

Research Article

Knowledge, Risk Perceptions and Patters of Hookah/Water Pipe Smokers in Calabar Metropolis, Cross River State

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Abstract

Background: Frequent consumption of hookah has now gained popularity among young urban populations despite contribution on its general health effect.

Aim: This study aimed to assess the knowledge, Risk perception, and Patterns of hookah smokers in Calabar Metropolis, Cross River State, Nigeria.

Methodology: A comparative cross-sectional descriptive design, using two-stage sampling method and snowball sampling technique was used to select respondents in selected bars, lounges, and nightclubs, with a sample size of 90 participants. Data were collected via a semi-structured interviewer-administered questionnaire, data were analyzed using SPSS version 25. Data were summarized using descriptive statistics

Results: Majority of respondents 79(87.8%) are knowledgeable about the health effects of hookah smoking, 62 % had high perceived risk of respiratory outcome and 64% of the respondents had increased frequency and longer duration of hookah sessions

Conclusion: The study recommends enforcing strict government regulations on hookah use in public places, and providing regular respiratory health screenings and counseling for smokers to support early detection and informed health decisions.

Keywords: knowledge; perception; patterns; hookah smokers

Introduction

Smoking continues to be a significant factor in the rise of Non-Communicable Diseases (NCDs) [7]. NCDs are responsible for 74% of global mortality, some of these deaths occur before reaching the age of seventy; furthermore, 80% of these premature deaths happen in developing nation [35]. In sub-Saharan Africa NCDs have become the leading cause of death in sub-Saharan Africa over the last twenty years [8]. accounting for 37% of deaths in 2019, up from 24% in 2000 [34]. Nigeria is experiencing a shift in disease patterns, with an increasing number of NCDs contributing to nearly 30% of all death in the country [24]. with tobacco smoking identified as the primary preventable risk factor for NCDs. Tobacco plays a role in the development of some respiratory diseases which is one out of the four leading NCDs [7].

Tobacco is consumed in the form of cigarettes, cigars, e-cigarettes, hookahs (water pipes), and smokeless tobacco products [23]., with hookah being traditional and widely practiced method of consumption which utilizes water to smoke specially flavoured tobacco that comes in different sizes, flavours, shapes, colours and designs [9]. While the use of hookah in the western world is a new occurrence, it has been around for a thousand years, originating in the North Western provinces of India, spreading to Iran, the Arab world, and Turkey and currently experiencing a surge in popularity in the United States of America, Europe and Africa [31]. The smoke from hookahs contains a lot of harmful substances like carbon monoxide, nicotine, tar, and heavy metals. These substances are as bad as or even worse than what is found in cigarette smoke, and they have the potential to cause significant harm to the body. [29]. The harmful substances and residues from tobacco in hookah pose a greater health threat to smokers, increasing their vulnerability to conditions like lung cancer, respiratory ailments, nasopharyngeal cancer etc. [28]. People who smoke hookah often believe that it is not as harmful as smoking cigarettes but on like every other product containing tobacco its effect on the body and health of its users exposes them to different kinds of chemical compounds [9]. The CDC in a study in 2021 found that during a 1-hour hookah smoking session, the individuals using it may inhale 100 – 200 times more smoke than they would from a single stick of cigarette.

Globally, approximately 100 million people use hookah every day and data indicate that hookah usage is more among teenagers and young individuals. [32]. There is a concerning increase in hookah tobacco smoking, especially among young

individuals, which poses significant health risks. These risks include recurring infections, persistent coughing, and the development of oral and oesophageal cancers, as well as triggering inflammatory responses in the body. [29]. Although there is a lack of comprehensive data regarding the occurrence of hookah smoking among young individuals in the emergent and third world countries worldwide, notably in sub-Saharan Africa, a study shows the percentage of young people who have ever used hookah ranges from 3% in Ghana [18] to that of Rwanda at a private university Kigali City, Rwanda, involving 427 of its students, revealed that 26.1% of the participants had tried smoking hookah at least once, and 20.8% had hookah within the last 30 days [26].

In major cities of Nigeria, the popularity of hookah smoking has instantly grown. The reasons behind this sudden surge vary, such as smoking for enjoyment, seeking its stimulating effects, experimentation, or the belief that it's safer than smoking cigarettes, the perception that hookah is less harmful to health due to the addition of fruit flavours, the belief that it is less addictive than cigarette smoking and its societal significance as a fashion statement contribute to its popularity. [17]. Although many publications capture the knowledge and use of this trend amongst adolescents, there is a notable lack of awareness concerning the detrimental effect of hookah smoking on respiratory and general health. By sharing beneficial information about the risk of hookah use this study will contribute to the ongoing effort to mitigate respiratory diseases due to the use of hookah.

The global tobacco epidemic presents an immense public health crisis, claiming over 8 million lives annually. The WHO statistics of 2019 showed 454.6 million of respiratory disease cases, 1.5 million deaths attributed to chronic respiratory disorders, 1.2 million deaths related to cancer (tracheal, bronchus, and lung), 6 hundred thousand deaths resulting from respiratory infections and tuberculosis [33]. Owing to the widespread hookah smoking in Nigeria, data from the 2018 Nigerian Demographic and Health Survey (NDHS) suggests that 0.2% of Nigerians aged fifteen to fifty-nine years smoke hookah [21]. The annual mortality from the tobacco world-wide estimated about 5 million, accounting for 1 in every 5 male deaths and 1 in every 20 female deaths of those over the age of 30. It is projected that using current smoking patterns annual tobacco death will rise to 10 million by 2030, most of them in low-income countries [16].

In Nigeria although there is limited research on the knowledge and respiratory health of hookah users a study carried out on the awareness of the harmful effects of hookah was only 27.5% by [25]. The percentage of those knowledgeable about the constituent and ill effect of hookah smoking was 14.8%, those with poor knowledge was 94.1% among hookah smokers [27]. Hence, this study intends to assess the knowledge, risk perception and respiratory health status of hookah smokers in Nigeria particularly in Calabar Metropolis and as well as increase the knowledge about its effects on the health of smokers by providing more information about it to the public.

Methodology

Study Area

The study focused on the Calabar Metropolis, encompassing Calabar South and Calabar Municipality in Cross River State, Nigeria. Calabar Municipality, acting as the administrative capital and central hub for the Southern Senatorial district, has an estimated population of 685,000 [19]. It spans 331.551 square miles and is primarily urbanized, housing diverse ethnic groups such as Efiks, Efuts, Quas, and Ibibios. Calabar South, established separately in 1976, covers 269.99 square kilometers with a population of 191,630, primarily comprising Efuts and Efiks [1]. Both areas have predominantly Christian communities with minorities practicing Islam and traditional beliefs, sustaining livelihoods through occupations like fishing, trading, and farming. The Quas predominantly engages in farming, hunting, trading, and blacksmithing. The healthcare infrastructure is robust, with one general hospital, one Teaching Hospital, and numerous primary health centers and secondary facilities. Calabar is renowned for its vibrant nightlife and cultural mix, with nightclubs playing a significant role in its social and economic fabric [1; 14, 15]. Traditional worship, centered around the water deity "Ndem" and the Ekpe Society upholds plays a role of discipline and authority in the region [1].

Study Design

This study adopted a comparative cross-sectional descriptive study design using quantitative methods of data collection. Additionally, a spirometry test was performed to measure lung function.

Study Population

The study population comprised of young adults within the age range of 18-26 years in selected bars, lounges and night clubs in Calabar Metropolis.

Sample Size Determination

In this study, the sample size was estimated using formula for sample size estimation Leslie Fischer's formula, prevalence of poor knowledge about hookah smoking among hookah smokers as reported by [13]., 94.1%. Using the Fischer's formula as follows;

$Z = 1.96$ (i.e., 95% standardized confidence interval), $d = 5\%$ therefore $d^2 = (0.05)^2 = 0.0025$ (acceptable margin of error) $p = 94.1\% = 0.941$ [13]. $q = 1 - 0.941 = 0.059$ yielding $n = 85.3$. Accounting for a 5% non-response rate, the final sample size was $n = 90$

Sampling Procedure

Two Stage Sampling Technique Was Used for This Study.

Stage 1: Selection of Hotels/nightclub/bars: Using purposive sampling technique

bars/nightclubs/hotels in Calabar Metropolis which comprises of Calabar south and Calabar municipality were selected. The criteria that guided this purposive selection process was based on popularity of the venue where hookah smoking is practiced, the presence of dedicated hookah smokers and particularly the willingness of venue owners or managers to participate and their customers also participate in the study. The venues were Doris O, Delves bar, Suya village bogobiri, Kings winery, Ignite korokke, Jasper, and Naks club.

Stage 2: Selection of participants: In each of the bars/nightclubs/hotel Snowballing sampling technique was used to select respondents and purposive sampling was used to select participants who were none smokers and who meets the selection criteria for the control group that was used to compare. From the first location (Doris O) quite a number of hookah smokers were seen but only seven respondents were willing to participate. Using the snow balling approach, it allowed for these respondents to refer and recommend other hookah smokers who met the criteria for participation and their location. This process continued until the desired sample size for hookah smokers were achieved.

Instruments for Data Collection

A semi-structured interviewer-administered questionnaire and spirometry testing was used for data collection. The questionnaire was divided into different sections:

Section A contained questions that assessed the sociodemographic information of participants.

Section B assessed the knowledge on hookah (Shisha) and health effect of its use.

Section C contains questions that assesses the risk perceptions of respondents on hookah smoking.

Section D contained questions which assessed their hookah use patterns

Method of Data Collection

Data were collected by two (2) trained researchers who administered an interviewer-administered questionnaire. The questionnaire was developed in English, comprising semi-structured questions and the spirometry test was conducted on the total sample size.

Method of Data Analysis

After data collection, the retrieved data was cleaned using excel package and analyzed using IBM SPSS statistics version 25. The analyzed data were presented in pie charts, tables, frequencies. Knowledge level and perception was assessed by assigning a score of 1 for a correct answer and score 0 for wrong answer. A mean score was determined and study participants who scored the mean score and above were considered having good knowledge level, while participants who scored below the mean scored were classified as having poor knowledge level, the same method was use to determined perception of respondents.

Results

Socio-Demographic Data of Respondents

The Socio-demographic characteristics of respondents presented in the table 1 below shows that of the total number of hookah smokers ($n=90$), majority are young adults aged 18-26 years, with 41 individuals (45.6%) aged 18-21 years and 38 individuals (42.2%) aged 22-26 years. There is a slight predominance of females, with 53 individuals (58.9%) compared to 37 males (41.1%). Most participants (68 individuals, 75.6%) have attained tertiary education, while 19 (21.1%) have secondary education. A significant proportion earns low to middle incomes, with 45 individuals (50.0%) earning between 10,000 and 25,000 Naira monthly. Ethnic distribution is diverse, with 36 Efik (40.0%) and 26 Yoruba (28.9%) being the most represented groups, while only 4 participants (4.4%) are Hausa. The majority (62 individuals, 68.9%) reside in Calabar Municipal, and 72 individuals (80.0%) are students, indicating the widespread use of hookah among young, educated individuals in urban and academic settings, with 7 individuals (7.8%) employed and 10 (11.1%) unemployed.

Table 1: Demographic Information of Respondents

Variable	hookah smokers (n=90)	Percentage (%)
Age group (years)		
13-17	11	(12.2)
18-21	41	(45.6)
22-26	38	(42.2)
Other	0	(0.0)
Gender		
Male	37	(41.1)
Female	53	(58.9)
Educational level		
Primary	3	(3.30)
Secondary	19	(21.1)
Tertiary	68	(75.6)
Monthly income (N)		
<10,000	24	(26.7)
10,000-25,000	45	(50.0)
26,000-50,000	9	(10.0)
51,000-100,000	7	(7.8)
>100,000	5	(5.6)
Ethnicity		
Igbo	24	(26.7)
Hausa	4	(4.4)
Yoruba	26	(28.9)
Efik	36	(40.0)
Others	0	(0.0)
Residential location		
Calabar south	28	(31.1)
Calabar municipal	62	(68.9)
Employment status		
Employed	7	(7.8)
Unemployed	10	(11.1)
Student	72	(80.0)
Retired	1	(1.1)
Total	90	100.0

Knowledge Level of Hookah / Waterpipe (Shisha) and Health Effect of its Use.

All respondents (100%) have heard of hookah smoking. The sources of information on hookah smoking vary, with 17.8% learning about it from the internet, 33.3% from health professionals, 18.9% from social media, 23.3% from family or friends, and 6.7% from other sources. In terms of frequency, 34.8% of respondents believe hookah is smoked more often than cigarettes, 10.1% think it's about the same, 40.4% say it's less often, and 14.6% are not sure. Regarding the substances smoked in hookahs, 22.2% of respondents report smoking tobacco as a content, 70.0% indicated that the content was just flavor, 6.7% marijuana, and 1.1% a herbal blend. A majority of respondents (87.8%) are knowledgeable about the health effects of hookah smoking, while 5.6% believe there are no health effects, and 6.7% are unsure. Concerning the specific health risks, 57.8% of respondents associate hookah smoking with lung cancer, 6.7% with heart disease, 32.2% with respiratory disease, 2.2% with mouth disease, and 1.1% believe there are no associated risks.

Table 2: Knowledge level on health effect of hookah/waterpipe use.

Variable	Frequency (n=90)	Percentage (%)
Ever Heard of effect of hookah smoking?		
Heard	90	100.0
Not Heard	0	0.0
Source of information on hookah smoking effect?		
Internet	16	17.8
Health professionals	30	33.3
Social media	17	18.9
Family/friends	21	23.3

Others	6	6.7
Frequency of hookah compared to cigarettes?		
More often	31	34.8
About the same	9	10.1
Less often	36	40.4
Not sure	13	14.6
Total	89	100
Substance/content of hookah?		
Tobacco	20	22.2
Just flavor	63	70.0
Marijuana	6	6.7
Herbal blend	1	1.1
Are there health effects of hookah?		
There are	79	87.8
There are none	5	5.6
Don't know	6	6.7
Health effect of hookah smoking?		
Lung cancer	52	57.8
Heart disease	6	6.7
Respiratory disease	29	32.2
Mouth disease	2	2.2
None of the above	1	1.1
Total	90	100

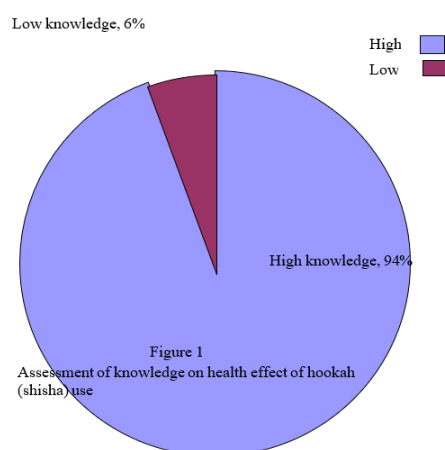


Figure 1: Summary of Knowledge level on health effect of hookah/waterpipe use.

Risk Perceptions Regarding Hookah/Waterpipe Smoking

When comparing the health risks of hookah smoking to other forms of smoking; to cigarettes, 33.3% of respondents perceive hookah as less harmful, 43.3% view it as equally harmful, 5.6% consider it more harmful, and 17.8% are unsure. Regarding the perceived risk level of hookah smoking on a scale of one to five, one being the least risky and five the riskiest 21.3% rated it as 1, 9.0% as 2, 29.2% as 3, 19.1% as 4, and 21.3% as 5. The majority, 75.6%, believe that occasional hookah smoking poses fewer risks, while 12.2% disagree, and another 12.2% are uncertain. Sources of information on the health risks of hookah include healthcare professionals (33.3%), educational programs (27.8%), family or friends (30.0%), and the internet or social media (8.9%).

Table 3: Risk perceptions regarding hookah/waterpipe smoking

Variable	Frequency	Percentage (%)
Health risks of hookah compared to cigarettes?		
Less harmful	30	33.3
Equally harmful	39	43.3
More harmful	5	5.6
Don't know	16	17.8

Risk level of hookah smoking (1 to 5)?		
1	19	21.3
2	8	9.0
3	26	29.2
4	17	19.1
5	19	21.3
Does occasional hookah smoking pose fewer risks?		
Poses fewer risk	68	75.6
Does not	11	12.2
Don't know	11	12.2
Source of info on hookah health risks?		
Healthcare professionals	30	33.3
Educational programs	25	27.8
Family/Friends	27	30.0
Internet/social media	8	8.9
Total	90	100

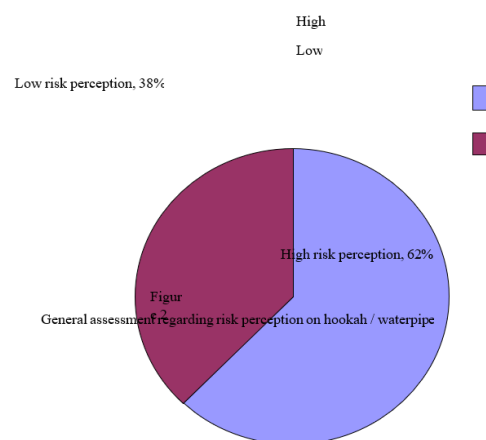


Figure 2: Summary of Risk perceptions regarding hookah/waterpipe smoking

Hookah / Waterpipe (Shisha) Use Pattern

All respondents (100%) were hookah smokers. The majority started using hookah between the ages of 13-17 years (44.4%), followed by 46.7% who began between 18-21 years, and 8.9% who started between 22-26 years. In terms of duration, 67.8% have used hookah for less than one year, 18.9% for 1-2 years, 11.1% for 3-4 years, and 2.2% for 5-6 years. Weekly hookah sessions vary, with 37.8% having one session per week, 23.3% having two sessions, 14.4% having three sessions, 11.1% having four sessions, and 6.7% each having five or six sessions. The duration of each session is less than 30 minutes for 78.9% of respondents, 30 minutes to 1 hour for 15.6%, 1-2 hours for 1.1%, and over 2 hours for 4.4%. The types of waterpipe use are predominantly flavored (60.0%), followed by sweetened (22.2%), mixed (14.4%), specific (1.1%), and 2.2% are unsure. More than half of the respondents (57.8%) mix different tobaccos, while 34.4% do not, and 7.8% are unsure. The reasons for smoking hookah include flavor enjoyment (16.7%), cultural or traditional reasons (22.2%), and other unspecified reasons (1.1%). A significant majority (72.2%) report that their mood prompts hookah use, 15.6% say it does not, 6.7% say maybe, and 5.6% are uncertain. The usual places for hookah use include lounges or nightclubs (41.1%), waterpipe spots (25.6%), parties (31.1%), and home (2.2%). Regarding attempts to quit or reduce hookah use, 15.6% have successfully quit or reduced, 53.3% have tried unsuccessfully, and 31.1% have not tried.

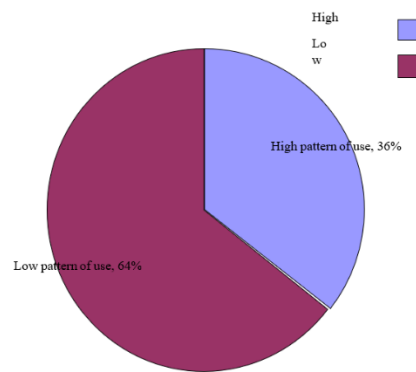


Figure 3: Assessment of hookah / waterpipe (Shisha) use pattern.

Discussion

The findings provide a comprehensive insight into the knowledge and understanding of the health effects associated with hookah or waterpipe (Shisha) smoking among the respondents. The results indicate that knowledge of hookah smoking is widespread, with all respondents acknowledging familiarity with the practice. This high level of knowledge is consistent with the growing global popularity of hookah smoking, particularly among young adults, as highlighted in previous studies by [5], which found similar trends in knowledge among university students in Jordan.

The diversity of information sources about hookah smoking suggests varying levels of exposure to both accurate and misleading information. Social media, known for disseminating both accurate and inaccurate health information, often glamorizes hookah smoking, as noted by [30]. This indicates that while some respondents may be well-informed, others might be exposed to misinformation, potentially influencing their risk perceptions and behaviours.

Perceptions of how frequently hookah is smoked compared to cigarettes varied among respondents, with 34.8% believing it is smoked more often, and 40.4% thinking it is less frequent. This disparity could be related to the social context in which hookah smoking occurs, often seen as a social or cultural activity rather than a regular habit. This disagrees with a study by [4] who reported that hookah smoking is more frequent than cigarette but aligns with [20], who noted that hookah smoking is often perceived as less frequent and less harmful than cigarette smoking, despite evidence to the contrary.

Knowledge of substances smoked in hookahs varied, with 70.0% recognizing that flavors are common, 22.2% acknowledging tobacco use, and 6.7% identifying marijuana. This demonstrates general knowledge of the substances involved but also reflects a misconception that flavored hookah is less harmful than tobacco products. [10] highlighted that even non-tobacco hookah smoking exposes users to harmful chemicals and carcinogens.

Most respondents (87.8%) were aware of the health effects of hookah smoking, which is encouraging; however, a small percentage (5.6%) believed there are no health effects, and 6.7% were unsure. This level of knowledge aligns with [3] who noted that while many hookah users are aware of potential health risks, there is still a significant gap in knowledge about specific risks. Identified health risks included lung cancer (57.8%), respiratory diseases (32.2%), and to a lesser extent, heart disease (6.7%) and mouth disease (2.2%). These findings indicate that while there is some knowledge of severe health issues associated with hookah smoking, it is not comprehensive. [13] corroborated these findings, observing that while many hookah smokers were aware of the risk of lung cancer, fewer recognized the association with other diseases such as cardiovascular and oral health problems.

Risk Perception Regarding Hookah Smoking

The findings reveal that respondents have varied perceptions of the health risks of hookah smoking compared to other forms of tobacco smoking. About 33.3% of respondents believe hookah smoking is less harmful than cigarette smoking, while 43.3% think it is equally harmful. Only 5.6% view it as more harmful, and 17.8% are uncertain. This aligns with [20] who found that many individuals perceive hookah smoking as less harmful due to misconceptions about the water filtration process reducing toxicant exposure. However, study by [13] have demonstrated that hookah smoking can deliver similar or even higher levels of harmful substances than cigarettes.

Perceived Risk Level of Hookah Smoking When asked to rate the risk level of hookah smoking on a scale from 1 (not risky) to 5 (very risky), respondents provided mixed responses: 21.3% rated it as 1 (not risky), 9.0% as 2, 29.2% as 3 (moderately risky), 19.1% as 4, and 21.3% as 5 (very risky). These results suggest a broad spectrum of risk awareness, consistent with [30], who noted that social perceptions and peer influence significantly affect individuals' risk assessments of smoking behaviors. Most respondents (75.6%) believe that occasional hookah smoking poses fewer health risks than regular or daily smoking, while 12.2% disagree, and another 12.2% are unsure. This belief is problematic as occasional smoking can still lead to significant health risks, as emphasized by [10], who highlighted that even infrequent hookah uses exposes smokers to harmful substances like those in cigarette smoke.

Sources of Information on Hookah Health Risks Regarding the sources of information on the health risks of hookah smoking, 33.3% of respondents cited healthcare professionals, 27.8% educational programs, 30.0% family or friends, and 8.9% the internet or social media. This distribution suggests that traditional and interpersonal sources of information are the most trusted, but it also underscores the need for more effective public health campaigns leveraging digital platforms. [5] support the idea that targeted educational interventions could improve awareness and correct misconceptions about hookah smoking's risks.

Hookah Use Patterns

The data on hookah use pattern shows that all respondents (100%) have used hookah, with the majority (46.7%) starting between ages 18-21, and 44.4% beginning between ages 13-17. This early initiation is concerning, as it mirrors findings by [6] who noted that younger age groups are increasingly engaging in hookah use, heightening their risk for nicotine addiction and other health issues. It was also observed that most respondents (67.8%) have used hookah for less than a year, and 37.8% engage in hookah sessions once per week. These patterns indicate relatively recent adoption among many users, possibly driven by the social appeal of hookah smoking. A significant proportion of respondents (78.9%) reported that their hookah sessions last less than 30 minutes, and 60.0% preferred flavored tobacco. These findings align with [21], who highlighted that flavoring in hookah tobacco is a major factor attracting users, particularly younger demographics. Over half of the respondents (57.8%) mix different types of tobacco, and 22.2% smoke hookah due to cultural traditions. This reflects the cultural acceptance of hookah in certain communities, as noted by [3] who discussed the deep-rooted cultural ties that contribute to the normalization of hookah smoking in social settings. Furthermore, the data indicates that mood prompts hookah use for 72.2% of respondents, and the most common places for hookah use are lounges/nightclubs (41.1%) and parties (31.1%). This portrait the role of social and emotional factors in hookah use, consistent with the findings of [20], who observed that social interaction and relaxation are key motivators for hookah smoking. It was noted that over half of the respondents (53.3%) have attempted to quit or reduce their hookah use but were unsuccessful, highlighting the challenges of cessation.

Strengths and limitations of the Study

Strengths include two stage random sampling. Limitations include self-reported bias, interviewer administration

Conclusion

This study highlights the significant health risks associated with waterpipe (hookah) smoking, particularly its adverse effects on lung function. The findings demonstrate that both the frequency and duration of hookah smoking sessions are correlated with reduced respiratory efficiency, notably in the decline of FEV1 and FEV1%. Although some lung function indices like Forced Vital Capacity (FVC) and Peak Expiratory Flow Rate (PEFR) were found to be higher among regular users, these increases may be misleading, as they are accompanied by a significant reduction in airflow efficiency. Overall, the evidence underscores the growing concerns about waterpipe smoking and its harmful implications, particularly for respiratory function, reinforcing the need for greater public awareness and more stringent regulations to mitigate these risks.

Declarations

Ethics and Guidelines: Ethical approval was obtained from the Ethics and Research Committee of the Public Health Department, University of Calabar (UC/CM/PUH/ETH/2548). Before the survey, preliminary visits were conducted in the study areas, and informed consent was obtained from participants. To maintain confidentiality, all data and information that were gathered through completed questionnaires were also safeguarded to prevent unauthorized access by third parties. The entire

study was carried out in accordance with the 1964 Declaration of Helsinki and its later amendments.

Consent to Participate: Before the survey, preliminary visits were conducted in the study areas, and informed consent was obtained from participants. Participants were assured of their voluntary participation and the option to withdraw from the study at any point without facing any repercussions.

Consent for Publication: Not applicable

Availability of data and materials: Data will be made available on request to the corresponding author

Competing interests: None

Funding: No funding was received for this study.

Trial Registration: Not applicable

Authors Contributions: PO conceived the study and took part in every other section of the study under the supervision of FI., AO and MA wrote the methodology section, MU analyzed the results, and ME reviewed the contents of the study and LE reviewed the manuscript contents.

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