHowat J. Recent insights into cigarette smoking as a lifestyle risk factor for breast cancer. Breast Cancer (Dove Med Press) 2017;9:127-132. https://doi.org/10.2147/BCTT.S129746.
26. Dasgupta P, Rizwani W, Pillai S, Kinkade R, Kovacs M, Rastogi S, *et al.* Nicotine induces cell proliferation, invasion and epithelial-mesenchymal transition in a variety of human cancer cell lines. Int J Cancer 2009;124:36–45. https://doi.org/10.1002/ijc.23894.
27. Li P, Wu WK, Wong HP, Zhang ST, Yu L, Cho CH. Chloroform extract of cigarette smoke induces proliferation of human esophageal squamous-cell carcinoma cells: modulation by beta-adrenoceptors. Drug Chem Toxicol 2009;32:175–181.
28. Hanahan D, Weinberg RA. Hallmarks of cancer: the next generation. Cell. 2011;144:646–674. https://doi.org/10.1016/j.cell.2011.02.013.
29. Gaudet MM, Carter BD, Brinton LA, Falk RT, Gram IT, Luo J, *et al.* Pooled analysis of active cigarette smoking and invasive breast cancer risk in 14 cohort studies. Int J Epidemiol 2017;46:881-893. https://doi.org/10.1093/ije/dyw288.
30. Pierce JP, Patterson RE, Senger CM, Flatt SW, Caan BJ, Natarajan L, et al. Lifetime cigarette smoking and breast cancer prognosis in the after breast cancer pooling project. J Natl Cancer Inst 2014;106:djt359.
31. IARC (International Agency for Research on Cancer). IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Vol 83, Tobacco Smoke and Involuntary Smoking. Lyon, France: France International Agency for Research on Cancer; 2004. [Accessed 2 Feb, 2017]. Available from: http://monographs.iarc.fr/ENG/Monographs/vol83/index.php.
32. Dossus L, Boutron-Ruault MC, Kaaks R, Gram IT, Vilier A, Fervers B *et al.* Active and passive cigarette smoking and breast cancer risk: results from the EPIC cohort. Int J Cancer 2014;134:1871–1888. https://doi.org/10.1002/ijc.28508.
33. IARC. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans Vol 100E, Personal Habits and Indoor Combustions. International Agency for Research on Cancer; 2012. [Accessed 2 Feb, 2017]. Available from: http://monographs.iarc.fr/ENG/Monographs/vol100E/
34. Ait-Khaled N, Enarson D, Bousquet J. Chronic respiratory diseases in developing countries: The burden and strategies for prevention and management. Bull World Health Organ 2001; 79:971-979.
35. Shafey O, Dolwick S, Guindon GE. Tobacco control country profiles, 2nd ed. Atlanta, GA: American Cancer Society, Inc., World Health Organisation and International Union against Cancer; 2003:38-40.
36. Ibeh CC, Ele PU. Prevalence of cigarette smoking in young Nigerian females. Afr J Med Sci. 2003; 32:335-338.
37. Odeyemi KA, Osibogun A, Akinsete AO, Sadiq L. The prevalence and predictors of cigarette smoking among secondary school students in Nigeria. Niger Postgrad Med J 2009;16:40-45.
38. Desalu OO, Adekoya AO, Elegbede AO, Dosunmu A, Kolawole TF, Nwogu KC. Knowledge of and practices related to smoking cessation among physicians in Nigeria. J Bras Pneumol 2009;35:1198-1203.
39. Hussain NA, Akande M, Adebayo ET. Prevalence of cigarette smoking and knowledge implications among Nigerian soldiers. East Afr J Public Health 2010;7:81-83.
40. Desalu OO, Olokoba A, Danburam A, Salawu F, Issa B. Epidemiology of tobacco smoking among adults population in North-East Nigeria. Internet J Epidemiol 2008;6:1.
41. World Health Organization. WHO global report on trends in tobacco smoking 2000-2025. Geneva: World Health Organization; 2015. Available from: http://www.who.ink/tobacco/publications/surveillance/reportontrendstobaccosmoking/en/ (Accessed 21 Jan, 2019)
42. Obot IS. Epidemiology of tobacco and alcohol use in Nigeria. In IS Obot (ed.) Epidemiology and Control of Substance Abuse in Nigeria. 1993; pp. 67-87. https://doi.org/10.1016/S0899-3289(00)00047-X.

43. World Health Organisation. Tobacco-free youth: break the tobacco marketing net. World No Tobacco Day, 31 May 2008. Available at http://www.who.int/tobacco/wntd/2008/wntd_2008_brochure.pdf?ua=1. Accessed 26 Jan 2015.
44. The Global Burden of Disease Child and Adolescent Health Collaboration. Child and Adolescent Health From 1990 to 2015: Findings From the Global Burden of Diseases, Injuries, and Risk Factors 2015 Study. *JAMA Pediatr* 2017;171:573–592. doi:10.1001/jamapediatrics.2017.0250
45. Chambers RA, Taylor JR, Potenza MN. Developmental neurocircuitry of motivation in adolescence: a critical period of addiction vulnerability. Am J Psychiatry 2003;160:1041–1052. https://doi.org/10.1176/appi.ajp.160.6.1041.
46. Crews F, He J, Hodge C. Adolescent cortical development: a critical period of vulnerability for addiction. Pharmacol Biochem Behav 2007;86:189–199. doi:10.1016/j.pbb.2006.12.001.
47. Kelder S, Perry C, Klepp KI, Lytle L. Longitudinal tracking of adolescent smoking, physical activity, and food choice behaviours. Am J Public Health 1994;84:1121–1126. https://doi.org/10.2105/AJPH.84.7.1121.
48. Karp I, O'Louglin J, Paradis G, Hanley J, Difranza J. Smoking trajectories of adolescent novice smokers in a longitudinal study of tobacco use. Ann Epidemiol 2005;15:445–452. doi:10.1016/j.annepidem.2004.10.002.
49. Park S, Weaver TE, Romer D. Predictors of the transition from experimental to daily smoking among adolescents in the United States. J Spec Paediatr Nurs 2009;14:102–111. https://doi.org/10.1111/j.1744-6155.2009.00183.x.
50. Ekanem IA, Asuzu MC, Anunobi CC, Malami SA, Jibrin PG, Ekanem AD, *et al.* Prevalence of tobacco use among youths in five centres in Nigeria: a global youth tobacco survey (GYTS) approach. J Comm Med Primary Health Care 2010;22:62–67.
51. Omokhodion FO, Faseru BO. Perception of cigarette smoking and advertisement among senior secondary school students in Ibadan, southwestern Nigeria. West Afr J Med 2007;26:206–209.
52. Abasiubong F, Atting I, Bassey E, Ekott J. A comparative study of use of psychoactive substances amongst secondary school students in two local government areas of Akwa-Ibom state, Nigeria. Niger J Clin Pract 2008;11:45–51.
53. Aniwada EC, Uleanya ND, Ossai EN, Nwobi EA, Anibueze M. Tobacco use: prevalence, pattern, and predictors, among those aged 15-49 years in Nigeria, a secondary data analysis. Tob Induc Dis 2018;16:7. https://doi.org/10.18332/tid/82926.
54. Oyewole BK, Animasahun VJ, Chapman HJ. Tobacco use in Nigerian youth: A systematic review. Plos One 2018;13:e0196362. https://doi.org/10.1371/journal.pone.0196362.
55. Gana GJ, Idris SH, Sabitu K, Oche MO, Abubaka AA, Nguku PM. Prevalence and perception of cigarette smoking among out-of-school adolescents in Birnin-Kebbi, North-western Nigeria. Pan Afr Med J 2018;30:304. https://doi.org/10:11604/pamj.2018.30.304.16641.
56. 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. https://doi.org/10.1186/s 12889-019-8010-8.
57. Drope J, Schluger N, Cahn Z, Drope J, Hamill S, Islami F, *et al.* The Tobacco Atlas. Atlanta: American Cancer Society and Vital Strategies 2018. https://www.scirp.org/reference/referencespapers?referenceid=2807951
58. Kale Y, Olarewaju I, Usoro A, Ilori E, Ogbonna N, Ramanandraibe N, *et al.* Global Adult Tobacco Survey: Country Report 2012. Abuja. 2012. https://www.nigerianstat.gov.ng/pdfuploads/GATS_Nigeria_Country_Rpt_2012.pd
59. Vellios N, Ross H, Perucic A-M. Trends in cigarette demand and supply in Africa. PloS One 2018;13:e0202467.
60. Bilano V, Gilmour S, Moffiet T, d'Espaignet ET, Stevens GA, Commar A, *et al.* Global trends and projections for tobacco use, 1990–2025: an analysis of smoking indicators from the WHO Comprehensive Information Systems for Tobacco Control. Lancet (London, England) 2015;385: 966–976.

61. World Health Organization. WHO Report on the Global Tobacco Epidemic, 2019. Geneva: World Health Organization; 2019. Available from: https://apps. who.int/iris/bitstream/handle/10665/326043/ 9789241516204-eng.pdf. (Accessed 3 Nov 2019). https://www.who.int/tobacco/publications/surveillance/reportontrendstobaccosmoking/en/. (Accessed 21 Jan 2019).
62. Lo J, Patel P, Roberts B. A systematic review on tobacco use among civilian populations affected by armed conflict. Tob Control 2016;25:129–140.
63. Jawad M, Khader A, Millett C. Differences in tobacco smoking prevalence and frequency between adolescent Palestinian refugee and non-refugee populations in Jordan, Lebanon, Syria, and the West Bank: cross-sectional analysis of the Global Youth Tobacco Survey. Conflict Health 2016;10:20.
64. Odiase EJ. Risk of breast cancer amongst women who start smoking as teenagers. Breast Cancer Res. 2009; 11:12. doi:10.1186/bcr2295.
65. Ima-Obong E. Global Youth Tobacco Survey for Nigeria. 2008. https://untobaccocontrol.org/impldb/wp-content/uploads/nigeria_2018_annex-3_GYTS_report_2008.pdf
66. World Health Organization. WHO Framework Convention on Tobacco Control. Geneva, Switzerland: World Health Organization. 2003. https://www.who.int/fctc/text_download/en/
67. Cross-River State of Nigeria Gazette, Cross River State Law No. 4 of 2002- Advertisement of Cigarette and other Tobacco-related products (Prohibition) Law, 2002. https://www.tobaccocontrollaws.org/files/live/Nigeria/Nigeria%20-%20Advertisement%20-%20national.pdf
68. CDC. Global youth tobacco surveillance, 2000--2007. MMWR 2008; 57(No. SS-1).
69. World Health Organization. WHO report on the global tobacco epidemic, 2008. Geneva, Switzerland: World Health Organization; 2008. Available at http://www.who.int/tobacco/mpower/mpower_report_full_2008.pdf.
70. World Health Organization. MPOWER: a policy package to reverse the tobacco epidemic. Geneva: World Health Organization; 2008.
71. Murnaghan, D. A., Sihvonen, M., Leatherdale, S. T., Kekki, P. (2007). The relationship between school-based smoking policies and prevention programs on smoking behaviour among Grade 12 students in Prince Edward Island: A multilevel analysis. *Preventive Medicine* 2007;*44*:317–322. https://doi.org/10.1016/j.ypmed.2006.11.020.
72. World Health Organisation, Smoke Free Inside: Create and Enjoy 100% Smoke-Free Environments. Geneva, Switzerland. WHO,2007. http://www.who.int/tobacco/resources/publications/wntd/2007/en/index.htm
73. Kong G, Laestadius L, Vassey J, Majmundar A, Stroup AM, Meissner HI, et al. Tobacco promotion restriction policies on social media. Tob Control 2024;33:398-403. doi:10.1136/tc-2022-057348
74. Ma C, Yang H, Sun J, Zhao M, Magnussen CG, Xi B. Proportions and trends in exposure to pro-and anti-tobacco advertisements among young adolescents aged 12-16 years in 142 countries/territories, 1999-2018: an analysis of repeated cross-sectional surveys. Lancet Glob Health 2023; 11:e586-96.
75. Keller-Hamilton B, Ferketich AK. Importance of online exposures to pro-tobacco messaging. Lancet Global Health 2023; 11:E491-E492. https://doi.org/10.1016/S2214-109X(23)00119-5.
76. Aslam HM, Saleem S, German S Qureshi WA. Harmful effects of shisha: literature review. Int Arch Med 2014;7:16. http://www.intarchmed.com/content/7/1/16.
77. Kadhum M, Sweidan A, Jaffery AE, Al-Saadi A, Madden B. A review of the health effects of smoking shisha. Clin Med 2015;15:263-266.
78. Maziak W. The waterpipe: an emerging global risk for cancer. Cancer Epidemiol 2013;37:1–4.
79. Kirby J. Health warning to shisha smokers. The Independent. 2012. www.independent.co.uk/life-style/health-and-families/health-news/health-warning-to-shisha-smokers-7565842.html (Accessed 27 Feb, 2015).
80. Neergaard J, Singh P, Job J, Montgomery S. Waterpipe smoking and nicotine exposure: a review of the current evidence. Nicotine Tob Res 2007;9:987-994.

81. World Health Organization. Advisory note: waterpipe tobacco smoking: health effects, research needs and recommended actions by regulators. Geneva, Switzerland: World Health Organization; 2015. https://apps.who.int/iris/bits... (Accessed 22 Apr 2020).
82. Maziak W. The global epidemic of waterpipe smoking. Addict Behav 2011;36:1-5.
83. Mughal F, Meki A, Kassamali RH. Shisha: Is this addressed within smoking cessation in general practice? Br J Gen Pract 2014;64:173.
84. Al-Naggar RA, Saghir FSA. Water pipe (shisha) smoking and associated factors among Malaysian university students. Asian Pac J Cancer Prev 2011;12:3041–3047.
85. Haroon M, Munir A, Mahmud W, Hyder O. Knowledge, attitude, and practice of waterpipe smoking among medical students in Rawalpindi, Pakistan. J Pak Med Assoc 2014;64:155–158.
86. Grekin ER, Ayna D. Waterpipe smoking among college students in the United States: a review of the literature. J Am Coll Health 2012; 60:244–249.
87. Amin TT, Amr MAM, Zaza BO, Kaliyadan F. Predictors of waterpipe smoking among secondary school adolescents in Al Hassa, Saudi Arabia. Int J Behav Med 2012;19:324–335.
88. Jawad M, Jawad S, Mehdi A, Sardar A, Jawad AM, Hamilton FL. A qualitative analysis among regular waterpipe tobacco smokers in London universities. Int J Tuberc Lung Dis 2013;17:1364–1369.
89. West R. Tobacco smoking. Health impact, prevalence, correlates and interventions. Psychology & Health 2017; 32:1018-1036. doi:10.1080/08870446.2017.1325890.
90. Aljarrah K, Ababneh ZQ, All-Delaimy WK. Perceptions of hookah smoking harmfulness: Predictors and characteristics among current hookah users. Tob Induc Dis 2009;5:16.
91. Maziak W. The global epidemic of waterpipe smoking. Addict Behav2011;36:1-5
92. Knishkowy B, Amitai Y. Waterpipe (narghile) smoking: an emerging health risk behavior. Pediatrics 2005;116:e113-e119.
93. Group WS. The scientific basis of tobacco product regulation. World Health Organ Tech Rep Ser 2007;945:1-112.
94. Baker RR. Smoke generation inside a burning cigarette: modifying combustion to develop cigarettes that may be less hazardous to health. Progress Energy Combustion Sci 2006;32:373-385.
95. Koul PA. Hajni MR, Sheikh MA, Khan UH, Shah A, Khan Y, *et al.* Hookah smoking and lung cancer in the Kashmir valley of the Indian subcontinent. Asian Pac J Cancer Prev 2011;12:519-524.
96. Chaouachi K. Hookah (Shisha Narghile) Smoking and Environmental Tobacco Smoke (ETS). A critical review of the relevant literature and the public health consequences. Int J Environ Res Public Health 2009;6:798-843.
97. Sepetdjian E, Saliba N, Shihadeh A. Carcinogenic PAH in waterpipe charcoal products. Food Chem Toxicol 2010;48:3242–3245.
98. Hammal F, Chappell A, Wild TC, (add 3 more authors before et al. "Herbal" but potentially hazardous: an analysis of the constituents and smoke emissions of tobacco-free waterpipe products and the air quality in the cafes where they are served. Tob Control 2013. doi:10.1136/tobaccocontrol-2013-051169.
99. Tayo AO. Is the cool fad as dangerous as smoking? [Internet]. Pulse.ng; 2016 [cited 2021 25 Feb]. Available from: https://www.pulse.ng/gist/hookah-is-the-cool-fad-as-dangerous-as
100. Lasebikan VO, Ola BA, Lasebikan TO. Shisha smoking in selected nightclubs in Nigeria. Pan Afr J Med 2019; 33:136. doi:10.11604/pamj.2019.33.136.17149.
101. Osibogun O, Odukoya OO, Odusolu YO, Osibogun A. Knowledge and risk perception of e-cigarettes and hookah amongst youths in Lagos State, Nigeria: An exploratory study. Niger Postgrad Med J 2020;27:384-390.
102. Nwafor NJ, Kanmodi KK, Omoleke SA, Enaibe TW. Doctors' knowledge of shisha and attitudes towards clinical counselling of shisha smokers: Nigerian study. Med J Zambia 2020;47:16-24.
103. Abraham EA, Egbe CO, Ayo-Yusuf OA. News media coverage of shisha in Nigeria from 2014 to 2018. Tob Induc Dis 2019;17:33. doi:10.18332/tid/106139.
104. Omaduvie U, Adisa A. Exposure to second-hand smoke in home and public areas among adolescents in Abuja, Nigeria: Tobacco control implications. Tobacco Prev Cessation 2015;1. doi:10.18332/tpc/61178.

105. World Health Organization. Advisory note: waterpipe tobacco smoking: health effects, research needs and recommended actions by regulators. Geneva, Switzerland: World Health Organization; 2015. https://apps.who.int/iris/bits.... (Accessed 22 Apr, 2020).
106. Kanmodi KK, Mohammed FA, Nwafor NJ, Fagbule OF, Adesina M, Aliyu BM, *et al.* Poor knowledge of the harmful effects of shisha among shisha smokers: Findings from a preliminary survey in Northwest Nigeria. Med Univ 2019;2:49-56. doi:10.2478/medu-2019-0009.
107. Kanmodi KK, Kanmodi PA. Combatting the silent shisha epidemic in Nigeria: The need for public health education. Popul Med 2020;2:18. https://doi.org/10.18332/popmed/120967.
108. Dadipoor S, Kok G, Aghamolaei T, Heyrani A, Ghaffari M, Ghanbarnezhad A. Factors associated with hookah smoking among women: A systematic review. Tob Prev Cessation 2019;5. doi:10.18332/tpc/110586.
109. Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS. Conference of the Parties to the WHO Framework Convention on Tobacco Control. Report by WHO FCTC/COP/7/11. http://who.int/tobacco/industry/product_regulation/electronic-cigarettes-report-cop7/en/index.html
110. What do we know about e-cigarettes? American Cancer Society. https://www.cancer.org/cancer/cancer-causes/tabacco-and-cancer/e-... (Accessed 21 May, 2020)
111. Bullen C, Howe C, Laugesen M, McRobbie H, Parag V, Walker N. Electronic cigarettes for smoking cessation: a randomized controlled trial. Lancet 2008;382:1629-1637. doi:10.1016/s0140-6736(13)61842-5.
112. Cobb N, Cobb C. Regulatory challenges for refined nicotine products. Lancet 2013;1:431-433
113. Hajek P, Foulds J, Houezec JL, Sweanor D, Yach D. Should e-cigarettes be regulated as a medicinal device? Lancet 2013;1:429-431
114. Blaha MJ. 5 Vaping Facts You Need to Know. Johns Hopkins Medicine. 2021 https://www.hopkinsmedicine.org/health/wellness-and-prevention/5-truths-you-need-to-know-about-vaping
115. Metal concentrations in e-cigarette liquid and aerosol. John Hopkins Bloomberg School of Public Health. Published online 2018. doi:10.1289/EHP2175.
116. Jensen RP, Luo W, Pankow JF, Strongin RM, Peyton DH. Hidden Formaldehyde in E-Cigarette Aerosols. N Engl J Med 2015;372:392-4. doi:10.1056/NEJMc1413069.
117. Visser W, Geraets L, Klerx W, Hernandez L, Stephens E, Croes E, *et al.* The health risks of using e-cigarettes. [Internet]. Bilthoven The Netherlands: National Institute for Public Health and the Environment; 2015. Available from: http://www.rivm.nl/bibliotheek/rapporten/2015-0144.pdf
118. Goniewicz M, Knysak J, Gawron M, Kosmider L, Sobczak A, Kurek J, *et al.* Levels of selected carcinogens and toxicants in vapour from electronic cigarettes. Tob Control 2013;23:133-139.
119. Lee HW, Park SH, Mao-wen W, Wang HT, Huang WC, Lepor H, *et al.* E-cigarette smoke damages DNA and reduces repair activity in mouse lung, heart, and bladder as well as in human lung and bladder cells. PNAS 2018; E1560-E1569. www.pnas.org/cgi/doi/10.1073/pnas.1718185115
120. Zubko A. Breast cancer and e-cigarettes: Is vaping a safer alternative to smoking? 2018. https://www.maurerfoundation.org/breast-cancer-e-cigarettes-is-vaping-a-safer-alternative-to-smoking/
121. Combes RD, Balls M. On the safety of e-cigarettes: "I can resist anything except temptation". Alternatives to Laboratory Animals. 2 Combes RD, Balls M. On the safety of e-cigarettes: "I can resist anything except temptation". Alternatives to Laboratory Animals. 2015;43:417-425.
122. Hess IM, Lachireddy K, Capon A. A systematic review of the health risks from passive exposure to electronic cigarette vapour. Public Health Res Pract 2016;26:2621617. doi: 10.17061/phrp2621617.
123. Ganz O, Cantrell J, Moon-Howard J, Aidala A, Kirchner T, Vallone D. Electronic cigarette advertising at the point-of-sale: a gap in tobacco control research. Tob Control 2014;24:e110-e112.

124. Czoli C, Goniewicz M, Islam T, Kotnowski K, Hammond D. Consumer preferences for electronic cigarettes: results from a discrete choice experiment. Tob Control 2015;25:e30-e36.
125. Ford A, MacKintosh A, Bauld L, Moodie C, Hastings G. Adolescents' responses to the promotion and flavouring of e-cigarettes. Int J Public Health 2015;61:215-224.
126. Ambrose B, Day H, Rostron B, Conway K, Borek N, Hyland A, *et al.* Flavored Tobacco Product Use Among US Youth Aged 12-17 Years, 2013-2014. JAMA 2015;314:1871.
127. Vasiljevic M, Petrescu D, Marteau T. Impact of advertisements promoting candy-like flavoured e-cigarettes on appeal of tobacco smoking among children: an experimental study. Tob Control 2016;25:e107-e112. doi:10.1136/tobaccocontrol-2015-052593.
128. Boseley S. The great vape debate: are e-cigarettes saving smokers or creating new addicts? 2020. https://www.theguardian.com/society/2020/feb/18/the-great-vape-debate-are-e-cigarettes-saving-smokers-or-creating-new-addicts
129. WHO Right to call for E-Cigarette Regulation. World Lung Federation, 2014. https://www.vitalsstrategies.org/press/who-right-to-e-cigarette-regulation/
130. Electronic nicotine delivery systems. World Health Organization. 2014. pp 1-13. http://apps.who.int/gb/fctc/PDF/cop6/FCTC_COP6_10-en.pdf(PDF)
131. Kanmodi KK, Kanmodi PA. Paucity of literature on e-cigarette use (vaping) in sub-Saharan Africa: A wake-up call. Yenagoa Med J 2020;2:1-2.
132. Folayan MO, El Tantawi M, Oginni O, Alade G, Adeniyi A, Finlayson TL. Differences in risk indicators associated with electronic cigarette use and tobacco smoking among adolescents and young people in Nigeria. *BMJ Open Respiratory Res* 2022;9:e001285. https://doi.org/10.1136/bmjresp-2021-001285.

List of Acronyms

ANDS – Alternative Nicotine Delivery Systems
ATCA – Anti Tobacco Control Day
BC – Breast Cancer
CDC – Centers for Disease Control
CPHA – Canadian Public Health Association
ECs – Electronic cigarettes
ENDS – Electronic nicotine delivery systems
ENNDS – Electronic non-nicotine delivery systems
ER – Endocrine Receptor
ERA – Environmental Rights Action
FA – Food and Drug Administration
FCTC – Framework Convention on Tobacco Control
GP – General Practitioners
GYTS – Global Youth Tobacco Survey
IARC – International Agency for Research on Cancer
N – Nitrosamines
NCS – Nigerian Cancer Society
NGO – Non-governmental Organization
NHO – Nigeria Heart Foundation
NNK – 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone
NNN – N'-nitrosonornicotine
PAH – Polycyclic Aromatic Hydrocarbons
SHA – Second-hand aerosol
SHS – Second-hand smoke
SON – Standard Organization of Nigeria
SONCAP – SON Conformity Assessment Programme
THC – Tetrahydrocannabinol
TobReg – Tobacco products Regulation
TSNAs – Tobacco-specific nitrosamines
USB – Universal Serial Bus
VOCs – Volatile Organic Compounds
WHO – World Health Organisation