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Substance use and risky sexual behavior among Ghanaian youth: Testing the moderating role of Health Belief Model and Theory of Planned Behavior constructs

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Abstract

Background

Substance use and risky sexual behavior are common among young people in urban Ghana, but it is unclear whether the beliefs targeted by health education weaken the link between them. This study estimated the prevalence of substance use, risky sexual behavior and self-reported sexually transmitted infection (STI) symptoms among young people in Ablekuma North Municipality, Accra (Ghana), and tested whether Health Belief Model (HBM) and Theory of Planned Behavior (TPB) constructs moderate the association between substance use and risky sexual behavior.

Methods

A cross-sectional survey was completed by 383 participants aged 18 to 35 years, recruited at community venues in all 14 electoral areas of the municipality. Data were analyzed with chi-square tests, odds ratios (ORs), hierarchical multiple regression and moderation analysis (PROCESS Model 1).

Results

Alcohol (51.7%), aphrodisiacs (26.4%) and shisha (19.6%) were the most used substances. Half of participants (50.9%) reported unprotected sex and 19.6% reported transactional sex in the past six months. Symptoms consistent with gonorrhea were reported by 18.8%, and only 25.6% had tested for HIV. Substance use was strongly associated with risky sexual behavior after adjustment for demographic characteristics ($\beta = 0.727$, $p < 0.001$). HBM and TPB constructs explained an additional 21.6% of the variance in risky sexual behavior. Perceived severity and perceived behavioral control were associated with lower risk, while perceived susceptibility, attitudes toward sex and subjective norms were associated with higher risk. None of the six constructs moderated the association between substance use and risky sexual behavior.

Conclusions

The beliefs that predicted risky sexual behavior did not weaken its association with substance use. Prevention programs for young people in urban Ghana may be more effective if they address substance use and sexual health together rather than relying on risk awareness alone.

Background

Psychoactive substance use is a growing public health concern, and young people carry a large share of its burden. The United Nations Office on Drugs and Crime estimated that 296 million people aged 15 to 64 years used a drug in 2021, an increase of 23% over the previous decade [1]. Alcohol remains the most

widely used substance. The World Health Organization (WHO) reported that 23.5% of 15- to 19-year-olds worldwide were current drinkers and that young people aged 20 to 39 years accounted for the highest proportion (13%) of alcohol-attributable deaths in 2019 [2]. Young adults are therefore at particular risk, yet most surveillance and research in sub-Saharan Africa have focused on adolescents in school. Multi-country surveys have documented alcohol, cannabis and amphetamine use among school-going adolescents across the region [3]-[5], and Ghanaian studies have reported substance use among school-going adolescents [6], [7] and tertiary students [8].

Evidence on young adults outside school in Ghana is more limited, although the available studies point to a substantial burden. A 2026 survey of 1,039 young people aged 15 to 35 years in La Nkwantanang-Madina Municipality, Greater Accra (Ghana), found that 45.1% had used a substance for non-medical purposes and that alcohol was the most used substance (40.8%) [9]. Among adults experiencing homelessness in Accra (Ghana), alcohol, tobacco and drug use were common [10], and qualitative work has linked non-medical tramadol use among young Ghanaians to unemployment and economic uncertainty [11]. These findings suggest that urban young adults aged 18 to 35 years, who are sexually active, often economically insecure and exposed to commercial access to alcohol, tobacco and prescription opioids, are an important but understudied group.

Risky sexual behavior refers to sexual practices that increase the likelihood of sexually transmitted infections (STIs), unintended pregnancy or other harm [12]. It is usually measured through unprotected intercourse, multiple or concurrent partners, sex with casual or non-romantic partners, transactional sex and sex under the influence of alcohol or drugs [12], [13]. These behaviors tend to cluster, and they are more common where young people face economic precarity, insecure living conditions and permissive peer environments [14], [15]. In Ghana, risky sexual behavior has been documented among unmarried adolescent girls in an urban municipality [16] and among young people in national survey data [17].

The link between substance use and risky sexual behavior is well established. A meta-analysis of 87 studies with more than 120,000 adolescents found a small to moderate overall association ($r = 0.22$). The association was strongest for number of sexual partners ($r = 0.25$) and weakest for unprotected sex ($r = 0.15$), and it varied by sex, age and type of sample [18]. A more recent meta-analysis of 50 studies of adolescents and young adults found that alcohol consumption was associated with early sexual initiation (OR 1.96), inconsistent condom use (OR 1.23) and multiple sexual partners (OR 1.72) [19]. Experimental and event-level evidence suggests that part of this association is causal. Drug administration studies show that acute alcohol intoxication increases intentions to engage in sexual risk [20], psychoactive substances affect the neural systems that support self-control and social decision-making [21], and population surveys in sub-Saharan Africa found that alcohol use at last sex was associated with unprotected sex on the same occasion [22]. Ghanaian studies show the same pattern. All substance use behaviors examined among sexually experienced in-school youth were associated with having sexual partners [23], and substance use has been linked to sexual risk among street-connected youth in Accra (Ghana) [24] and among fishers in Elmina (Ghana) [25].

These behaviors expose young people to STIs, including HIV. STIs remain a substantial global burden [26], [27], and self-reported STIs are common among sexually active men in Ghana [28]. Among patients seeking care at selected health facilities in southern Ghana, the prevalence of common STIs was 24.72%, mainly gonorrhea, chlamydia and syphilis [29]. Uptake of HIV testing among young people in Ghana also remains a concern [17], [30]. Understanding what shapes sexual risk among young adults who use substances is therefore important for STI prevention.

Prevention programs in sub-Saharan Africa have relied heavily on two cognitive models, the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). The HBM proposes that people take protective action when they believe they are susceptible to a health threat (perceived susceptibility), believe its consequences are serious (perceived severity), expect the action to be beneficial, see few barriers to it and feel confident that they can carry it out (self-efficacy) [31], [32]. A meta-analysis of longitudinal studies found that perceived benefits and barriers were the most consistent HBM predictors of behavior, while the predictive value of the other constructs varied with the behavior studied [33]. The TPB proposes that behavior follows from intentions, which depend on attitudes toward the behavior, subjective norms (perceived social expectations) and perceived behavioral control (the perceived ease or difficulty of performing the behavior) [32], [34]. TPB constructs predict condom use intentions and condom use [35], and African studies have linked attitudes, perceived behavioral control and social influence on condom use among adolescents [36], [37]. Both models assume that behavior results from a reasoned appraisal of risks, benefits and social expectations.

This assumption raises an important question for young people who use substances. If protective beliefs work as the models propose, young people who regard STIs as serious, feel in control of their sexual behavior or hold favorable attitudes toward condom use should be less likely to take sexual risks even when they drink or use drugs. In statistical terms, these beliefs should moderate, or buffer, the association between substance use and risky sexual behavior. Alcohol myopia theory offers a competing prediction. It proposes that intoxication narrows attention to the most immediate cues in a situation, such as sexual arousal or pressure from a partner, so that more distant considerations, such as the risk of infection, carry less weight [38]. On this account, beliefs held when sober would do little to weaken the association. Evidence on these competing predictions is scarce. A study of 480 Black South African men who have sex with men found that substance use was associated with unprotected anal intercourse only among men who intended to practice safer sex [39]. In other words, substance use appeared to undermine good intentions rather than being offset by them.

In Ghana, research on sexual health has focused mainly on young people's knowledge of STIs and HIV [40] and on how adolescent health policies are implemented [41]. Few studies have examined how risk perception relates to sexual behavior [42], and we found none that tested whether HBM or TPB constructs moderate the association between substance use and risky sexual behavior among young adults. This gap matters for prevention. If protective beliefs do not weaken the link between substance use and sexual risk, programs that rely mainly on raising awareness of STI risk are unlikely to protect young people who drink or use drugs.

This study therefore aimed to (1) estimate the prevalence of substance use, risky sexual behavior and self-reported STI symptoms among young people aged 18 to 35 years in Ablekuma North Municipality, Accra (Ghana); (2) examine the associations between substance use, risky sexual behavior and self-reported STI symptoms; (3) assess whether HBM and TPB constructs predict risky sexual behavior beyond demographic characteristics; and (4) test whether these constructs moderate the association between substance use and risky sexual behavior.

Methods

Study design, setting and participants

A cross-sectional survey was conducted in Ablekuma North Municipality, a highly urbanized area of Greater Accra with a population of 159,208 and 14 electoral areas [43]. Eligible participants were aged 18 to 35 years and had lived in the municipality for at least six months. Sampling was stratified by electoral area. Because no sampling frame of young residents was available, trained research assistants recruited participants at community venues within each electoral area (community centers, churches, mosques, markets, football fields, recreational centers and drinking spots), guided by quotas for sex, religion and education. The minimum sample size, calculated with the Yamane formula [44] at a 5% margin of error, was 400, increased to 440 for non-response. In total, 383 participants completed the survey (response rate 87%). Participants gave informed consent and completed a self-administered questionnaire on Google Forms, accessed with a unique code. The questionnaire was pretested with 25 young people in the neighboring Ablekuma West Municipality.

Measures

Substance use. Six items developed for the study asked how often participants had used alcohol, cigarettes, marijuana, tramadol without a prescription, shisha (flavored tobacco smoked through a waterpipe) [45] and aphrodisiacs in the past six months, each scored from 0 (never) to 4 (daily or almost daily). Scores were summed (possible range 0 to 24; $\alpha = 0.927$).

Risky sexual behavior. Eight items adapted from the Sexual Risk Survey [13] measured, for the past six months, unplanned sex, regretted sex, number of partners, sex without a condom, sex without pregnancy protection, sex with non-romantic partners, alcohol or drug use before or during sex and transactional sex. Each item was scored from 0 to 4 (possible range 0 to 32; $\alpha = 0.929$).

Self-reported STI symptoms and HIV status. Participants reported whether they had experienced symptoms consistent with gonorrhea, syphilis, chlamydia, genital herpes or HIV in the past six months, whether they had tested for HIV and their HIV status as known to them. These outcomes were not clinically confirmed.

HBM and TPB constructs. An adapted version of the Sexual Risk Behavior Beliefs and Self-Efficacy scales [46], with eight added HBM items, measured perceived susceptibility (Cronbach α = .678), perceived severity (Cronbach α = .876), attitudes toward sex (776), subjective norms (Cronbach α = .831), self-efficacy (Cronbach α = .824) and perceived behavioral control (Cronbach α = .899). The full scale had acceptable internal consistency (α = 0.729).

Statistical analysis

Analyses were conducted in SPSS version 26. For bivariate analyses, substance use was coded as any use versus none and each sexual behavior as any occurrence versus none (multiple partners as two or more). Associations were tested with chi-square tests, and unadjusted ORs with 95% confidence intervals (CIs) were calculated. A hierarchical regression entered sex, age group, education, employment and religion (Model 1) and then the substance use score (Model 2). A second hierarchical regression entered education and employment (Model 1) and then the six HBM and TPB constructs (Model 2). Moderation was tested with the PROCESS macro (Model 1) [47] in six separate models, with substance use as the predictor, risky sexual behavior as the outcome and each construct as the moderator, using mean-centered variables. Statistical significance was set at $p < 0.05$.

Ethical considerations

Ethical approval

was obtained from the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB CPN 067/24–25).

Results

Participants, substance use, sexual behavior and STI symptoms

Of the 383 participants, 50.1% were male, 53.8% were aged 18 to 24 years, 61.6% had tertiary education and 42.0% were unemployed (Table 1). Alcohol was the most used substance (51.7%), followed by aphrodisiacs (26.4%), shisha (19.6%), cigarettes (15.9%), marijuana (14.6%) and non-medical tramadol (14.6%) (Fig. 1). Substances were often used together: among cigarette smokers, 86.7% also used marijuana and 95.0% also smoked shisha.

In total, 228 participants (59.5%) reported at least one sexual partner in the past six months and 113 (29.5%) reported two or more. As a share of the full sample, 50.9% reported unprotected sex, 47.5% unplanned sex, 42.8% regretted sex, 35.2% sex with a non-romantic partner, 25.6% alcohol or drug use before or during sex and 19.6% transactional sex. Only 25.6% had tested for HIV in the past six months. Of 379 participants who answered the HIV status question, 59.4% did not know their status and 15.6%

reported a positive status. Symptoms consistent with gonorrhea were reported by 18.8%, chlamydia by 14.4%, syphilis by 10.7% and genital herpes by 9.9%. Only 21.7% had sought treatment and 13.1% had informed a partner.

Table 1
Characteristics of participants (N = 383)

Variable	Category	n	%
Sex	Male	192	50.1
	Female	185	48.3
	Other	6	1.6
Age group (years)	18 to 24	206	53.8
	25 to 29	124	32.4
	30 to 35	53	13.8
Education	No formal education	4	1.0
	Primary	1	0.3
	Junior high school	4	1.0
	Senior high school	138	36.0
	Tertiary	236	61.6
Employment status	Employed full-time	99	25.8
	Employed part-time	54	14.1
	Self-employed	69	18.0
	Unemployed	161	42.0
Religious affiliation	Christianity	314	82.0
	Islam	54	14.1
	Traditional beliefs	2	0.5
	No religion	9	2.3
	Other	4	1.0

Substance use and risky sexual behavior

Demographic characteristics explained 16.5% of the variance in risky sexual behavior. Adding substance use raised this to 57.4% ($\Delta R^2 = 0.409$), and substance use was the strongest predictor ($\beta = 0.727$, $p < 0.001$) (Table 2). Each substance was associated with every risky sexual behavior (all $p < 0.001$; Table 3).

ORs ranged from 4.03 to 13.30 for alcohol and were larger, with wide CIs, for cigarettes and tramadol, reflecting small groups in which almost all users reported each behavior (for example, 59 of 60 smokers reported unprotected sex).

Table 2
Hierarchical multiple regression of risky sexual behavior on substance use (N = 383)

Predictor	B	SE	β	t	p
Model 1: demographic characteristics					
Sex	0.008	0.789	0.000	0.010	0.992
Age group	4.337	0.626	0.354	6.932	< 0.001
Education	-3.068	0.652	-0.222	-4.705	< 0.001
Employment status	1.483	0.361	0.209	4.109	< 0.001
Religious affiliation	0.058	0.605	0.005	0.097	0.923
Model 2: Model 1 plus substance use					
Sex	-0.064	0.564	-0.004	-0.114	0.909
Age group	1.764	0.467	0.144	3.775	< 0.001
Education	0.276	0.498	0.020	0.554	0.580
Employment status	0.011	0.269	0.002	0.042	0.966
Religious affiliation	-0.554	0.434	-0.043	-1.276	0.203
Substance use score	1.311	0.069	0.727	19.011	< 0.001

Model 1: $R^2 = 0.165$, adjusted $R^2 = 0.154$, $F(5, 377) = 14.88$, $p < 0.001$. Model 2: $R^2 = 0.574$, adjusted $R^2 = 0.567$, $F(6, 376) = 84.49$, $p < 0.001$; $\Delta R^2 = 0.409$. Tolerance > 0.7 and VIF ≤ 1.29 for all predictors. B, unstandardized coefficient; SE, standard error; β, standardized coefficient; VIF, variance inflation factor.

Table 3
Bivariate associations between use of specific substances and risky sexual behaviors (N = 383)

Risky sexual behavior	Users engaged, n (%)	Non-users engaged, n (%)	OR (95% CI)	χ^2 (1)
Alcohol (users n = 198; non-users n = 185)				
Unplanned sex	126 (63.6)	56 (30.3)	4.03 (2.61 to 6.23)	42.70
Regretted sex	120 (60.6)	44 (23.8)	4.93 (3.17 to 7.67)	52.96
Multiple sexual partners	99 (50.0)	14 (7.6)	12.21 (6.62 to 22.52)	82.79
Unprotected sex	139 (70.2)	56 (30.3)	5.43 (3.51 to 8.40)	61.02
Sex without pregnancy protection	129 (65.2)	44 (23.8)	5.99 (3.83 to 9.37)	66.08
Sex with non-romantic partners	110 (55.6)	25 (13.5)	8.00 (4.82 to 13.27)	74.07
Transactional sex	68 (34.3)	7 (3.8)	13.30 (5.92 to 29.91)	56.72
Cigarettes (users n = 60; non-users n = 323)				
Unplanned sex	54 (90.0)	128 (39.6)	13.71 (5.73 to 32.81)	51.48
Regretted sex	56 (93.3)	108 (33.4)	27.87 (9.85 to 78.88)	74.14
Multiple sexual partners	55 (91.7)	58 (18.0)	50.26 (19.27 to 131.07)	132.18
Unprotected sex	59 (98.3)	136 (42.1)	81.13 (11.10 to 592.77)	64.01
Sex without pregnancy protection	56 (93.3)	117 (36.2)	24.65 (8.72 to 69.70)	66.64
Sex with non-romantic partners	57 (95.0)	78 (24.1)	59.68 (18.18 to 195.90)	111.29
Transactional sex	52 (86.7)	23 (7.1)	84.78 (36.00 to 199.69)	203.32
Non-medical tramadol (users n = 54; non-users n = 329)				
Unplanned sex	46 (85.2)	136 (41.3)	8.16 (3.73 to 17.84)	35.76

Risky sexual behavior	Users engaged, n (%)	Non-users engaged, n (%)	OR (95% CI)	χ^2 (1)
Alcohol (users n = 198; non-users n = 185)				
Regretted sex	48 (88.9)	116 (35.3)	14.69 (6.10 to 35.36)	54.49
Multiple sexual partners	46 (85.2)	67 (20.4)	22.49 (10.13 to 49.91)	93.71
Unprotected sex	48 (88.9)	147 (44.7)	9.91 (4.12 to 23.79)	36.27
Sex without pregnancy protection	48 (88.9)	125 (38.0)	13.06 (5.43 to 31.40)	48.51
Sex with non-romantic partners	51 (94.4)	84 (25.5)	49.58 (15.08 to 163.06)	96.52
Transactional sex	42 (77.8)	33 (10.0)	31.39 (15.05 to 65.51)	135.20

All associations p < 0.001 (Pearson chi-square test). Percentages are within users or non-users of each substance. Group sizes are those in the cross-tabulations. OR, unadjusted odds ratio; CI, confidence interval. Users are participants reporting any use in the past six months; behaviors are any occurrence in the past six months (multiple partners: two or more).

Risky sexual behavior and self-reported STI symptoms

Each risky sexual behavior was associated with every self-reported STI outcome (all p < 0.001; Table 4). For example, 55.8% of participants with two or more partners reported symptoms consistent with gonorrhea, compared with 3.3% of other participants (OR 36.54), and 44.6% of those reporting transactional sex reported an HIV-positive status, compared with 8.5% of others (OR 8.64).

Table 4
Bivariate associations between risky sexual behaviors and self-reported STI outcomes (N = 383)

Self-reported outcome	Engaged, n/N (%)	Did not engage, n/N (%)	OR (95% CI)	χ^2
Two or more sexual partners (yes n = 113; no n = 270)				
HIV positive (self-reported)	40/112 (35.7)	19/267 (7.1)	7.25 (3.96 to 13.29)	50.63
Gonorrhea symptoms	63/113 (55.8)	9/270 (3.3)	36.54 (17.07 to 78.22)	143.39
Syphilis symptoms	39/113 (34.5)	2/270 (0.7)	70.62 (16.66 to 299.31)	95.05
Chlamydia symptoms	44/113 (38.9)	11/270 (4.1)	15.01 (7.37 to 30.60)	78.73
Genital herpes symptoms	31/113 (27.4)	7/270 (2.6)	14.20 (6.03 to 33.46)	55.00
Unprotected sex (yes n = 195; no n = 188)				
HIV positive (self-reported)	44/194 (22.7)	15/185 (8.1)	3.32 (1.78 to 6.22)	19.60
Gonorrhea symptoms	68/195 (34.9)	4/188 (2.1)	24.63 (8.76 to 69.23)	67.23
Syphilis symptoms	40/195 (20.5)	1/188 (0.5)	48.26 (6.56 to 355.06)	39.98
Chlamydia symptoms	51/195 (26.2)	4/188 (2.1)	16.29 (5.75 to 46.13)	44.93
Genital herpes symptoms	37/195 (19.0)	1/188 (0.5)	43.79 (5.94 to 322.79)	36.43
Alcohol or drug use before or during sex (yes n = 98; no n = 285)				
HIV positive (self-reported)	39/97 (40.2)	20/282 (7.1)	8.81 (4.79 to 16.20)	61.34
Gonorrhea symptoms	62/98 (63.3)	10/285 (3.5)	47.36 (22.31 to 100.55)	170.59
Syphilis symptoms	38/98 (38.8)	3/285 (1.1)	59.53 (17.79 to 199.25)	108.56
Chlamydia symptoms	43/98 (43.9)	12/285 (4.2)	17.79 (8.81 to 35.90)	93.30
Genital herpes symptoms	34/98 (34.7)	4/285 (1.4)	37.32 (12.79 to 108.91)	90.43
Transactional sex (yes n = 75; no n = 308)				

Self-reported outcome	Engaged, n/N (%)	Did not engage, n/N (%)	OR (95% CI)	χ^2
Two or more sexual partners (yes n = 113; no n = 270)				
HIV positive (self-reported)	33/74 (44.6)	26/305 (8.5)	8.64 (4.69 to 15.89)	59.71
Gonorrhea symptoms	51/75 (68.0)	21/308 (6.8)	29.04 (15.05 to 56.02)	147.90
Syphilis symptoms	34/75 (45.3)	7/308 (2.3)	35.66 (14.84 to 85.67)	116.99
Chlamydia symptoms	38/75 (50.7)	17/308 (5.5)	17.58 (9.03 to 34.23)	99.96
Genital herpes symptoms	28/75 (37.3)	10/308 (3.2)	17.75 (8.10 to 38.92)	78.41

All associations $p < 0.001$ (chi-square test). STI outcomes are self-reported symptoms in the past six months and are not laboratory confirmed. HIV status was self-reported and unverified, with four missing responses (n = 379); the OR compares positive with negative or unknown status. χ^2 has 1 degree of freedom except. ORs and CIs were calculated from the cell counts shown. OR unadjusted odds ratio; CI, confidence interval.

HBM and TPB constructs and moderation

Education and employment explained 5.7% of the variance in risky sexual behavior. Adding the six constructs raised this to 27.3% ($\Delta R^2 = 0.216$, $p < 0.001$) (Table 5). Perceived susceptibility ($\beta = 0.124$), attitudes toward sex ($\beta = 0.156$) and subjective norms ($\beta = 0.151$) were positively associated with risky sexual behavior, whereas perceived severity ($\beta = -0.188$) and perceived behavioral control ($\beta = -0.215$) were negatively associated with it. Self-efficacy was not significant ($\beta = -0.042$, $p = 0.363$). In the moderation models, substance use predicted risky sexual behavior in every model (B = 0.987 to 1.539, $p < 0.001$), but none of the six interaction terms was significant ($p = 0.208$ to 0.802) (Table 6).

Table 5
Hierarchical multiple regression of risky sexual behavior on HBM and TPB constructs (N = 383)

Predictor	B	SE	β	t	p	95% CI for B
Model 1: socioeconomic controls						
Education	-3.097	0.688	-0.224	-4.503	< 0.001	-4.45 to -1.75
Employment status	0.537	0.354	0.076	1.518	0.130	-0.16 to 1.23
Model 2: Model 1 plus HBM and TPB constructs						
Education	-0.656	0.669	-0.048	-0.980	0.328	-1.97 to 0.66
Employment status	0.367	0.319	0.052	1.151	0.250	-0.26 to 1.00
Perceived susceptibility	0.363	0.151	0.124	2.405	0.017	0.07 to 0.66
Perceived severity	-0.461	0.144	-0.188	-3.199	0.001	-0.74 to -0.18
Attitudes toward sex	0.335	0.133	0.156	2.524	0.012	0.07 to 0.60
Subjective norms	0.317	0.119	0.151	2.674	0.008	0.08 to 0.55
Perceived behavioral control	-0.342	0.090	-0.215	-3.809	< 0.001	-0.52 to -0.16
Self-efficacy	-0.187	0.205	-0.042	-0.911	0.363	-0.59 to 0.22

Model 1: $R^2 = 0.057$, adjusted $R^2 = 0.052$, $F(2, 380) = 11.51$, $p < 0.001$. Model 2: $R^2 = 0.273$, adjusted $R^2 = 0.257$, $F(8, 374) = 17.54$, $p < 0.001$; $\Delta R^2 = 0.216$. HBM, Health Belief Model; TPB, Theory of Planned Behavior; B, unstandardized coefficient; SE, standard error; β, standardized coefficient; CI, confidence interval.

Table 6
Moderation of the association between substance use and risky sexual behavior by HBM and TPB constructs (PROCESS Model 1)

Moderator (W)	Term	B	SE	t	p	95% CI
Perceived susceptibility	Substance use (X)	1.539	0.179	8.620	< 0.001	1.188 to 1.890
	Moderator (W)	0.149	0.119	1.253	0.211	-0.085 to 0.384
	X × W	-0.021	0.019	-1.121	0.263	-0.057 to 0.016
Perceived severity	Substance use (X)	1.409	0.190	7.422	< 0.001	1.035 to 1.782
	Moderator (W)	0.066	0.117	0.568	0.570	-0.164 to 0.296
	X × W	-0.005	0.017	-0.282	0.778	-0.039 to 0.029
Attitudes toward sex	Substance use (X)	1.035	0.232	4.461	< 0.001	0.579 to 1.491
	Moderator (W)	0.130	0.097	1.332	0.184	-0.062 to 0.321
	X × W	0.017	0.016	1.070	0.286	-0.014 to 0.048
Subjective norms	Substance use (X)	0.987	0.235	4.207	< 0.001	0.526 to 1.448
	Moderator (W)	0.202	0.087	2.315	0.021	0.031 to 0.374
	X × W	0.020	0.016	1.262	0.208	-0.011 to 0.050
Perceived behavioral control	Substance use (X)	1.243	0.177	7.039	< 0.001	0.896 to 1.590
	Moderator (W)	-0.114	0.074	-1.547	0.123	-0.259 to 0.031
	X × W	0.003	0.011	0.251	0.802	-0.018 to 0.023
Self-efficacy	Substance use (X)	1.250	0.173	7.238	< 0.001	0.910 to 1.589
	Moderator (W)	-0.346	0.177	-1.956	0.051	-0.693 to 0.002

Moderator (W)	Term	B	SE	t	p	95% CI
	X × W	0.016	0.033	0.483	0.630	-0.050 to 0.082

Each moderator was tested in a separate model with the substance use score as X and the risky sexual behavior score as Y. Continuous variables were mean-centered. No interaction term was statistically significant. B, unstandardized coefficient; SE, standard error; CI, confidence interval.

Discussion

This study set out to answer a question that earlier Ghanaian research had left open: whether the beliefs emphasized in sexual health education protect young people who use substances. Substance use was common and strongly associated with risky sexual behavior, risky sexual behavior was associated with self-reported STI symptoms, and HBM and TPB constructs predicted sexual risk. However, none of these constructs changed the strength of the substance use-sexual risk association. The findings therefore separate two questions that are often treated as one, namely whether beliefs predict risk and whether beliefs protect against the risk that accompanies substance use.

Substance use and sexual risk

The association between substance use and risky sexual behavior agrees with Ghanaian studies of in-school youth [23], street-connected youth [24] and fishers [25], with meta-analyses of adolescents and young adults [18], [19] and with event-level survey data from sub-Saharan Africa [22]. This consistency across age groups, occupations and study designs suggests a robust pathway, and the present study extends it to urban young adults aged 18 to 35 years, a group largely missing from Ghanaian evidence. The strength of the association, however, departs from earlier work. Substance use explained 40.9% of additional variance, and alcohol users had 12 times the odds of having multiple partners, far above the modest effects pooled in meta-analyses [19]. Three features of the present study probably explain this difference. First, recruitment at venues that included drinking spots is likely to have concentrated participants at the high end of both behaviors, whereas the studies in the meta-analyses mostly used school or household samples. Second, the composite outcome included one item on alcohol or drug use before or during sex, which overlaps with the predictor. Third, substances were used in clusters. Most cigarette smokers also used marijuana and shisha, so the very large ORs for cigarettes and tramadol probably mark a small, high-risk group with multiple risk behaviors rather than an effect of any one substance. Drug administration studies support a causal role for alcohol in sexual risk-taking but show less consistent effects for other drugs [20], which supports reading the substance-specific ORs here as markers of risk rather than as estimates of effect.

Sexual risk and STI symptoms

The association between risky sexual behavior and STI symptoms is consistent with evidence from Ghanaian facility and survey data [28], [29]. The prevalence estimates are less consistent. Symptoms consistent with gonorrhea were reported by 18.8% of participants, which is higher than the laboratory-confirmed rates among patients attending health facilities in southern Ghana [29], and 15.6% reported an HIV-positive status, compared with a national estimate of about 334,000 people living with HIV, roughly 1% of the population [48], [49]. The difference is best explained by measurement. Symptom checklists capture discharge or pain that may arise from several infections or from non-infectious causes, and self-reported HIV status may reflect misunderstanding of the question. At the same time, only a quarter of participants had tested for HIV, so undiagnosed infections may also be missed. The associations are therefore informative, but the prevalence figures should not be read as estimates of infection.

HBM and TPB constructs as predictors

Perceived severity, perceived behavioral control, attitudes and subjective norms were associated with risky sexual behavior in the directions predicted by the HBM and TPB [31], [34]. This agrees with meta-analytic evidence that TPB constructs predict condom use [35] and with African studies linking perceived control, attitudes and social influence to condom use among adolescents [36], [37]. The association with subjective norms also agrees with a systematic review showing that peers shape the sexual behavior of young people in sub-Saharan Africa [14]. Two findings contradict theoretical expectations. Perceived susceptibility was positively rather than negatively associated with risk. The HBM treats susceptibility as a motivator of protection, but in a cross-sectional survey it is measured after the behavior has occurred, so young people who engage in risky sex may simply recognize that they are at risk. Afriyie and Essilfie reported the same pattern among Ghanaian adolescents, in whom perceived HIV risk was concentrated among those who already had multiple partners [42]. Self-efficacy was not significant, which contrasts with its central place in both models but agrees with evidence that self-efficacy explains only a modest share of condom use in sub-Saharan Africa [36] and that adolescents in northern Uganda often could not act on high self-efficacy when facing partner or peer pressure [50]. Together, these contradictions suggest that, when measured cross-sectionally, risk perceptions describe past exposure more than they predict protection, and that confidence in one's ability to act is constrained by relationships and context.

Why the constructs did not moderate the association

The central contribution of this study is the null moderation result. The constructs added 21.6% of explained variance, so they were relevant to sexual risk, yet the association between substance use and sexual risk was equally strong at every level of each construct. This pattern agrees with alcohol myopia theory, which predicts that intoxication shifts attention to immediate cues and reduces the influence of beliefs held in advance [38], and with self-control accounts of drug use during sex [51]. It also agrees, in part, with the only comparable study we identified. Among Black South African men who have sex with men, safer sex intentions did moderate the association, but in the opposite direction to buffering: substance use was linked to unprotected sex only among men with strong intentions [39]. In both studies, favorable cognitions failed to protect substance users. The difference, moderation in one study and none in the other, may reflect the populations and the measures, since the South African study

assessed intentions and anal sex in a key population, whereas the present study assessed general beliefs and a broad behavior score in a community sample.

Methodological explanations must also be considered. Interaction effects are typically small, and tests of interaction have low statistical power when predictors are skewed or measured with error [52]. The substance use score was strongly skewed (mean 3.01 on a possible range of 0 to 24), and only the overall reliability of the belief scale was available (α = 0.729). In addition, global six-month measures cannot show whether beliefs were set aside on the occasions when participants were intoxicated. Event-level designs, which link substance use and sex on the same occasion [22], are needed to test the alcohol myopia interpretation directly. With these caveats, the findings address the gap identified in the Ghanaian literature [40], [42]: favorable beliefs about STI risk and condom use were associated with less risky sex overall, but they did not weaken the link between substance use and sexual risk. This suggests that awareness-based programs are unlikely, on their own, to protect young people who drink or use drugs.

Implications

Programs for young people in urban Ghana should address substance use and sexual health together, target peer norms and the settings in which drinking and sex co-occur, such as drinking spots, and expand access to HIV and STI testing and treatment.

Strengths and limitations

To our knowledge, this is the first Ghanaian study to test HBM and TPB constructs as moderators of the substance use-sexual risk association, and it drew participants from all 14 electoral areas of the municipality. The main limitations are venue-based rather than random sampling, which may have overrepresented substance users; reliance on self-report, which is vulnerable to recall and social desirability bias [53]; STI outcomes based on non-specific symptoms and unverified HIV status; and a cross-sectional design that does not establish the direction of effects. The risky sexual behavior score included an item on substance use during sex, which may have inflated the main association, and the bivariate ORs are unadjusted and imprecise.

Conclusions

Substance use, risky sexual behavior and self-reported STI symptoms were common among young people in Ablekuma North Municipality. HBM and TPB constructs predicted risky sexual behavior but did not weaken its association with substance use. Risk awareness alone may therefore not protect young people who use substances, and integrated programs that address substance use, sexual health, peer norms and access to testing deserve evaluation.

Abbreviations

CI

confidence interval
HBM
Health Belief Model
OR
odds ratio
STI
sexually transmitted infection
TPB
Theory of Planned Behavior.

Declarations

Ethics approval and consent to participate

The study was approved by the Noguchi Memorial Institute for Medical Research Institutional Review Board (NMIMR-IRB CPN 067/24-25) and was conducted in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants before data collection.

Consent for publication

Not applicable.

Availability of data and materials

The dataset analyzed during the current study is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

RO-M conceived and designed the study, collected and analyzed the data, and drafted the manuscript. FHB supervised the study, contributed to the study design and the interpretation of the findings, and critically revised the manuscript. Both authors read and approved the final manuscript.

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Figures

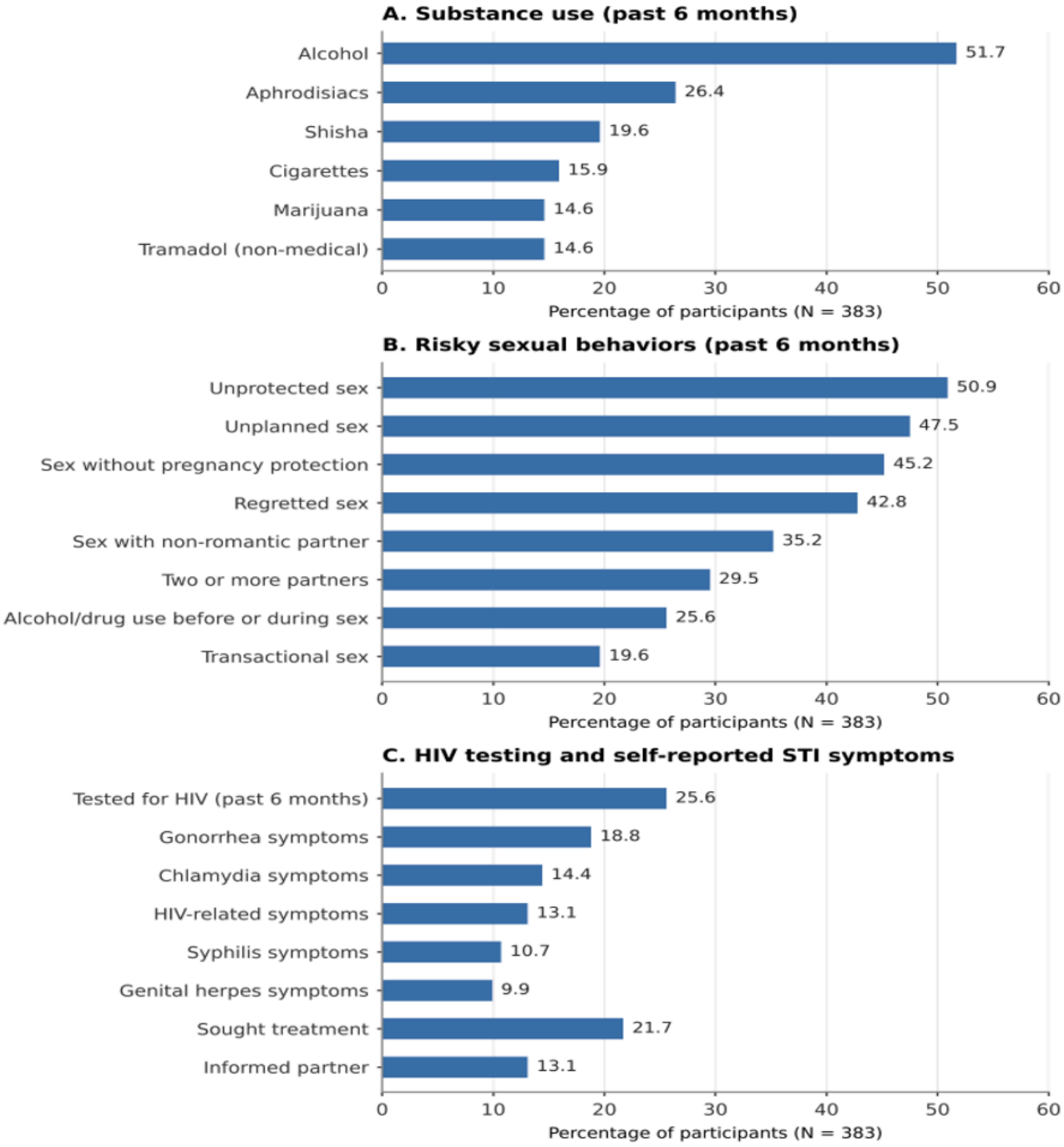


Figure 1

Prevalence of (A) substance use, (B) risky sexual behaviors and (C) HIV testing and self-reported STI symptoms in the past six months (N = 383).