Estimating the Association between Alcohol Consumption, Tobacco Smoking, and Sexual Behaviors among Men in Côte d'Ivoire

Abstract

Background: In Cote d'Ivoire, men have higher rates of alcohol use disorders and tobacco smoking compared to women and the African regional average, while Sub-Saharan Africa has the highest global burden of sexually transmitted diseases, with limited current evidence on the sexual contexts of alcohol and tobacco use.
Methods: This study is a cross-sectional secondary data study using a nationally representative sample from the 2021 Code d'Ivoire Demographic and Health Survey (N=5,309). This study examines the association between alcohol consumption, tobacco smoking, and sexual behaviors. Utilizing the IBM SPSS version 29, the prevalence estimates were derived from frequencies and proportions, while a multivariate logistic regression model analyzed the association between independent (alcohol consumption and tobacco smoking) and dependent variables (sexual behaviors).
Results: Significant relationships were found between alcohol consumption, tobacco smoking, and sexual activity, multiple sexual partnerships excluding spouse, and Sexually Transmitted Infections (STI) knowledge respectively. There were higher odds of alcohol consumption and tobacco smoking among sexually active participants, engaged in multiple sexual partnerships outside their spouse, used condom during recent sex, and have heard of other STIs. Moreover, among those who had knowledge of HIV Pre-Exposure Prophylaxis (PrEP) and had tested for HIV, there were higher odds of alcohol consumption compared to those who never consumed alcohol.
Conclusion: Alcohol and tobacco use are predictors of male sexual behaviors in relation to recent sexual activity and multiple sexual partnerships in Cote d'Ivoire. Interventions to reduce negative sexual reproductive health outcomes among men should also involve stricter innovative alcohol and tobacco control measures in Cote d'Ivoire.

Keywords: Alcohol consumption, Tobacco smoking, Sexual behaviors, Men, Cote d'Ivoire

Introduction

Historically, alcohol remains integral to social interaction, with moderate consumption often bringing enjoyment while excessive intake poses a wide range of negative consequences such as HIV transmission risk behaviors, criminality, accidents, and potential addiction [1, 2]. Whereas smoking is the second most common cause of death worldwide accounting for about 7.69 million deaths annually, alcohol is the eight highest cause of death accounting for 2.44 million deaths yearly; representing about 29.8 deaths per 100, 000 people [1]. Therefore, smoking and alcohol consumption are risk factors for mortality [1]. Due to their higher prevalence in substance use disorders and greater likelihood to abuse alcohol and tobacco, men experience a disproportionate impact from the resulting health consequences,

Comment [1]: abstract follows the guidelines: aims, study design, place and duration, methodology, results and conclusion

Comment [2]: Aim??

Comment [3]: Explain place and duration questionnaire??

Comment [4]: Score or value?? Result multivariate?

Comment [5]: Add implication or future studies suggestions.

Comment [6]: *[Put four to eight keywords } (Arial, inclined, 10 font, justified)*

Comment [7]: (ARIAL, BOLD, 11 FONT, LEFT ALIGNED, CAPS)

contributing to numerous disease conditions such as substance use disorders– alcohol consumption that leads to physical and mental health problems – and dependence [1, 3].

In Cote d'Ivoire, 38.5% of adults out of an estimated current population of 29, 426, 061 million consume alcohol and 5.7% of health outcomes are attributable to alcohol, constituting about 54.6 deaths per 100, 000 people [1]. The rate of untimely deaths owing to alcohol is higher in Cote d'Ivoire than the world average. A higher 12-month prevalence estimate of alcohol use disorder (15.6%) and dependence (5.3%) were reported among Ivoirian men compared to females with a 4.1% alcohol use disorder and a 1.6% alcohol dependence [4]. Similarly, Ivorian men exceeded the World Health Organization (WHO) African region 12-month alcohol use disorder prevalence by 11.9%, suggesting a very high rate of alcohol consumption among men in Cote d'Ivoire [4]. Cote d'Ivoire has an existing national action plan on alcohol that restricts the sale of alcohol beer, wines, spirits to underage persons below 18 and intoxicated persons. While the Ivorian government has relaxed regulations on importing goods and services, beverages with an alcohol content exceeding 20 percent require licensing from the Department of External Trade in the Ministry of Commerce [5]. Nevertheless, this policy potentially puts alcohol drinks in the hands of any consumer who may need it, which is a mismatch for effective sexually transmitted infection control efforts in the country given the potential links of alcohol consumption and sexual behaviors.

Regarding tobacco control, Cote d'Ivoire became a signatory to the World Health Organizations Framework Convention on Tobacco Control on July 24, 2003, ratified it by August 13, 2010, and took further steps in 2015 to ratify an additional protocol on the elimination of illicit trade in tobacco products [6, 7]. The country has achieved significant milestones in tobacco control, including banning smoking in public places and transport in 2012, implementing health warning labels and neutral packaging in 2019, establishing a monitoring system for tobacco products in 2022, alongside initiatives like a national strategic plan for tobacco control [8]. Cote d'Ivoire is currently guided by an existing 2019 tobacco control law No. 2019-676, and the National Program for the Fight against Tobacco, Drug, Alcohol and Other Addictions (PNLTA) agency to promote tobacco control interventions [8]. However, about 25% of men are tobacco smokers in Cote d'Ivoire with an 11-point increase in tobacco use among men aged 25-34 years [8]. The adult smoking prevalence for men in Cote d'Ivoire is 14.9% translating to about 1,894,222 male smokers overall [9]. Tobacco control policies have not reduced the overall prevalence of smoking tobacco given that 8,603 people die from smoking yearly in Cote d'Ivoire [8, 9].

Currently, sexual behaviors in Cote d'Ivoire are characterized by a significantly overall high rate of sexual activity (83.8%), with a high rate of multiple sexual partnerships outside their spouses among a third of the Ivorian male population [10]. Similar prior findings in demographically congruent Zimbabwe actually found a significant link between alcohol intoxication, and unprotected casual sex under the influence of alcohol [11, 12]. Conversely, a low engagement in HIV testing and low comprehensive knowledge of HIV pre-exposure prophylaxis (PrEP) – bio-medical interventions with potent proven efficacy against HIV infection in HIV negative people – among Ivorian men remains some of the most significant concern with dire sexual health implications for Cote d'Ivoire [10]. This portends ominous consequences for the overall reduction of negative comprehensive sexual reproductive health outcomes for men in Cote d'Ivoire.

Several gaps exist in the literature regarding the association between alcohol consumption, tobacco smoking, and sexual behaviors such as recent sexual activity, multiple sexual partnerships, condom use behaviors, HIV testing, HIV PrEP knowledge, and sexually transmitted infections (STI) knowledge. However, a combination of alcohol and substance abuse-related personal, interpersonal, and structural factors have been linked to sexual behaviors [13, 14], supported by an avalanche of empirical prior evidence in Botswana, Namibia, Zimbabwe, South Africa, and the United States [11, 15-18]. Generally, existing best available evidence on the predictors of sexual behaviors have shown a correlation between alcohol consumption, tobacco smoking, and sexual behaviors or even mental health conditions among men, sexual minorities, people of color, and adolescent and young adults [2, 14, 16, 19]. Specifically in the U.S, nearly 70% of adults aged 18 and above over consume alcohol and most of them experiencing a substance use disorder began the habit in adolescence and young adulthood [20, 21]. Alcohol and age are risk factors and predisposing factors for negative sexual health behaviors and outcomes particularly for young adults [14, 19, 21]. Evidence suggests that risky sexual behaviors such as underage sexual debut, inconsistent or lack of condom use during sex, and multiple sexual partnerships, increases with frequency of substance use [19, 21]. Similarly, alcohol abuse has been linked to an increase in sexual risk behaviors in adolescents and young adults due to challenges in executive functioning from adverse childhood experiences coupled with significant developmental changes occurring at this transition milestone from adolescence to young adulthood [22]. This indicates that age group may be associated with differentials in sexual health behaviors [14, 22]. Moreover, the Alcohol Myopia Theory suggests that alcohol consumption impairs cognitive processing, narrowing attention to immediate cues, potentially leading to risky behaviors, emphasizing the importance of understanding these mechanisms for developing effective prevention and intervention strategies to mitigate associated negative health outcomes [19, 23]. Researchers have suggested that people who use drugs or alcohol are more likely to engage in early sexual activity due to the disinhibiting effects of these substances, supporting the Jessor Problem-Behavior Theory, which links risky sexual behavior to a broader syndrome of problem behaviors [56]. According to this theory, the likelihood of engaging in such behaviors depends on personality traits, social environmental factors, and other behaviors reflecting an orientation towards or away from conventional values and institutions [57]. Likewise, the Framework Convention on Tobacco Control places emphasis on monitoring tobacco use through population-based surveys [6], yet evidence on the association between alcohol consumption, tobacco smoking, and sexual behaviors are currently unavailable in Cote d'Ivoire and in many sub-Saharan African nations.

In this study, we estimate the association between alcohol consumption, and sexual behaviors such as recent sexual activity, multiple sexual partnerships, condom use behaviors, HIV testing, HIV PrEP knowledge, and STI knowledge. We also estimate the association between tobacco smoking, and sexual behaviors such as recent sexual activity, multiple sexual partnerships, condom use behaviors, HIV testing, HIV PrEP knowledge, and STI knowledge. Using a nationally representative sample, the following research question will be answered: 1) Is there a significant relationship between alcohol consumption, tobacco smoking, and sexual behaviors among men in Cote d'Ivoire? 2) Are alcohol and tobacco use predictors of sexual behaviors among men in Cote d'Ivoire?

Methods

Data Source

The 2021 Demographic and Health Survey in Côte d'Ivoire (DHS-CI 2021) was conducted by the National Institute of Statistics (INS), with technical assistance provided by Inner City Fund (ICF) and specialized departments within the Ministry of Health, Public Hygiene, and Universal Health Coverage [24]. Data was collected from September to December 2021, utilizing a questionnaire tailored for male participants aged 15 to 59. The questionnaire aimed to gather information on HIV knowledge, attitudes, behavior, and testing, among other areas.

Sampling Design and Sample Size

This study is both a population-based nationally representative study and a secondary cross-sectional study based on the 2021 Côte d'Ivoire Demographic and Health Survey (DHS-CI 2021) [24]. Adopting a stratified, two-stage cluster design, the survey utilized enumeration areas (EAs) as the first-stage sampling units. In the second stage, a complete listing of households was conducted. The survey included for this current study were conducted with 7,591 men aged 15-59 mostly from the rural areas encompassing topics such as HIV Knowledge, Attitudes, and Behavior [24].

Inclusion criteria

Men aged 15 to 59 years in Cote d'Ivoire.

Exclusion Criteria

Men aged below 15 years or 60 years and above, and women in Cote d'Ivoire.

Measures

Comment [8]: already represented by the inclusion criteria

Independent Variables

The independent measures were obtained thus: (1) *alcohol consumption* was assessed by asking the participants, 'Did you drink alcoholic in the past month'? This was originally coded with options, '*Did not have even one drink*'=0, '*Every day/almost every day*'=95, '*Never have consumed alcohol*'=96. In the current study, '*Never consumed alcohol*' was re-coded as 'No' =0, and '*Every day/almost every day*' and '*Did not have even one drink in the past month*' were both re-coded as Yes =1 because we intended to measure if the participant ever drank alcohol. In the current study, this categorical variable was intended to measure whether the participants ever or never consumed alcohol (2) *tobacco smoking* was assessed by asking the participants about the frequency of smoking, ''Do you currently smoke tobacco?' Originally, this was coded as, '*Do not smoke*' =0, '*Every day*' =1, *Some days* =2. In the current study, this was re-coded as *No*=0, and *Yes*=1. Participants smoking every day and smoking some days were coded as smokers given the deleterious impact of both intermittent and daily smoking on health [25]. Also, this categorical variable was intended to measure whether participant smokes or not in the current study.

Comment [9]: what independent variables? questionnaire used? validity and reliability test resultsIs the questionnaire adopted from another questionnaire or the result of development? or created by researchers?

Dependent Variables

As the outcome variable, sexual behaviors such as recent sexual activity and number of sexual partners excluding spouse (multiple sexual partnership), and condom use behavior were chosen because of their dominance in the literature and presence in the DHS dataset [24]. A combination of alcohol and substance abuse-related personal, interpersonal, and structural factors have been linked to sexual behaviors [13, 14] . The measures analyzed aim to estimate the association between alcohol consumption, tobacco smoking, and sexual behaviors among men aged 15-

UNDER REVIEW

59 years in Cote d'Ivoire. The dependent measures were obtained thus: (1) *recent sexual activity* was assessed by asking the participants: "I would like to ask you about your sexual activity. When was the last time you had sexual intercourse?" The response was coded as 0=Never had sex (No), and 1=sexually active (Yes). (2) *multiple sexual partners* were assessed by asking, "In total, with how many different people have you had sexual intercourse with excluding your spouse?" (3) *Condom use* during last sex with most recent partner: this was assessed by asking the participants: Did you use condom every time you had sex with the most recent partner in the last 12 months, and was a condom used every time you had sexual intercourse with this person in the last 12 months? (4) *HIV testing:* thiswas assessed by asking the participants: "I don't want to know the results, but have you ever been tested for HIV?" (5) *STIs knowledge* was measured by asking participants: "apart from HIV, have you heard about other infections that can be transmitted through sexual contact?" (6) Recognizing the importance of remaining HIV negative while on PrEP, *HIV PrEP* knowledge was assessed by asking participants the following items: (1) knowledge about PrEP, "Have you heard about PrEP used to prevent someone from getting infected with HIV? All responses in the six models were "yes" or "no" for each outcome variable and were coded "yes" or "no".

Comment [10]: what dependent variables? questionnaire used? validity and reliability test resultsIs the questionnaire adopted from another questionnaire or the result of development? or created by researchers?

Sociodemographic Characteristics

The study incorporated various socio-demographic factors as control variables, including region, ethnicity, residency status, marital status, educational background, employment status, and religion.

Data Analysis

IBM SPSS software version 29.0 was utilized for data analysis. Frequencies and proportions across various sociodemographic characteristics were generated as univariates. A logistic regression model was adopted to estimate the relationship between independent and dependent variables. Six multivariate logistic regression models were conducted to explore associations between key independent variables (alcohol consumption, and tobacco smoking) and the dependent variables (sexual activity, multiple sexual partnerships excluding spouse, condom use during recent sex, HIV testing behavior, knowledge of Sexually transmitted infections STI, and knowledge of HIV Pre-exposure Prophylaxis PrEP). Specifically, in Model 1, logistic regression evaluated the association between the independent variables and the dependent variable *recent sexual activity*. Model 2 examined the same independent variables and the dependent variable *number of sexual partners excluding spouse*. Model 3 also examined the same independent variables and the dependent variable *condom use during last sex with most recent partner*. Model 4 examined the same independent variables and the dependent variable *HIV testing*. Model 5 examined the same independent variables and the dependent variable *STI knowledge apart from HIV.* Model 6 examined the same independent variables and the dependent variable *HIV PrEP knowledge.* All six models were adjusted for sociodemographic characteristics. The findings from both models were summarized into a unified table as the independent variables remained consistent across all model analyses. The significance level for determining statistical significance in this study was set at a p-value < 0.05.

Comment [11]: explain more briefly but still systematically

Ethical Considerations

This comprehensive survey spanned from September 8, 2021, to December 30, 2021, covering urban and rural areas in all 14 administrative districts nationwide [24]. The Ivorian Government, in collaboration with development partners, undertook the 2021 Demographic and Health Survey (DHS-CI 2021) to collect social health

indicators. The survey protocol underwent rigorous scrutiny and approval from both the National Institute of Statistics (NIS) and the ICF Institutional Review Board. Permission to utilize the CDHS data for the present research was granted by the Department of Health and Human Services (DHS) and Inner City Fund International (ICF), with approval secured on November 27th, 2023. It's important to note that the datasets pertaining to research participants do not contain any personally identifiable information.

Results

Descriptive Characteristics of the Participants

Table I presents the demographic characteristics of the study participants, comprising 5309 males aged between 15 and 59 years from Cote d'Ivoire. These individuals were distributed across various regions, with the highest proportion located in Woroba (9.5%), followed by Denguele (9.4%), and Sassandra-Marahone (8.6%), while Yamoussoukro had the lowest representation at 5.2%. The majority hailed from urban areas (51%), were in the 40-59 age bracket (40.7%), unmarried (43.6%), adherents of Islam (64.3%), currently employed (80.7%), and possessed at least a primary school education or higher (54.9%). Regarding alcohol consumption, 5% had ever consumed alcohol and 9.4% were tobacco smokers in the sample. Additionally, 79.5% were sexually active, 27.6% reported engaging in multiple sexual partnerships outside their spouse, whereas only 16.1% used condom in the last sex with most recent partner. Furthermore, only 20.1% had undergone HIV testing, 57.2% were aware of other Sexually Transmitted Infections (STIs), and only 10.7% had knowledge of the existence of Pre-exposure Prophylaxis (PrEP).

Comment [12]: explain the highest value...don't repeat everything in the table

Table I

Descriptive Characteristics of the Participants (n=5309)

Comment [13]: follow the writing guide

Variables	N	%
Region		
Abidjan	415	7.8
Yamoussoukro	278	5.2
Bas Sassandra	445	8.4
Comoe	320	6.0
Denguele	499	9.4
Goh-Djiboua	378	7.1
Lacs	250	4.7
Lagunes	313	5.9
Montagnes	421	7.9
Sassandra-Marahoue	456	8.6
Savanes	399	7.5
Vallee du Bandama	328	6.2
Woroba	505	9.5
Zanzan	302	5.7
Resident type		
Urban	2710	51
Rural	2599	49
Age group (years)		

UNDER PEER REVIEW

15 – 24	1895	35.7
25 – 39	1254	23.6
40 – 59	2160	40.7
Marital status		
Married	2059	38.8
Never married	2315	43.6
Living-in partner	805	15.2
Others	130	2.4
Highest level of education		
No education	2394	45.1
Primary and Higher	2915	54.9
Employment status		
Not working	1026	19.3
Currently working	4283	80.7
Religion		
Christian	1361	25.6
Muslim	3414	64.3
Others	534	10.1
Alcohol consumption		
No	5042	95
Yes	267	5
Tobacco smoking		
No	4809	90.6
Yes	500	9.4
Sexual activity		
Never had sex	1087	20.5
Sexually active	4222	79.5
Multiple sexual partners excluding spouse		
No	3842	72.4
Yes	1467	27.6
Condom use during last sex		
No	3541	83.9
Yes	681	16.1
Ever tested for HIV		
No	4244	79.9
Yes	1065	20.1
Knowledge of STIs		
No	2274	42.8
Yes	3035	57.2
Knowledge of HIV PrEP		
No	4447	89.3
Yes	532	10.7

UNDER PEER REVIEW

Logistic Regression Results Showing the Relationship between Alcohol Consumption, Tobacco Smoking, and Sexual Behaviors

The Relationships between Alcohol Consumption, Tobacco Smoking, and Sexual Behaviors are presented in Table IIa (sexual activity, multiple sexual

partnership, and condom use during last sex), and Table IIb (HIV testing, STI knowledge, and HIV PrEP knowledge).

In Table IIa, Model I show a significant association between alcohol consumption, tobacco smoking, and sexual activity. There were significantly higher odds of alcohol consumption (AOR =3.85, 95% CI=1.83-8.11, *p*<0.001) and tobacco smoking (AOR =5.94, 95% CI=3.32-10.61, *p*<0.001) among participants who were sexually active compared to those who neither consume alcohol nor smoke tobacco. Similarly, a significant association were found between alcohol consumption, tobacco smoking, and multiple sexual partnerships (Model II). There were significantly higher odds of alcohol consumption (AOR =1.79, 95% CI=1.35-2.38, *p*<0.001*)*, and tobacco smoking (AOR =1.11, 95% CI=.88-1.40, *p*<0.001) among participants who engaged in multiple sexual partnerships compared to those who neither consumed alcohol nor smoked tobacco (Model II). Model III, shows that tobacco smoking (AOR 1.28, 95% CI=1.01-1.64, *p*=0.264) was associated with higher odds of condom use during sex than those who do not smoke.

In Table IIb, Model IV show a significantly higher odds of alcohol consumption (AOR =2.02, 95% CI=1.55-2.65, *p*<0.001) among participants who are tested for HIV compared to those who do not take consume alcohol. Model V also show a significantly higher odds of alcohol consumption (AOR =2.2, 95% CI=1.60-3.06, *p*<.001) and tobacco smoking (AOR =1.31, 95% CI=1.06-1.62, *p=0.012)* among participants who have knowledge of STIs compared to those who neither consumed alcohol nor smoke tobacco.

Comment [14]: follow the writing guide

Table IIa

Logistic Regression Results Showing the Relationship between Alcohol Consumption, Tobacco Smoking, and Sexual Behaviors (sexual activity, multiple sexual partnership, condom use during last sex)

	Model I	Model II	Model III
Variable	Sexual activity AOR (95% C.I)	Multiple sexual partnership AOR (95% C.I)	Condom use during last sex AOR (95% C.I)
Alcohol consumption			
No	Ref	Ref	Ref
Yes	3.85 (1.83-8.11)***	1.79 (1.35-2.38)***	0.72 (0.49-1.05)
Tobacco smoking			
No	Ref	Ref	Ref
Yes	5.94 (3.32-10.61)***	1.11 (0.88-1.40)***	1.18 (0.88-1.57)

*=*P*<.05, **=*P*<.01, ****P*<.001, *AOR = Adjusted Odd Ratio, CI = Confidence Intervals.* In Model I, *sexual activity* is analyzed as an outcome variable. In Model II, *multiple sexual partnerships* are analyzed as outcome variables. Model III shows that *condom use during last sex* is also analyzed as an outcome variable.

Comment [15]: follow the writing guide

Table IIb

UNDER PEER REVIEW

Logistic Regression Results Showing the Relationship between Alcohol Consumption, Tobacco Smoking, and Sexual Behaviors (HIV testing, STI knowledge, and HIV PrEP knowledge)

	Model IV	Model V	Model VI
Variable	HIV testing AOR (95% C.I)	STI knowledge AOR (95% C.I)	HIV PrEP knowledge AOR (95% C.I)
Alcohol consumption			
No	Ref	Ref	Ref
Yes	1.40 (1.06-1.85)**	2.2 (1.60-3.06)***	0.78 (0.51-1.18)
Tobacco smoking			
No	Ref	Ref	Ref
Yes	0.79 (0.62-1.0)	1.31 (1.06-1.62)**	0.69 (0.49-0.96)*

*=*P*<.05, **=*P*<.01, ****P*<.001, *AOR = Adjusted Odd Ratio, CI = Confidence Intervals.* In Model IV, *HIV testing* is analyzed as an outcome variable. In Model II, *STI* knowledge is analyzed as outcome variables. Model III shows that *HIV PrEP knowledge* is also analyzed as an outcome variable.

Comment [16]: follow the writing guide

Discussion

Although alcohol consumption and tobacco smoking among the participants were 5% and 9.4% respectively in this sample, the combined number of either alcohol consumers or tobacco smokers grossed a significant 767 participants from the total sample size (*N*=5,309). Comparatively, 38.5% of adults aged 15 years and above are projected alcohol consumers in Cote d'Ivoire [1]. Therefore, our finding reflects the inherent limitations of our study. For example, our study focused on men aged 15 to 59 years only, and witnessed missing/incomplete responses by up to 30%. Hence, rather than using the CDHS men's sample size of 7,591, this study was conducted based on the completely available dataset of only 5,309 participants which may have affected the findings. Nevertheless, noteworthy findings were recorded in this study.

Comment [17]: add discussion to previous research
why alcohol consumption and smoking occur at ages 15-59...relation to developmental phases

Firstly, there were significantly higher odds of alcohol consumption and tobacco smoking among participants who were sexually active compared to those who neither consume alcohol nor smoke tobacco. This finding suggest that alcohol consumption and tobacco smoking are significant predictors of sexual activity which indicates that sexual intercourse increases as alcohol consumption and tobacco smoking increases. Over the years, previous studies also found significant correlations between substance use and abuse with sexual behaviors which is consistent with the current study [26-30]. Specifically, some people engage in risky sex despite the negative consequences given that alcohol or tobacco driven sexual euphoria is the sole method they know for enjoying sex without inhibitions [26]. Similarly, years of over-indulgence on these substances might have created a dependence in their psyche which may make sexual arousal only possible with concurrent misuse of alcohol and tobacco [26]. The need for substance abuse prior to sex is a common practice, which underscores the importance of re-education about sexual pleasure that is devoid of concurrent use of substances [30]. The focus of educational campaigns should be to challenge the wrong habit of using alcohol or tobacco in enhancing sexual function; which can be done effectively by

PREVIEW

characterizing engaging in sober sex as a better sexual practice than drunken sex. Persistent substance abuse adversely affects sexual function and induces diverse forms of sexual dysfunction in individuals of all genders [31]. Moreover, alcohol consumption leads to central nervous system depression, decreased arousal, impaired erection, decreased ability to ejaculate in men, and decreased vaginal lubrication, dyspareunia, and difficulty achieving orgasm in women, while chronic use can lead to hypogonadism, erectile dysfunction, and risky sexual behavior [31]. Similarly, smoking leads to erectile dysfunction, affecting both the ability to start and sustain an erection [31-33]. Therefore, all effort should be made to made to make the relationship between substance abuse and sexual dysfunction the focus of public enlightenment campaigns in Cote d'Ivoire.

Comment [18]: Why does consuming alcohol, smoking and drugs lead to sexual behavior? What content does it have that can increase sexual behavior?

Secondly, we found a significantly higher odds of alcohol consumption, and tobacco smoking among participants who engaged in multiple sexual partnerships aside their primary spouses compared to those who neither consumed alcohol nor smoked tobacco. This suggests that alcohol consumption and tobacco smoking are indeed predictors of multiple-sexual partnerships behaviors. Several prior research support this finding notably for early adolescence when they tend to accumulate sexual partners, indicating a robust connection between substance use and engaging in multiple partnerships [34-38]. Likewise, the consumption of alcohol prior to sexual activity correlated with a higher number of sexual partners in previous studies [38].As the number of sexual partners rises, so does the risk of developing substance dependence disorder [39]. Moreover, the most significant predictors of having multiple sexual partners were alcohol, tobacco, and marijuana usage, along with experiences of dating violence [40]. The current findings raise concerns over the future of prevention science, particularly for the younger age groups 15-32 years over whom the serial exchange of sexual partners have been most reported [19, 40, 41].

Thirdly, we found a significantly higher odds of alcohol consumption were found among participants who are tested for HIV compared to those who do not consume alcohol. Again, this finding is not supported in existing literature and adds to the body of scientific knowledge to further explore mechanism or contextual contributors to this phenomenon. Future research should focus on clarifying the relationship between alcohol consumption and HIV testing. Overall, these findings underscore the need for smoking cessation training and alcohol addiction centers to be established, especially in areas with higher number of male adolescent and young adult population in Cote d'Ivoire who are more susceptible to substance abuse. Unlike prior studies, these results indicate that tobacco smoking was a significant predictor of condom use during sex while alcohol consumption was a significant predictor of HIV testing respectively. Given that causality is beyond the scope of this research, we must sustain the advocacy for the adoption of evidence-based strategies in tobacco and alcohol control to instigate transformation and mitigate the adverse impacts of tobacco consumption among Ivorian men [9].

Finally, there were significantly higher odds of alcohol consumption and tobacco smoking among participants who had knowledge of STIs compared to those who neither consumed alcohol nor smoke tobacco. This indicates that knowledge of sexually transmitted infections were not necessarily preventive mechanisms against substance abuse in themselves. However, when sexually transmitted infections are actually contracted may be a better indicator of their association with alcohol consumption and tobacco smoking. Previous studies have established that substance use and abuse are associated with high-risk sexual behaviors such as

UNDER PEER REVIEW

transactional sex and STIs [42-45]. Therefore, there is need to advocate for the low cost-to-nothing concurrent screening of young people with a substance use history for STIs during school enrollment or pre-employment. Any integration of STI screening with substance abuse tests should be aimed at reversing negative sexual reproductive health outcome among the adolescent and youth population in Cote d'Ivoire.

Implications for Prevention Science

Prevention is the most effective strategy for eliminating sex-related disease burden [46]. Tobacco smoking and over-indulgence in alcohol poses a dual threat to the public and economic well-being, undermining endeavors to enhance health equity, combat poverty, safeguard the environment and prevent negative sexual reproductive health outcomes [9, 14]. In Cote d'Ivoire, half of males aged 15-19 consume alcohol while nearly half of young males aged 13-15 smoke tobacco [47]. Existing reports indicate that tobacco and alcohol commercials sometimes appear to target lower-income populations who are already encumbered by disproportionate social determinants of health such as poor education outcomes [9]. A substance abuse prevention strategy is crucial for Cote d'Ivoire particularly among the youth and the population with the poorest wealth index. We call for evidence-based strategies in tobacco and alcohol control to instigate transformation and mitigate the adverse impacts of their use. A possible prevention strategy that should be implemented in Cote d'Ivoire is increased taxation and tariff on alcohol and tobacco products to make them too expensive to purchase, particularly by young people. In turn, revenues derived from the increased taxation should be channeled towards protecting adolescents and young adults from these substances through community level and school-based campaigns. When school-based strategies are adopted, high school and college curriculum should incorporate alcohol, and tobacco prevention science in such a way that every student has an opportunity to learn and re-learn about the dangers of both or strategies to prevent initiation of both, on a recurrent yearly basis. This is necessary given that young people below 20 years constitute about 49% of the Ivoirian population [48]. Like many Sub-Saharan African nations, Cote d'Ivoire has suffered from an absence of overall youth prevention strategy to tackle the myriad of issues negatively impacting millions of them such as alcohol and tobacco use which have been identified as potential predictors of sexual risk behaviors, gender-based violence, and chronic diseases.

The current study underscores the necessity of integrating effective interventions to mitigate negative sexual reproductive health outcomes among men, coupled with stringent and innovative alcohol and tobacco control measures in Côte d'Ivoire. Prevention strategies should address alcohol and tobacco production, distribution, and marketing while engaging youth in decision-making processes and providing resources for youth-friendly programs that promote awareness and prevention of alcohol and tobacco use. People are swayed by the behavioral norms of their social circles or by their aspiration to fulfill the expectations set by those they admire [49].Therefore, a model of behavioral control founded on persuasion, incentives, or the structure of opportunities maybe effective for alcohol and tobacco prevention programs to work in Cote d'Ivoire, particularly for the behaviorally vulnerable 49% of the population that are less than 20years old. The use of peer education and interactions is an evidence based and time proven intervention strategy in many cultural and community health programs because of the ability to introduce fresh perspectives or ideas, which can influence subsequent actions [50]. In Sub-Saharan African populations where resistance to change is common and

access to care is limited, peer to peer education has been a proven success [51-55]. Cote d'Ivoire must do the same in adopting these evidence-based prevention sciences.

Limitations and Strengths

The final report of the 2021 Cote d'Ivoire Demographic and Health Survey (DHS-CI 2021) was originally in French and later translated into English to incorporate some of its findings into this research. Because HIV disease is closely tied to social and economic disparities and remains highly stigmatized, the use of self-report surveys in this study could introduce social desirability bias. Moreover, the study's design, being cross-sectional, means it cannot definitively establish or infer a causal relationship between HIV PrEP, HIV testing, and behaviors related to sexual experience. Additionally, our study focused on men aged 15 to 59 years only, and witnessed missing/incomplete responses by up to 30%. Despite these limitations, the study has several strengths. Unlike previous studies focusing on Cote d'Ivoire, which relied on older versions of DHS datasets, this study presents the most recent evidence in the field. The primary data, collected in 2021 with final reports only becoming available in 2022, provides the most up-to-date information on alcohol consumption, tobacco smoking, and sexual behaviors in Cote d'Ivoire. Our models included variables chosen for their significance in existing literature on substance abuse, and prevention related sexual health studies. Crucially, the study utilized a nationally representative sample, enhancing reliability and enabling generalizability to other Sub-Saharan African countries.

Conclusion

Alcohol consumption and tobacco smoking are common behaviors among men which makes them vulnerable to risky sexual behaviors that drive up mortality rates in Cote d'Ivoire. This study found that participants who smoke tobacco and consume alcohol were more likely sexually active, engaged in multiple sexual partnerships outside of their spouses, but had knowledge of STIs than those who did not consume alcohol or smoke tobacco. This indicates that, consistent with prior studies, alcohol consumption and tobacco smoking are significant predictors of sexually activity, multiple sexual partnerships, and knowledge of STIs for Ivorian men. We conclude that the prevention science favors taking drastic actions in integrating alcohol and tobacco control measures into sexual reproductive health interventions/services and vice-versa in order to effectively address the sexual health impact of substance use and misuse in Cote d'Ivoire.

Comment [19]: Add implication or future studies suggestions

Availability of data and materials

All data for this study are provided in this document, and the comprehensive dataset is freely available through the www.dhsprogram.com website.

UNDER PEER REVIEW

References

1. Ritchie, H. and M. Roser, *Alcohol consumption.* Our world in data, 2023. https://ourworldindata.org/alcohol-consumption
2. Harvey, T.D., I. Opara, and E.A. Wang, *Role of the intersections of gender, race and sexual orientation in the association between substance use behaviors and sexually transmitted infections in a national sample of adults with recent criminal legal involvement.* International Journal of Environmental Research

and Public Health, 2022. 19(7): p. 4100. https://doi.org/10.3390/ijerph19074100
3. Woolf-King, S.E. and S.A. Maisto, *Alcohol use and high-risk sexual behavior in Sub-Saharan Africa: a narrative review.* Archives of sexual behavior, 2011. 40: p. 17-42. DOI https://doi.org/10.1007/s10508-009-9516-4
4. World Health Organization. *Alcohol Côte d'Ivoire 2019 country profile.* 2019 April 6, 2024]; Available from: https://www.who.int/publications/m/item/alcohol-civ-2019.
5. International Trade Administration. *Côte d'Ivoire commercial guides - prohibited and restricted imports*. 2024 April 6, 2024]; Available from: https://www.trade.gov/country-commercial-guides/cote-divoire-prohibited-and-restricted-imports.
6. Burci GL. World Health Organization (WHO): Framework Convention on Tobacco Control. International Legal Materials. 2003;42(3):515-539. doi:10.1017/S0020782900010202
7. United Nations. *WHO Framework Convention on Tobacco Control*. 2024 April 7, 2024]; Available from: https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IX-4&chapter=9&clang=_en.
8. The World Bank. *Tobacco use and tobacco taxation in Côte d'Ivoire*. 2024; Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/339371561709392205/tobacco-use-and-tobacco-taxation-in-c%C3%B4te-divoire.
9. The Tobacco Atlas. *Current Rates of Smoking and Tobacco Use in Côte d'Ivoire.* 2024 April 9, 2024]; Available from: https://tobaccoatlas.org/factsheets/cote-divoire/.
10. Odii, I.O. and E. Chipalo, *Prevalence and association between HIV PrEP knowledge and approval, and HIV Testing among sexually experienced men in Côte d'Ivoire.* Texila International Journal of Public Health, 2024. 12(1): p. 99. DOI: 10.21522/TIJPH.2013.12.01.Art009
11. Fritz, K.E., et al., *The association between alcohol use, sexual risk behavior, and HIV infection among men attending beerhalls in Harare, Zimbabwe.* AIDS and Behavior, 2002. 6: p. 221-228. https://doi.org/10.1023/A:1019887707474
12. Mataure, P., et al., *Alcohol use and high-risk sexual behavior among adolescents and young adults in Harare, Zimbabwe.* AIDS and Behavior, 2002. 6: p. 211-219. https://doi.org/10.1023/A:1019835723404
13. Wagenaar, C., et al., *Factors influencing the relationship between alcohol consumption and risky sexual behaviour among young people: A systematic review.* Cogent Psychology, 2018. 5(1): p. 1483049. https://doi.org/10.1080/23311908.2018.1483049
14. Opara, I., et al., *The Association Between Racial Attitudes, Alcohol Use and Mood Disorders Among Black Adolescents.* Journal of Prevention, 2023. 44(1): p. 85-104. DOI https://doi.org/10.1007/s10935-022-00706-y
15. Weiser, S.D., et al., *A population-based study on alcohol and high-risk sexual behaviors in Botswana.* PLoS medicine, 2006. 3(10): p. e392. https://doi.org/10.1371/journal.pmed.0030392
16. May, P.A., et al., *Prevalence and characteristics of fetal alcohol spectrum disorders.* Pediatrics, 2014. 134(5): p. 855-866. https://doi.org/10.1542/peds.2013-3319

UNDER PEER REVIEW

17. Morojele, N.K., et al., *Alcohol use and sexual behaviour among risky drinkers and bar and shebeen patrons in Gauteng province, South Africa.* Social science & medicine, 2006. 62(1): p. 217-227. https://doi.org/10.1016/j.socscimed.2005.05.031
18. Lightfoot, E., M. Maree, and J. Ananias, *Exploring the relationship between HIV and alcohol use in a remote Namibian mining community.* African Journal of AIDS Research, 2009. 8(3): p. 321-327. https://doi.org/10.2989/AJAR.2009.8.3.8.929
19. Cho, H.-S. and Y. Yang, *Relationship between alcohol consumption and risky sexual behaviors among adolescents and young adults: a meta-analysis.* International Journal of Public Health, 2023. 68: p. 1605669. https://doi.org/10.3389/ijph.2023.1605669
20. Center for Disease Control and Prevention. *Heavy Drinking Among U.S. Adults, 2018*. 2020; Available from: https://www.cdc.gov/nchs/products/databriefs/db374.htm.
21. Centers for Disease Control and Prevention. *Substance Use and Sexual Risk Behaviors Among Youth*. 2024; Available from: https://www.cdc.gov/healthyyouth/factsheets/substance_use_fact_sheet-detailed.htm.
22. Tapert, S.F. and S. Eberson-Shumate, *Alcohol and the Adolescent Brain: What We've Learned and Where the Data Are Taking Us.* Alcohol Res, 2022. 42(1): p. 07. doi: 10.35946/arcr.v42.1.07
23. Creazzo, J., *Understanding the Silent Killer: A Review of NIAAA, the National Institute on Alcohol Abuse and Alcoholism.* Journal of Consumer Health on the Internet, 2022. 26(3): p. 293-299. https://doi.org/10.1080/15398285.2022.2100167
24. Demographic and Health Survey. *2021 Cote d'Ivoire Demographic and Health Survey*. 2022 December 30, 2023]; Available from: https://www.dhsprogram.com/publications/publication-FR385-DHS-Final-Reports.cfm.
25. Shiffman, S., et al., *Smoking patterns and stimulus control in intermittent and daily smokers.* PloS one, 2014. 9(3): p. e89911. https://doi.org/10.1371/journal.pone.0089911
26. Buffum, J., *Substance abuse and high-risk sexual behavior: Drugs and sex—the dark side.* Journal of Psychoactive Drugs, 1988. 20(2): p. 165-168. https://doi.org/10.1080/02791072.1988.10524489
27. Tapert, S.F., et al., *Adolescent substance use and sexual risk-taking behavior.* Journal of Adolescent Health, 2001. 28(3): p. 181-189. https://doi.org/10.1016/S1054-139X(00)00169-5
28. McKay, A., *Sexuality and substance use: The impact of tobacco, alcohol, and selected recreational drugs on sexual function.* The Canadian journal of human sexuality, 2005. 14(1/2): p. 47. https://www.proquest.com/openview/9a12f2c4e492596dcce6a6c1758e26b3/1?pq-origsite=gscholar&cbl=33400
29. Siegal, H.A., et al., *Under the influence: Risky sexual behavior and substance abuse among driving under the influence offenders.* Sexually transmitted diseases, 1999. 26(2): p. 87-92. https://journals.lww.com/stdjournal/fulltext/1999/02000/under_the_influence__risky_sexual_behavior_and.4.aspx?casa_token=xELcnTmT9jAAAAAA:8O77_bvncUS0KIJb-

6KgL2ztOM1wF1UesrTuVAGpnKWEYEcn3s_4t0JJ9D1fbzeb8WfBz9BuQu1L-jdBQeP5qxA

30. Trillo, A.D., et al., *Interrelationship of alcohol misuse, HIV sexual risk and HIV screening uptake among emergency department patients.* BMC Emergency Medicine, 2013. 13(1): p. 9. https://doi.org/10.1186/1471-227X-13-9
31. Ghadigaonkar, D.S. and P. Murthy, *Sexual Dysfunction in Persons With Substance Use Disorders.* Journal of Psychosexual Health, 2019. 1(2): p. 117-121. https://doi.org/10.1177/2631831819849365
32. Yilmaz, M., et al., *Relationship between smoking and female sexual dysfunction.* Andrology Open Access, 2015. 4(02): p. 2167-0250.1000144. DOI: 10.4172/2167-0250.1000144
33. Harte, C.B. and C.M. Meston, *Acute effects of nicotine on physiological and subjective sexual arousal in nonsmoking men: a randomized, double-blind, placebo-controlled trial.* The journal of sexual medicine, 2008. 5(1): p. 110-121. https://doi.org/10.1111/j.1743-6109.2007.00637.x
34. Vasilenko, S.A. and S.T. Lanza, *Predictors of multiple sexual partners from adolescence through young adulthood.* Journal of Adolescent Health, 2014. 55(4): p. 491-497. https://doi.org/10.1016/j.jadohealth.2013.12.025
35. Rossi, E., F. Poulin, and M.-A. Boislard, *Trajectories of annual number of sexual partners from adolescence to emerging adulthood: Individual and family predictors.* Journal of Youth and Adolescence, 2017. 46: p. 995-1008. https://doi.org/10.1007/s10964-016-0571-6
36. Vasilenko, S.A. and S.T. Lanza, *Predictors of multiple sexual partners from adolescence through young adulthood: An application of the time-varying effect model.* Journal of Adolescent Health. in press. 2012. https://doi.org/10.1016/j.jadohealth.2013.12.025
37. Santelli, J.S., et al., *Multiple sexual partners among US adolescents and young adults.* Family planning perspectives, 1998: p. 271-275. https://doi.org/10.2307/2991502
38. Bazargan-Hejazi, S., et al., *Alcohol misuse and multiple sexual partners.* Western Journal of Emergency Medicine, 2012. 13(2): p. 151. doi: 10.5811/westjem.2011.6.6676
39. Ramrakha, S., et al., *The Relationship Between Multiple Sex Partners and Anxiety, Depression, and Substance Dependence Disorders: A Cohort Study.* Archives of Sexual Behavior, 2013. 42(5): p. 863-872. https://doi.org/10.1007/s10508-012-0053-1
40. Valois, R.F., et al., *Relationship between number of sexual intercourse partners and selected health risk behaviors among public high school adolescents.* Journal of Adolescent Health, 1999. 25(5): p. 328-335. https://doi.org/10.1016/S1054-139X(99)00051-8
41. Obeagu, E.I., E.U. Alum, and G.U. Obeagu, *Factors associated with prevalence of HIV among youths: a review of Africa perspective.* Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035, 2023. 3(1): p. 13-18. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/93
42. Liebschutz, J.M., et al., *Screening for sexually transmitted infections in substance abuse treatment programs.* Drug and alcohol dependence, 2003. 70(1): p. 93-99. https://doi.org/10.1016/S0376-8716(02)00361-7
43. Belani, H., et al., *Integrated prevention services for HIV infection, viral hepatitis, sexually transmitted diseases, and tuberculosis for persons who use drugs*

illicitly: summary guidance from CDC and the US Department of Health and Human Services. 2012: Centers for Disease Control and Prevention. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6105a1.htm?s_cid%3Drr6105a1_w
44. Ellis, M.S., et al., *Associations of transactional sex and sexually transmitted infections among treatment-seeking individuals with opioid use disorder.* American Journal of Preventive Medicine, 2023. 64(1): p. 17-25. https://doi.org/10.1016/j.amepre.2022.07.011
45. Chung, T., et al., *Alcohol and marijuana use in pathways of risk for sexually transmitted infection in white and black adolescent females.* Substance abuse, 2017. 38(1): p. 77-81. https://doi.org/10.1080/08897077.2016.1263591
46. Odii, I.O., et al., *HIV PrEP Coverage Among Black Adults: A Concept Analysis of the Inequities, Disparities, and Implications.* HEALTH EQUITY, 2024. 8(1): p. 314-324. DOI: 10.1089/heq.2023.0250
47. Organization for Economic Cooperation and Development. *Key issues affecting youth in Cote d'Ivoire*. 2024 April 10, 2024]; Available from: www.oecd.org.
48. United Nations Children's Fund. *Code d'Ivoire: Country office annual report 2022*. 2023 April 10, 2024]; Available from: www.unicef.org/coted'ivoire.
49. Heckathorn, D.D., *Collective sanctions and compliance norms: A formal theory of group-mediated social control.* American Sociological Review, 1990: p. 366-384. https://doi.org/10.2307/2095762
50. Fordjuoh, J., et al., *Peer-to-Peer Chain Recruitment for Enrolling Young South African Women into an HIV Pre-exposure Prophylaxis (PrEP) Intervention Study: How Did It Perform?* AIDS and Behavior, 2024. https://doi.org/10.1007/s10461-023-04256-0
51. Mishra, R.K., et al., *HIV risk behaviors of male injecting drug users and associated non-condom use with regular female sexual partners in north-east India.* Harm reduction journal, 2014. 11: p. 1-8. https://doi.org/10.1186/1477-7517-11-5
52. Embleton, L., et al., *Intersectional stigma and implementation of HIV prevention and treatment services for adolescents living with and at risk for HIV: opportunities for improvement in the HIV continuum in sub-Saharan Africa.* AIDS and Behavior, 2023. 27(Suppl 1): p. 162-184. https://doi.org/10.1007/s10461-022-03793-4
53. Hokororo, A., et al., *Barriers to access reproductive health care for pregnant adolescent girls: a qualitative study in Tanzania.* Acta paediatrica, 2015. 104(12): p. 1291-1297. https://doi.org/10.1111/apa.12886
54. Rosenberg, N.E., et al., *Assessing the impact of a small-group behavioral intervention on sexual behaviors among adolescent girls and young women in Lilongwe Malawi: A quasi-experimental cohort study.* AIDS and Behavior, 2020. 24(5): p. 1542-1550. https://doi.org/10.1111/apa.12886
55. Simons, P.Z., et al., *Building a peer network for a community level HIV prevention program among injecting drug users in Denver.* Public Health Reports, 1996. 111(Suppl 1): p. 50. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1382043/
56. Pamela J. Bachanas, Mary K. Morris, Jennifer K. Lewis-Gess, Eileen J. Sarett-Cuasay, Kimberly Sirl, Julie K. Ries, Mary K. Sawyer, Predictors of Risky Sexual Behavior in African American Adolescent Girls: Implications for Prevention Interventions, Journal of Pediatric Psychology, Volume 27, Issue 6, September 2002, Pages 519–530, https://doi.org/10.1093/jpepsy/27.6.519

UNDER PEER REVIEW

57. Costa, F. M., Jessor, R., Donovan, J. E., & Fortenberry, J. D. (1995). Early Initiation of Sexual Intercourse: The Influence of Psychosocial Unconventionality. Journal of Research on Adolescence, 5(1), 93–121. https://doi.org/10.1207/s15327795jra0501_5

UNDER PEER REVIEW