



Knowledge and perception of health implications of passive smoking among in-school female adolescents: a cross-sectional study

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Abstract

Despite the growing burden of passive smoking, there remains a critical gap in knowledge and perception of its health implications among in-school female adolescents. This study investigates the knowledge and perceptions of the health implications associated with passive smoking among female adolescents in public secondary schools within the Agara community, Ibadan, Oyo State. The study was descriptive and cross-sectional. Data were obtained from 394 in-school female adolescents selected from the study population using a multistage sampling technique. The study respondents' knowledge and perception of health implications and predisposing factors to passive smoking were assessed using a pre-tested, semi-structured, and interviewer-administered questionnaire. Data were analyzed using descriptive and inferential statistics, with statistical significance set at 5%. The mean age of the respondents was 14.9 ± 1.9 years, with the majority (57.1%) categorized as early adolescents. Most respondents (65.7%) had cigarette-selling shops on their street, 33.0% were exposed to smokers in their neighborhood, 40.9% had siblings who smoked, while 29.5% had parents who smoked. The majority of respondents (79.9%) had poor knowledge of passive smoking, and 45.4% had a negative perception of its health implications. There was a statistically significant association between age group and knowledge of passive smoking ($p = 0.006$). Respondents in early adolescence were less likely to have poor knowledge compared to those in late adolescence (OR = 0.475, 95% CI: 0.279-0.811). Additionally, knowledge was significantly associated with perception of the health implications of passive smoking ($p < 0.001$). Respondents with a negative perception were 3.54 times more likely to have poor knowledge than those with a positive perception (OR = 3.543, 95% CI: 2.003-6.266). The majority (79.2%) of respondents reported being taught the harmful effects of passive smoking by their teachers, while most (83.0%) and (81.5%) had family members and friends, respectively, who encouraged them to avoid passive smoking. Conclusively, in-school female adolescents demonstrated poor knowledge and suboptimal perception of the health implications of passive smoking, highlighting the need for strengthened health education, stricter smoking regulations, and improved parental engagement.

Keywords: passive smoking, female adolescents, health implications

Introduction

Passive smoking, also known as second-hand smoking, refers to the involuntary inhalation of smoke by non-smokers in the presence of smokers.¹ Second-hand tobacco smoke comes from cigarettes, pipes, cigars, and shisha pipes and is inhaled by nonsmokers from both the exhaled smoke of smokers and the burning end of tobacco products.² Passive smoking or second-hand smoke exposure has gained increasing recognition in recent years due to its significant health implications, particularly among adolescents. Globally, exposure to second-hand smoke remains a major public health concern. In 2019, it accounted for approximately 1.3 million deaths and contributed to about 37 million Disability-Adjusted Life Years (DALYs) worldwide.³ In addition to these global estimates, regional data further highlight its impact; for instance, within the WHO European Region, second-hand smoke exposure was responsible for 171,000 deaths and 4.3 million DALYs in 2019.⁴ The adverse effects of second-hand smoke have led to increased global efforts, including the implementation of smoke-free policies and public health campaigns, to reduce exposure and raise awareness about its dangers. The World Health Organization has also reported that second-hand smoke contributes significantly to the burden of respiratory and cardiovascular diseases, including coronary heart disease and lung cancer.⁴

Passive smoking poses a considerable global burden, with well-documented detrimental health impacts. Earlier global estimates provide insight into the scale and distribution of exposure. A landmark analysis by Oberg et al. estimated that in 2004, approximately 40% of children, 33% of male non-smokers, and 35% of female non-smokers were exposed to SHS globally. This exposure was responsible for an estimated 603,000 deaths, including 379,000 from ischemic heart disease, 165,000 from lower respiratory infections, 36,900 from asthma, and 21,400 from lung cancer, and accounted for about 1.0% of global mortality, as well as 10.9 million disability-adjusted life years (DALYs) lost worldwide.⁵ In Sub-Saharan

Africa (SSA), tobacco use and exposure to second-hand smoke remain important public health concerns, contributing significantly to the region's disease burden.⁶

Nigeria, Africa's most populous country, has one of the continent's leading tobacco markets. Over 18 billion cigarettes are sold annually in Nigeria, costing Nigerians over US \$931 million, with about 13 million smokers, representing approximately 7.8% of Nigeria's total population in 2012.⁷ The study of Oyapero *et al.* reported a high prevalence rate of 22% of second-hand smoke exposure among adolescents in Nigeria.⁸ These statistics highlight the urgent need for effective tobacco control measures in Nigeria to reduce the health impacts of both active and passive smoking.

Adolescents are particularly vulnerable to the health consequences of passive smoking. This transitional phase between childhood and adulthood is marked by significant physical, psychological, and social changes, making adolescents susceptible to environmental stresses, including passive smoke exposure. Enhanced cognitive functions, such as decision-making and impulse control, develop during this period, and exposure to passive smoking can impact their health and well-being.⁸ Studies have shown that a high proportion of adolescents are exposed to secondhand smoke. For example, the nationwide survey conducted among adolescents in the US in 2017 reported that over 55% were exposed to second-hand smoke annually.⁹

In Nigeria, many adolescents, including those within the Agara community, often experience involuntary exposure to second-hand smoke in various settings, including homes, schools, and public spaces.⁸ This exposure poses significant health risks, particularly during adolescence, a critical developmental stage. Female in-school adolescents are particularly vulnerable due to their social environment and gendered patterns of exposure. In many African settings, girls are more likely to encounter second-hand smoke within household and community contexts, while also facing barriers to accessing health information and resources.

This vulnerability is particularly concerning among in-school adolescents, who are expected to have some level of exposure to school-based health education. As such, their continued susceptibility highlights a crucial gap between exposure to information and adequate knowledge of health risks, raising important questions about the adequacy of existing health education and awareness strategies. Additionally, female adolescents in public secondary schools may be more vulnerable to passive smoking compared to their private school counterparts, largely due to socioeconomic disparities. Public school students often come from lower-income households with lower parental education, which may influence their knowledge and perception of health risks. Furthermore, engagement in activities such as after-school hawking can increase their exposure to smokers within the community, thereby heightening their susceptibility to the harmful effects of passive smoking.

Although the harmful effects of passive smoking are widely recognized globally, there is a scarcity of comprehensive studies examining the knowledge and perceptions of these health risks among in-school adolescents in Africa.¹⁰ Most existing evidence is derived from high-income countries, despite weaker tobacco control policies and differing social contexts in African settings.^{11,12} This creates a crucial gap in understanding how adolescents in contexts such as Agara, Ibadan, perceive and interpret the health implications of passive smoking. In-school female adolescents in the Agara community are particularly vulnerable due to high adult tobacco use, insufficient smoke-free policies, and limited awareness of passive smoking's health risks. This gap is concerning, given potential cultural and regional variations in smoking patterns and health education initiatives. Furthermore, their perception of these health implications may be influenced by societal norms, peer pressure, and inadequate awareness campaigns, leading to a lack of understanding of the issue's severity. Additionally, the extent to which these adolescents have access to information that helps reduce their exposure to passive smoking

is uncertain. This study, therefore, investigates the knowledge and perceptions of the health implications of passive smoking among female in-school adolescents in the Agara community. The findings are expected to inform evidence-based health education programmes and policy interventions aimed at reducing passive smoking-related health disparities.

Methods

Study design

This study is descriptive and cross-sectional in design. Data were collected at a single point in time. It utilized a cross-sectional design to assess the knowledge and perceptions of in-school female adolescents about the health implications of passive smoking.

Study area

The Agara community, located within Ward 2 of Oluyole Local Government Area, Oyo State, Nigeria, was selected as the study site. Oluyole Local Government Area is one of the oldest in the state, with its headquarters at Idi-Ayunre along the Old Lagos-Ibadan Road. The Local Government Area covers an estimated land area of approximately 629 km² and has a population of about 202,725 people according to the 2006 national census. It is geographically situated between approximately latitude 7.1°N and 7.5°N and longitude 3.6°E and 4.0°E. Agara is an urban settlement characterised by visible tobacco use in public spaces, the presence of retail outlets selling tobacco products, and occupational groups such as artisans who frequently smoke within the community. These factors contribute to heightened exposure to second-hand smoke within the environment.

In-school female adolescents aged 10–19 years were the focus of this study due to their increased vulnerability to passive smoking exposure. This is because they frequently socialize in public spaces where smoking is common and may also have interpersonal relationships with male smokers, further increasing their exposure. The normalization of smoking behaviors within the community, coupled with weak enforcement of smoke-free

regulations and limited awareness of the health risks of second-hand smoke, further exacerbates exposure among adolescents.

Evidence from Nigeria indicates that tobacco use and second-hand smoke exposure are more pronounced in urban and semi-urban settings compared to rural areas.⁸ Accordingly, Agara represents a typical urban Nigerian community where environmental and social conditions contribute to passive smoking exposure, making it an appropriate setting for examining urban patterns of passive smoking exposure. The study was conducted in two selected schools, Abe Technical Secondary School and Liberty Secondary Commercial Academy, around the Agara Community. Although there are no schools in the community, these are the nearest schools attended by female adolescents from Agara, making them a suitable representation of the local population.

Study population

The target population for this study consists of in-school female adolescents aged 10-19 years enrolled in public secondary schools nearest to the Agara community, specifically Abe Technical Secondary School and Liberty Secondary Commercial Academy. These students are considered representative of female adolescents residing in the Agara community.

Inclusion and exclusion criteria

The study included female adolescents aged 10-19 years who were currently enrolled and registered in selected public secondary schools in the study area. Private secondary schools were excluded from the study. In addition, students with severe physical or cognitive impairments that could limit their ability to participate in an interviewer-administered questionnaire were excluded. This was to ensure that all participants could adequately comprehend and respond to the study questions. Identification of such students was based on school records and guidance from class teachers during recruitment, without the use of formal clinical assessment.

Sample size

The sample size for this study was estimated using Cochran's formula for cross-sectional studies.¹³ A prevalence of 38.8% for exposure to passive smoking, as reported by Desalu et al.,¹⁴ was used with a margin of error of 5%. The estimated minimum sample size was 365 respondents. Although more recent studies have reported different prevalence estimates among adolescents,⁸ the Desalu et al. estimate was adopted as it provided a comparable baseline for non-smoking populations and was among the most widely cited Nigerian studies available at the time of study design. To account for possible non-response, a 10% adjustment was applied, resulting in a final sample size of 404 respondents.

Sampling technique

The study employed a multistage sampling technique to select 404 students from two selected secondary schools. In Stage 1, two schools (Liberty School and Abe School) were purposively selected. In Stage 2, the number of students to be drawn from each school was determined using probability proportionate to school size (PPS) based on their total student populations of 720 and 880, respectively. Consequently, 182 students were allocated to Liberty School and 222 to Abe School. In Stage 3, the sample from each school was further stratified by class level (Junior and Senior Secondary School). For Liberty School, 95 students were selected from JSS and 87 from SSS, while for Abe School, 86 students were selected from JSS and 136 from SSS, also based on PPS. In the final stage, students within each class were selected through systematic sampling using the class registers as the sampling frame to ensure equal representation and minimize selection bias.

Instrument for data collection

This study employed an interviewer-administered questionnaire as the data collection instrument. The questionnaire was developed based on questions adapted from the Global Youth Tobacco Survey (GYTS) and a comprehensive review of existing literature on knowledge

and perception of the health implications of passive smoking among adolescents.¹⁵ The instrument consisted of five sections. Section A contained information that assessed the socio-demographic characteristics of the respondent. Section B assessed the knowledge of passive smoking health implications among in-school female adolescents. This section comprises nine (9) open-ended items. Participants were required to provide written responses to questions such as: “Mention two health problems that can be caused by passive smoking among female adolescents,” “List two ways to avoid exposure to passive smoke,” and “List two things you can do to protect yourself from passive smoking,” among others. The section had a total obtainable score of 18 points, with one (1) point awarded for each correct response and zero (0) points for incorrect or blank answers. For analysis, knowledge scores were categorized using the 50th percentile as the cut-off point. Respondents who scored 0-9 points were classified as having poor knowledge, while those who scored above 9 points were classified as having good knowledge. The perception section (Section C) assessed respondents’ perceptions toward passive smoking using the Health Belief Model (HBM) framework. It comprised 25 items, with five items representing each of the five HBM components: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and perceived self-efficacy. Responses were measured on a two-point Likert scale (Agree/Disagree) with each positive perception scored 1 point and each negative perception scored 0 points, giving a maximum total score of 25. The 50th percentile was used as the cut-off point. Respondents who scored 0-12 points were categorized as having a negative perception, while those who scored above 12 points were categorized as having a positive perception. The use of median-based categorization for both knowledge and perception scores is supported by previous studies, where no standardized threshold exists for classifying non-validated assessment scales.^{16,17} Section D assessed the predisposing factors influencing exposure to passive smoking among in-school female adolescents. This

section explored environmental, familial, social, and media-related determinants that may increase or reduce susceptibility to passive smoking. It comprised 11 items covering domains such as family, neighborhood, school environment, peer influence, and social media exposure. Example statements included: “I live with at least one person who smokes,” “I have friends who smoke,” and “Smoking is seen in my school.” Responses were measured using a True/False scale. Section E examined the sources of information about passive smoking among in-school female adolescents. Respondents were asked whether they had seen or read any messages about passive smoking from specified sources, including school announcements, health classes, posters, health outreaches, community events, social media, and electronic media (television, radio, blogs, and websites). Responses were recorded using a Yes/No scale.

Data collection procedure

This study employed an interviewer-administered questionnaire to collect data from in-school female adolescents in Abe Technical Secondary School and Liberty Secondary Commercial Academy. Trained research assistants administered the questionnaire, gathered information on knowledge and perception of the health implications of passive smoking, and used scales to measure variables accordingly. Data collection occurred in designated quiet areas within the schools over one week, with each administration lasting approximately 10-15 minutes. To ensure participants’ privacy, confidentiality and anonymity were maintained throughout the process.

Validity of the instrument

The instrument for data collection was constructed from the specific objectives, variables from the conceptual framework, literature review, and research instruments of similar studies. The draft instrument was presented to the two professors in the Department of Health Promotion and Education for expertise validation.



Reliability

To ensure the reliability of the instrument, a pretest was conducted using 10% of the study sample size among students from Christ High School, Bankole, which is a public secondary school located within a similar urban setting in Oyo State. The school shares comparable socio-demographic characteristics with the study population, including a similar age range, educational level, and background of students. Internal consistency was assessed using Cronbach's alpha (α), with a value above 0.7 considered acceptable.

Data analysis

The copies of the questionnaire administered were serially numbered to ensure easy identification, entry, and recall. All the administered copies and questionnaires were checked carefully before data entry commenced to ensure they were completely and accurately filed. This study used both descriptive and inferential statistics using SPSS version 25. Descriptive analysis, including frequency and means, was used to summarise data. Inferential statistics included the Chi-square test, which was used to examine the relationship between variables. The results obtained from the analysis were summarized and presented in tables and charts.

Ethical Consideration

Ethical approval was obtained from the Oyo State Ministry of Health with approval number: NHREC/OYOSHRIEC/10/11/22 and the Institute for Advanced Medical Research and Training, University of Ibadan, with approval number: UI/EC/24/0796. A letter of introduction was obtained from the department and submitted to the head of administration of the respective school for written permission to conduct the research. Written informed assent was obtained before the study commenced. Respondents whose consent was not ascertained were excluded from the study. This study was carried out in a way that ensured the safety and beneficence of research participants.

Results

Sociodemographic characteristics of the respondents

Table 1 represents the respondents' socio-demographic characteristics. A total of 394 in-school female adolescents participated in the study. The mean age was 14.9 ± 1.9 years, with 57.1% categorized as early adolescents (10-14 years). Most (86.0%) were of the Yoruba ethnic group, while Christianity was the predominant religion of the respondents (66.2%). The majority (81.2%) of the respondents reported engaging in reading after school, which may include academic-related activities such as homework and personal study, while a few (9.9%) played with friends after school. The majority (83.0%) of the mothers were self-employed, and a few (17.3%) of the fathers were civil servants.

Table 1. Sociodemographic and socio-economic characteristics of the respondents (n=394)

Variables	Frequency	Percentage
Age (10-19yrs)		
Early Adolescence (10 – 14yrs)	225	57.1
Late Adolescence (15–19yrs)	169	42.9
Mean Age = 14.9±1.9years		
Religion		
Islam	131	33.2
Christianity	261	66.2
Traditional	2	0.6
Ethnicity		
Yoruba	339	86.0
Igbo	30	7.6
Hausa	8	2.0
Others	17	4.3
Who do you live with		
Father only	21	5.3
Mother only	62	15.7
Parents	273	69.3
Caregiver	38	9.6
Activities after school		
Hawking	20	5.1
Sleeping	13	3.3
Playing with friends	39	9.9
Reading	320	81.2
Apprenticeship	2	0.5

Variables	Frequency	Percentage
Mother/Caregiver's Occupation		
Self-employed	327	83.0
Civil servant	47	11.9
Unemployed	20	5.1
Father/Caregiver's Occupation		
Self-employed	315	79.9
Civil servant	68	17.3
Unemployed	11	2.8

Level of knowledge of passive smoking health implications among in-school female adolescents

Figure 1 indicates the level of knowledge of passive smoking's health implications among in-school female adolescents in public secondary schools around Agara community. Results showed that the majority (79.9%) of the respondents had poor knowledge of passive smoking's health implications, while a few (20.1%) had good knowledge.

Perception of Passive Smoking among In-school Female Adolescents

Figure 2 indicates the overall perception of the respondents, as it revealed that many (54.6%) of the respondents had a positive perception, while some (45.4%) of the respondents had a negative perception. Positive perception reflects favourable views toward the harmful effects of passive smoking and the importance of avoiding exposure, whereas negative perception reflects less favourable views regarding these health implications.

Factors Influencing exposure to passive smoking among the respondents

Table 2 presents the factors influencing exposure to passive smoking among the respondents. Overall, direct exposure to smokers was relatively low, as most respondents reported not always being around people who smoke (90.1%), and only a small proportion had friends (8.4%) or lived with someone who smoked (14.2%). However, exposure within the broader environment was evident, particularly in school settings

where smoking was observed by 23.9% of respondents. A substantial proportion reported receiving information on the harmful effects of passive smoking from teachers (79.2%), while many were also encouraged by family members (83.0%) and friends (81.5%) to avoid exposure. Despite this, a minority (16.0%) still believed that wearing a face mask would not protect them from inhaling smoke.

Table 2. Predisposing factors that influence exposure to passive smoking (n=394)

Statement	True N (%)	False N (%)
I am always around people who smoke	39 (9.9)	355 (90.1)
I live with at least one person who smokes	56 (14.2)	338 (85.8)
I have friends who smoke	33 (8.4)	361 (91.6)
I regularly visit places where smoking is allowed	47 (11.9)	347 (88.1)
Smoking is seen in my school	94 (23.9)	300 (76.1)
My parents/guardians smoke cigarettes or tobacco products	24 (6.1)	370 (93.9)
The teacher taught us the negative effects of passive smoking	312 (79.2)	82 (20.8)
Wearing a face mask in smoking environments will protect me	331 (84.0)	63 (16.0)
I read news about passive smoking on social media	317 (80.5)	77 (19.5)
My family members encourage me to avoid passive smoke	327 (83.0)	67 (17.0)
My friends encourage me to avoid passive smoke	321 (81.5)	73 (18.5)

Sources of information on passive smoking

Table 3 below presents the results on the sources of information regarding passive smoking. Results showed that most (86.5%) of the respondents had seen or read about passive smoking via electronic media (television, radio, websites, etc.) followed by social media with a percentage of 82.2% of respondents, a majority (77.2%) of the respondents reported to have heard about it on school announcements, while a few (37.6%) of the respondents reported

Figure 1. Level of knowledge of passive smoking health implications among in-school female adolescents

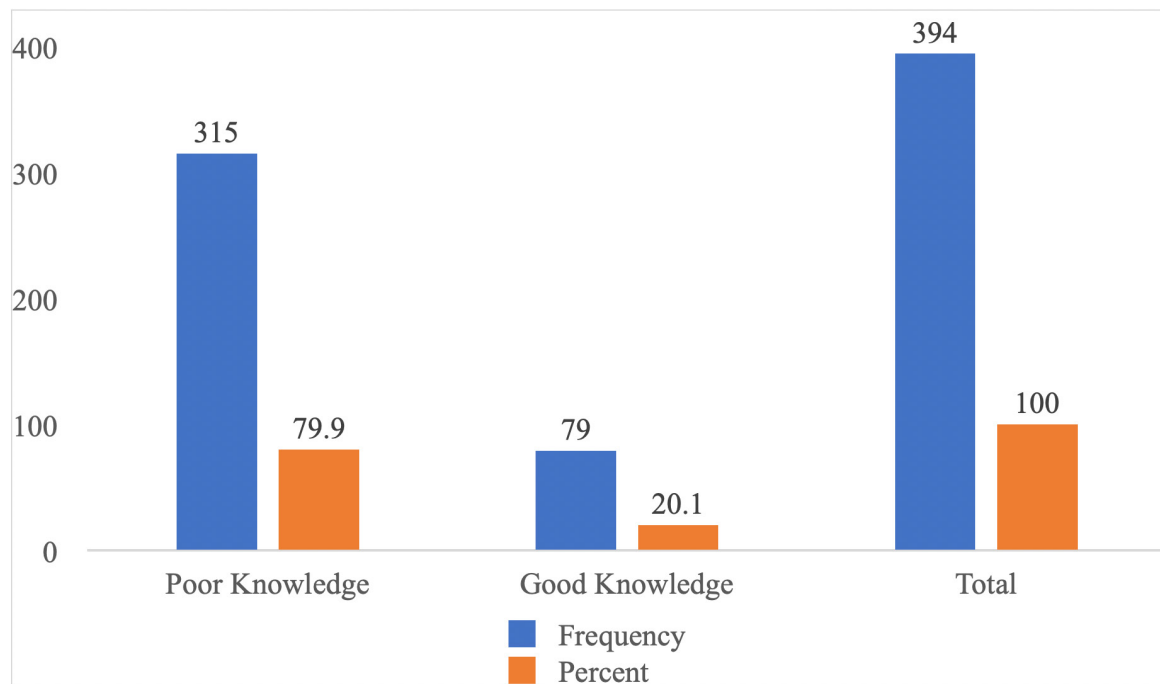
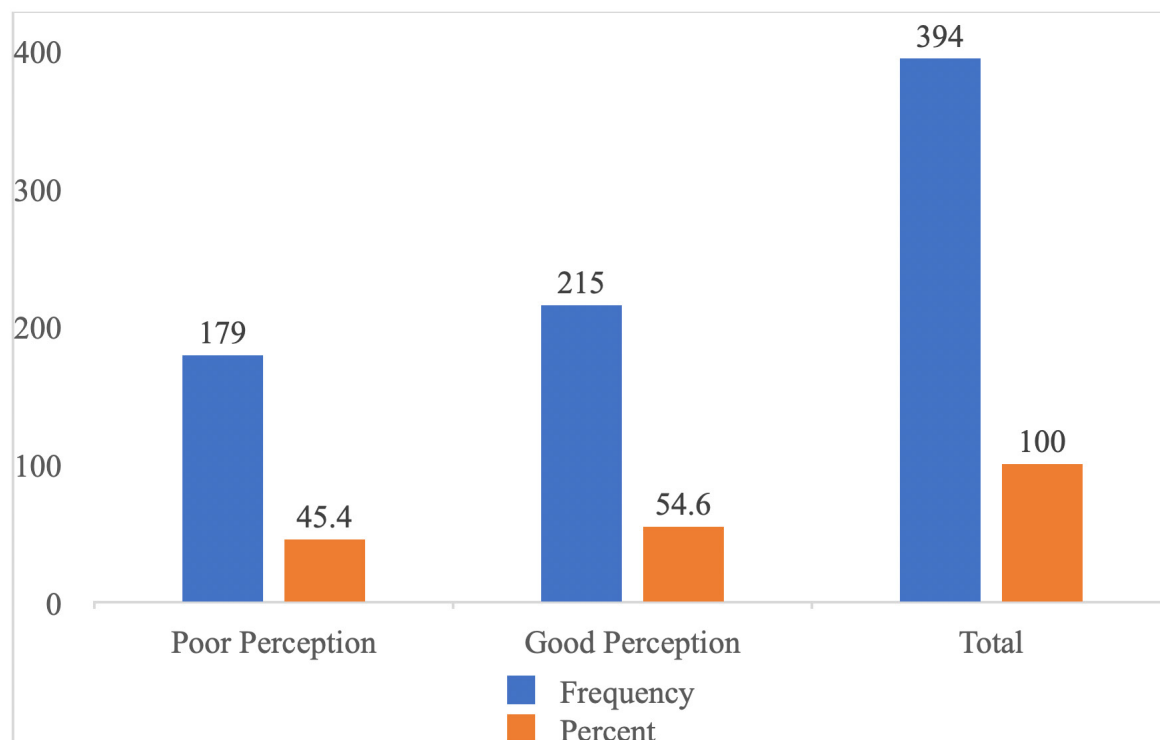


Figure 2. Level of perception of passive smoking among in-school female adolescents



the absence of posters about passive smoking in their schools, and a majority (75.1%) of the respondents reported to have heard about passive smoking during health classes. Regarding social media platforms, Facebook (80.2%) and Instagram (64.0%) were the most commonly reported sources, while fewer respondents reported receiving information via Snapchat (35.8%). Communication about passive smoking occurred more frequently with peers (61.4%) and family members (58.1%) than with teachers (33.8%), and over half (55.3%) of the respondents reported actively seeking information online.

Association between age, perception, and the level of knowledge of passive smoking of the respondents

Table 4 shows the result of the chi-square analysis examining the association between age group and knowledge of passive smoking. There was a statistically significant association between age group and knowledge level ($\chi^2 = 7.660$, $df = 1$, $p = 0.006$). Respondents in early adolescence were less likely to have poor knowledge of passive smoking compared to those in late adolescence ($OR = 0.475$, 95% $CI: 0.279-0.811$). Furthermore, there was a statistically significant relationship between level of knowledge and perception of the health implications of passive smoking among the respondents ($\chi^2 = 20.442$, $df = 1$, $p < 0.001$). Respondents with negative perception were 3.54 times more likely to have poor knowledge compared to those with a positive perception ($OR = 3.543$, 95% $CI: 2.003-6.266$).

Table 3. Sources of information on passive smoking (n=394)

Statement	Yes N (%)	No N (%)
Have you seen or read any messages about passive smoking from the sources below?		
School announcements	304 (77.2)	90 (22.8)
Social media	324 (82.2)	70 (17.8)
Posters in school	246 (62.4)	148 (37.6)
Health classes	296 (75.1)	98 (24.9)
Health Outreach	273 (69.3)	121 (30.7)
Community events	251 (63.7)	143 (36.3)
Electronic media (Television, radio, websites)	341 (86.5)	53 (13.5)
Received any information on passive smoking from the social media apps below?		
Facebook	316 (80.2)	78 (19.8)
Instagram	252 (64.0)	142 (36.0)
Twitter	210 (53.3)	184 (46.7)
Tiktok	228 (57.9)	166 (42.1)
Snapchat	141 (35.8)	253 (64.2)
Telegram	198 (50.3)	196 (49.7)
Spoken to any of these people about the health effects of passive smoke?		
Peer/friends	242 (61.4)	152 (38.6)
Family members	229 (58.1)	165 (41.9)
Teachers	133 (33.8)	261 (66.2)
Searched for any information on passive smoking's health implications online?	218 (55.3)	176 (44.7)

Table 4. Association between age, perception, and the level of knowledge of passive smoking of the respondents.

Variable	Poor Knowledge	Good Knowledge	χ^2 (df)	p-value	OR (95% CI)
Age Group					
Early Adolescence	169 (75.1)	56 (24.9)	7.660 (1)	0.006	0.475 (0.279–0.811)
Late Adolescence (Ref)	146 (86.4)	23 (13.6)			
Level of Perception					
Negative	161 (89.9%)	18 (10.1%)	20.442 (1)	<0.001	3.543 (2.003-6.266)
Positive (Ref)	154 (71.6%)	61 (28.4%)			

Note. Significant at $p < 0.05$ χ^2 (df) = Pearson Chi-square test (degree of freedom) OR = Odds Ratio
 Ref- Reference group

Discussion

The study aimed to assess students' knowledge of passive smoking and their perception of its health implications. The findings showed that although respondents were widely exposed to information about passive smoking through electronic media, schools, and social media, the majority demonstrated poor knowledge of its health implications. However, more than half of the respondents exhibited a positive perception of passive smoking hazards. Exposure to smoking was present through environmental and social influences, including neighborhood cigarette sales, observation of smoking in schools, and contact with smokers among family members and peers. Age was significantly associated with knowledge level, with early adolescents being less likely to demonstrate poor knowledge compared to late adolescents. Additionally, knowledge was significantly associated with perception, as respondents with a negative perception were more likely to have poor knowledge of passive smoking. These findings suggest persistent knowledge gaps despite widespread information exposure among adolescents.

The socio-demographic characteristics of the respondents showed that the mean age of participants was 14.9 ± 1.9 years, with the majority classified as early adolescents. This suggests that the study population largely consisted of younger secondary school students who are at a formative stage of behavioral and cognitive development. Mmari *et al.*¹⁸

opined that adolescents within this age range are often more receptive to health education and behavioral interventions, making them an important target group for preventive health programmes. Christianity was the dominant religion among respondents, which may influence health beliefs and attitudes towards smoking, as religious teachings often discourage harmful health behaviors. This finding aligns with the study by Nunziata and Toffolutti, which demonstrated that religion serves as a conveyor of behavioral norms rather than merely reflecting pre-existing attitudes.¹⁹ Their study showed that religious affiliation and participation can shape individual behaviors, including smoking patterns, by promoting moral guidelines and social expectations that discourage risky health behaviors.

The findings also revealed that most respondents engaged in reading as an after-school activity, which may reflect academic-related activities such as homework and personal study, commonly expected among secondary school students in Nigeria. This pattern may indicate academic engagement and increased likelihood of exposure to educational and health-related information. Previous studies have suggested that adolescents who engage more frequently in academic or educational activities are more likely to access health information and demonstrate improved health awareness.²⁰ Furthermore, parental occupation findings showed that the majority of mothers were self-employed, while a smaller proportion

of fathers were civil servants. Parental socioeconomic status has been widely reported to influence adolescents' health awareness, access to health information, and overall health-seeking behavior. Gautam *et al.*²¹ opined that adolescents with low socioeconomic status may face an elevated risk of unhealthy behaviors and vulnerability to environmental health risks such as passive smoking.

The study further revealed that the majority of respondents had poor knowledge of passive smoking, while only a minority demonstrated good knowledge. This indicates a significant knowledge gap among in-school female adolescents. In contrast, previous studies conducted in developed countries have reported significantly higher levels of knowledge regarding passive smoking among adolescents. These differences may be attributed to stronger tobacco control policies, school-based health education programmes, and widespread public health campaigns in such settings.^{22,23} The relatively low level of knowledge observed in the present study highlights the need for more structured, school-based health education programmes that provide detailed and age-appropriate information on the risks of passive smoking. In addition, strengthening adolescent-focused public health campaigns and integrating tobacco education into existing school curricula may improve passive smoking-related knowledge.

Furthermore, while most respondents demonstrated poor knowledge, over half of the participants exhibited a positive perception of the health implications of passive smoking. The observed difference between knowledge and perception levels may be due to increased exposure to general information about smoking hazards, which may influence perception without necessarily improving detailed understanding of specific health consequences. This suggests that although students may recognize passive smoking as harmful, they may lack comprehensive knowledge regarding its long-term health effects. This supports the work of Adediji *et al.* who found that negative perception among in-school adolescents in Ibadan significantly increased their exposure

to passive smoking.²⁴ The study also aligns with global findings from the Global Youth Tobacco Survey (GYTS), which reported that in countries with weak tobacco control policies, adolescents often have a more tolerant perception of passive smoking.²⁵ On the other hand, countries with strict anti-smoking laws, such as Ireland and New Zealand, have reported increased awareness and positive perceptions of passive smoking following the implementation of comprehensive smoke-free policies.²⁶

The findings indicate that only a few respondents reported exposure to cigarette smoke at home and within their neighborhoods, although many reported observing people smoking on the street. While household exposure appeared relatively low, community exposure remains a significant concern. This suggests that policies focused solely on restricting smoking within homes may be insufficient to protect adolescents from secondhand smoke exposure adequately. Exposure to passive smoking within the home was mainly linked to parental smoking behavior. This finding is consistent with Ghazali *et al.* and Hwang and Park, who reported that adolescents with at least one smoking parent were significantly more likely to be exposed to second-hand smoke.^{27,28} Similarly, the Global Youth Tobacco Survey (GYTS) has shown that households with smoking parents are associated with increased adolescent exposure to second-hand smoke.²⁹ The study also demonstrated that a considerable number of adolescents were exposed to passive smoking in public spaces. This finding aligns with Fagbule and Osuh, who reported substantial exposure to second-hand smoke among adolescents in Nigeria, particularly outside home environments.³⁰ Likewise, Nanninga *et al.*²⁶ reported that although public smoking bans successfully reduced second-hand smoke exposure in regulated environments such as bars and restaurants, exposure in informal public settings remained high. These findings highlight the importance of strengthening the enforcement of smoke-free policies and extending tobacco control regulations to cover informal public spaces in Nigeria.

The study found that the primary sources of information about passive smoking were schools, parents, and the media. However, many students reported limited access to accurate and reliable information. This supports the findings of Adediji *et al.*, who emphasized the need for improved health education programmes in Nigerian schools.²⁴ Mass media campaigns have played a significant role in increasing awareness in countries like Mauritius and China.^{31,32} The students in this study had limited exposure to such campaigns, which highlights the need for more targeted health communication strategies using social media, school-based interventions, and leveraging digital platforms more effectively to reach adolescents, while also strengthening teacher-led and family-based education on smoking hazards. These findings should be interpreted within the broader socio-environmental context, as adolescents' perceptions may also be influenced by factors such as social media exposure, limited enforcement of tobacco control policies, and variability in school-based health education.

The study revealed a significant association between age group and knowledge of passive smoking, with females in the early adolescents category being less likely to have poor knowledge compared to females in the late adolescents category. This finding may be influenced by differences in exposure to health information and health education across age groups. Although older adolescents may be expected to have greater cognitive maturity and cumulative exposure to health information, the findings of this study suggest that younger adolescents demonstrated comparatively better knowledge of passive smoking. This may be attributed to differences in health education exposure, school-based interventions, or access to relevant information among the respondents.

There was also a significant relationship between knowledge and perception of passive smoking. Respondents with a negative perception were more likely to have poor knowledge compared to those with a positive perception. This suggests that adequate knowledge plays an important role in shaping adolescents'

perception of the health risks associated with passive smoking. The observed association between knowledge and perception highlights the importance of targeted health communication strategies, particularly school-based and media-driven interventions, to improve both awareness and risk perception among adolescents.

Conclusion

The findings of this study provide valuable insights into the level of knowledge, perception, and factors influencing exposure to second-hand smoke among this vulnerable population. This study contributes novel, context-specific evidence from in-school female adolescents in a semi-urban Nigerian setting, demonstrating the interplay between knowledge, perception, and environmental exposure to passive smoking in a population where empirical data remain limited. The findings revealed a significant gap in adolescents' knowledge and perception of passive smoking's health implications. Many of the respondents had limited knowledge of the long-term effects of passive smoking, including cardiovascular diseases and cancer. Respondents' perceptions towards the health implications of passive smoking varied, with some minimizing its severity due to cultural norms and insufficient health education. The main factors influencing exposure to second-hand smoke among adolescents were household members' smoking behaviors, peer influence, and the lack of strict enforcement of smoke-free policies in public spaces. The study recommends that adolescents should be empowered as peer educators to share accurate information about the dangers of passive smoking with their peers through structured school-based programmes and health clubs. Schools should incorporate comprehensive health education on passive smoking into their curricula, utilizing age-appropriate, interactive teaching methods such as discussions, role-plays, and media-based learning to enhance student knowledge and awareness. Government and school authorities should implement and enforce stricter no-smoking policies in public places and schools through regular monitoring and enforcement mechanisms to reduce adolescents'

exposure to second-hand smoke. There is also a need for targeted awareness campaigns directed at parents and community leaders, aiming to reduce household and community-level exposure to second-hand smoke. Public health campaigns should utilize social media and digital platforms to reach adolescents with evidence-based, youth-friendly messages on the dangers of passive smoking and the benefits of a smoke-free environment.

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