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Effect of COVID-19 pandemic on smoking, alcohol consumption, and substance use in persons aged 15 years and older in Uganda

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In Uganda, the effect of the COVID-19 pandemic on substance and drug use at the national level has not been studied. Our study evaluated the effect of the COVID-19 pandemic on the frequency of smoking, alcohol consumption, and substance use among Ugandans aged ≥ 15 years based on a large, nationally representative survey. This quasi-experimental study used the Uganda National Household Survey data collected between June 2019 and November 2020, with the COVID-19 pandemic as the primary exposure and outcomes as smoking, alcohol consumption, and substance use frequency before and during the COVID-19 pandemic, measured on an ordered scale (none, less than daily, and daily). We used propensity score weighting to balance the exposed and unexposed groups, and analyzed the effect of COVID-19 on the outcomes using ordered logistic regression, adjusting for the propensity score weights. Sub-group analysis was conducted based on sex, residence, and age groups. We analyzed data on 34,312 participants (18,270 exposed vs. 16,042 unexposed) aged ≥ 15 years, with 53.8% male and 54.3% aged 25–59 years. Frequency of smoking (weighted proportional odds ratio [pOR] 0.13, 95% confidence interval [CI] 0.07–0.25), alcohol consumption (weighted pOR 0.36, 95% CI 0.26–0.48), and substance use (weighted pOR 0.04, 95% CI 0.01–0.29) were significantly lower during the COVID-19 pandemic compared to the pre-pandemic levels. In sex-stratified analysis, smoking, alcohol consumption, and substance use were lower during the COVID-19 pandemic compared to the pre-pandemic period. In rural areas, substance use was higher, but smoking and alcohol consumption were lower. In urban settings, the reductions in smoking, alcohol consumption, and substance use remained consistent with the pre-pandemic levels. In Uganda, the frequency of smoking, alcohol consumption, and substance use during the COVID-19 pandemic was lower compared to the pre-pandemic levels. Future studies should examine if the reductions were sustained after the pandemic and whether modified restrictions can reduce alcohol consumption.

Keywords Alcohol consumption, COVID-19, Impact, Smoking, Substance use, Uganda

Globally, a lockdown was used as a tool in many countries to control the spread of coronavirus disease 2019 or COVID-19[1,2]. Uganda instituted a national COVID-19 lockdown on March 18, 2020, which was 3 days before the first case was identified on March 22, 2019[3,4], and the lockdown stretched until June 4, 2020. The lockdown measures included suspension of the public transport system, enforcement of curfews from 7 pm to 6 am, restriction of private vehicle carrying capacity to two people, and closure of places of recreation like bars, discotheques, markets, places of worship namely churches and mosques, and schools among others.

Existing data suggest that the imposition of the COVID-19 lockdown influenced people's social lifestyles, but the evidence is conflicting. For example, an online cross-sectional study in West Africa conducted between August and September 2020 to determine the impact of the COVID-19 pandemic on alcohol use, access, treatment, and harm prevention showed that alcohol consumption was lower during the COVID-19 pandemic compared to the pre-pandemic period[5]. Another study conducted to explore the impact of the COVID-19

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pandemic on women's alcohol use in Central Uganda similarly found a reduction in alcohol use during the COVID-19 pandemic lockdown compared to the 6 months preceding the lockdown[6]. However, one study among adolescents found that substance use disorder during the COVID-19 pandemic increased although the increase was not significantly different from the pre-pandemic period[7]. Yet in one study, the proportion of older persons who consumed alcohol and smoked cigarettes during the COVID-19 pandemic was higher than the proportion in the pre-pandemic period[8].

Studies in Uganda[9,10] and elsewhere[11–13] have also shown differing effects of the COVID-19 pandemic on alcohol and substance use. However, most of the existing data are from studies with relatively smaller sample sizes, and at the country level, data have been mostly regional hence geographic variation in the data might not present a nationally representative picture. Therefore, the effect of the COVID-19 pandemic on substance and drug use at the national level has not been adequately studied. In addition, some of the studies are qualitative, making it difficult to quantify the effect of the COVID-19 pandemic on alcohol, smoking, and substance use. To fill these gaps, we evaluated the effect of the COVID-19 pandemic on the frequency of smoking, alcohol consumption, and substance use among Ugandans aged ≥ 15 years using data from a nationally representative survey.

Methods and materials
Data source
The data analyzed are from the Uganda National Household Survey (UNHS) of 2019/2020 which collected socio-economic and behavioral data on various indicators to inform and monitor development policies of national and international frameworks[14]. The UNHS is conducted every 5 years and the 2019/2020 UNHS is the seventh in the series since its inception in 199/2000. Household demographic, social, and economic data were collected from a nationally representative sample from urban and rural areas for 15 geographical regions—14,480 households from 1448 sample clusters. The UNHS used the same sampling frame as that of the Uganda Population and Housing Census conducted in August 2014. The sampling frame was a complete list of enumeration areas created for a national census, comprising 78,692 enumeration areas but it excluded refugees, forests and forest reserves, and institutions such as schools and universities. Each of the 129 districts at the time of the survey was subdivided into sub-counties, the sub-counties were subdivided into parishes, and the parishes were subdivided into villages and finally into enumeration areas. Each enumeration area had a designated residence type—urban or rural. The enumeration areas with less than 50 households were linked to other enumeration areas by a geographical information system so that the primary sampling units were not too small. Samples were selected independently from each stratum based on enumeration areas and socioeconomic status using a probability proportional to size approach.

The survey employed a two-stage stratified sampling design, with the first stage as the grouping of enumeration areas by districts of similar socio-economic characteristics as well as rural versus urban locations. In the second stage, households were sampled using a systematic random sampling approach. Overall, 1651 enumeration areas were selected from the 2014 National Population and Housing Census list to constitute the sampling frame, grouped into sub-regions considering standard errors required for the estimation of poverty indicators. The districts were stratified into 15 sub-regions based on similarity in socio-demographic characteristics. Some districts in Uganda are found in mountainous areas, making access difficult. Therefore, districts were divided into mountainous versus non-mountainous. Overall, 15,786 households were selected for the survey and 13,732 households were successfully interviewed, giving a 90% response rate (93% rural vs. 84% urban). Two rounds of random data collection were conducted, one before the COVID-19 pandemic and another during the pandemic, with response rates of 93% and 89%, respectively. Funding for the survey was provided by the Government of Uganda and the survey included 65,080 individuals.

Ethical considerations
The 2019/2020 Uganda National Household Survey (UNHS) dataset is publicly available at https://microdata .worldbank.org/index.php/catalog/3902[14]. The data are de-identified and therefore, according to the Uganda National research guidelines, no ethical approval was required. For this analysis, a request to conduct an analysis on the UNHS dataset was submitted to the Uganda Bureau of Statistics (UBOS), the agency in charge of the survey. UBOS provided a dataset containing variables necessary to complete the analysis. Therefore, all methods were carried out in accordance with relevant guidelines and regulations.

Study design and variable measurements
We designed a quasi-experimental study using nationally representative data, with the COVID-19 pandemic as the primary exposure. The exposed group included individuals who were surveyed during the COVID-19 pandemic, while the unexposed group included those surveyed before the pandemic. The exposed and unexposed groups were not comparable on several measured covariates due to the absence of randomization in exposure assignment, justifying a need for a quasi-experimental study[15]. To achieve comparability in measured covariates between the exposed and unexposed groups, we applied propensity-score weighting thus emulating a randomized controlled trial[16]. Propensity score weighting reduced the systematic differences in covariate distribution between the exposed and unexposed groups enabling an unbiased measure of effect between the primary exposure and the study outcomes[17]. The propensity score is the probability of being in the exposed group based on observed covariates; it ranges from 0–1[17].

The outcomes of interest included the frequency of smoking, alcohol consumption, and substance use. Each of these outcomes was measured on an ordinal scale. In the survey, individuals were asked to state the frequency of smoking tobacco product(s), consuming alcohol, or drug use, with the responses as none or not at all, less than daily, and daily. The tobacco products investigated in the survey included smoke such as cigarettes, cigars,

pipes full of tobacco, shisha, and others, and smokeless tobacco like snuff, chewed, Betel quid with tobacco, and others. The survey asked for substances namely opium, marijuana, and cannabis. For alcohol consumption, participants reported any form of alcohol consumed. The covariates included the individual's residence such as region, sub-region, and district, and whether the individual was from a mountainous region, and rural or urban setting.

Other covariates included the individual's sex, age, level of education, literacy levels, wealth quintile, labor (employment) status, marital status, and whether the individual was an internet or phone user. Age was initially measured in absolute years but later categorized as 15–24 years, 25–59 years, and ≥60 years to depict young, middle-aged, and older persons. The mobile phone technology considered was any portable telephone, both basic phones and smartphones, subscribing to a mobile telephone service provider and allowing financial transactions. This study hypothesized that mobile phone owners versus non-owners, and internet users versus non-users may differ systematically, introducing potential selection bias. The observed differences could correlate with the study outcomes, making the inclusion of mobile phone ownership and internet use as covariates important for improving the validity of the effect estimates.

Statistical analysis

The analysis was performed in R (R version 4.2.1 2022-06-23 ucrt). We performed exploratory data analysis where we summarized and presented categorical data using frequencies and percentages and numerical data using the mean and standard deviation if normally distributed otherwise the median and interquartile range were used. We cross-tabulated the covariates by the COVID-19 pandemic period (exposed vs. unexposed) and assessed differences in covariate distribution using tests of statistical significance at a 5% level. The chi-square test was used to assess differences in proportions between the categorical variables and COVID-19 exposure, while the Student's t-test was used to assess mean differences in numerical data between the exposed and unexposed groups.

We fitted a generalized boosted model (GBM) as a function of the exposure and the covariates adjusting for robust standard errors and used the generated coefficients to predict propensity scores. Compared to a binary logistic regression model, propensity scores generated from a GBM are more appropriate as the model automatically adds polynomials or interaction terms whenever needed compared to relying on a manual approach when using a logistic regression model. GBM uses decision trees to create a complex model by combining multiple simple models from iterative algorithms hence producing a better fit[18]. To achieve covariate comparability between the exposed and unexposed groups, we created a pseudo population by weighting the exposed group using the inverse of the propensity scores (1/propensity scores) and the unexposed group using the negative of the inverse of propensity scores (1/[1-propensity scores])[19].

We then assessed covariate balance (comparability) between the exposed and unexposed groups graphically using a back-back propensity-score mirror histogram, and statistically using the absolute standardized mean difference (SMD), with an SMD < 0.1 considered suggestive of balanced covariates[20]. After achieving covariate comparability between the two groups, we estimated the effect of the COVID-19 pandemic on the study outcomes using ordered logistic regression as the outcomes were ordinal, adjusting for the propensity score weights, reported as weighted proportional odds ratio (weighted pOR) with the 95% confidence interval (CI).

Additional analyses

We assessed whether the propensity score model (GBM) was correctly specified using a propensity score model specification test, with the null hypothesis being correct model specification. We assessed the robustness of the effect estimates by comparing them with the unadjusted and adjusted ordered logistic regression model results. We also performed a sub-group analysis to compare the outcomes during and before the COVID-19 pandemic separately for men, women, and rural and urban residents. All the results from the unadjusted and adjusted ordered logistic regression analyses were reported as supplementary using an unweighted proportional odds ratio (unweighted pOR). We tested the proportional odds assumption for ordered logistic regression using the Brant Test. The null hypothesis was that the parallel regression assumption holds and the alternative hypothesis was that it does not hold. Additionally, we conducted both non-causal and causal analyses to comprehensively examine the exposure-outcome relationship. The non-causal analysis described the raw association, while the causal analysis adjusted for confounding to provide more robust causal inferences. Comparing results from both approaches highlighted the impact of adjustments in the causal model and demonstrated its value in addressing confounding biases, ensuring consistent and reliable findings.

Reporting of findings

We followed the propensity score analysis guidelines[21] and the guidelines for Improving the Reporting Quality of Nonrandomized Evaluations of Behavioral and Public Health Interventions: The TREND statement[22] in reporting the findings.

Results

Characteristics of participants

Table 1 shows the distribution of participants. Overall, we analyzed data on 34,312 participants aged ≥15 years, with 16,042 unexposed to the COVID-19 pandemic and 18,270 exposed to the pandemic. The majority of the participants were from the Eastern region of Uganda (33.3%), female (53.8%), aged 25–59 years (54.3%), rural (74.6%), and with a primary level of education (38.8%). The overall mean age was 35.1 years (standard deviation, SD = 17.2), with the average age for the unexposed group being similar to that of the exposed group: 35.1 (SD = 17.4) vs. 35.2 (SD = 17.1), p = 0.650 respectively. We found systematic differences between the unexposed

Variables	Levels	All (n = 34,312) n (%)	COVID-19 unexposed (n = 16,042) n (%)	COVID-19 exposed (n = 18,270) n (%)	P-value
Region	Central	6687 (19.5)	2928 (18.3)	3759 (20.6)	< 0.001
	Eastern	11,430 (33.3)	5502 (34.3)	5928 (32.4)	
	Northern	7900 (23.0)	3724 (23.2)	4176 (22.9)	
	Western	8295 (24.2)	3888 (24.2)	4407 (24.1)	
Sex	Male	15,867 (46.2)	7463 (46.5)	8404 (46.0)	0.338
	Female	18,445 (53.8)	8579 (53.5)	9866 (54.0)	
Age group (years)	15–24	12,041 (35.1)	5674 (35.4)	6367 (34.8)	0.568
	25–59	18,618 (54.3)	8658 (54.0)	9960 (54.5)	
	60 and over	3653 (10.6)	1710 (10.7)	1943 (10.6)	
	mean (SD)	35.1 (17.2)	35.1 (17.4)	35.2 (17.1)	0.650
Residence	Rural	25,583 (74.6)	13,057 (81.4)	12,526 (68.6)	< 0.001
	Urban	8729 (25.4)	2985 (18.6)	5744 (31.4)	
Level of education	No formal education	5726 (16.7)	2887 (18.0)	2839 (15.5)	< 0.001
	Some primary	13,328 (38.8)	6380 (39.8)	6948 (38.0)	
	Completed Primary	4251 (12.4)	1895 (11.8)	2356 (12.9)	
	Some secondary	5986 (17.4)	2780 (17.3)	3206 (17.5)	
	Completed Secondary	2600 (7.6)	1117 (7.0)	1483 (8.1)	
	Post-secondary	2421 (7.1)	983 (6.1)	1438 (7.9)	
Literacy levels	Literate	24,619 (71.8)	11,302 (70.5)	13,317 (72.9)	< 0.001
	Illiterate	9655 (28.1)	4734 (29.5)	4921 (26.9)	
	Not stated	38 (0.1)	6 (0.0)	32 (0.2)	
Wealth quintile	Very poor/poor	29,538 (86.1)	13,820 (86.1)	15,718 (86.0)	0.501
	Neither poor nor rich	4374 (12.7)	2025 (12.6)	2349 (12.9)	
	Rich/Very rich	400 (1.2)	197 (1.2)	203 (1.1)	
Labor status	Employed	12,505 (36.4)	5990 (37.3)	6515 (35.7)	< 0.001
	Unemployed	1271 (3.7)	682 (4.3)	589 (3.2)	
	Outside the labor force	20,410 (59.5)	9314 (58.1)	11,096 (60.7)	
	Not reported	126 (0.4)	56 (0.3)	70 (0.4)	
Marital status	Never married	10,662 (31.1)	4996 (31.1)	5666 (31.0)	0.356
	Married	19,000 (55.4)	8922 (55.6)	10,078 (55.2)	
	Divorced/separated	2414 (7.0)	1117 (7.0)	1297 (7.1)	
	Widow/widower	2236 (6.5)	1007 (6.3)	1229 (6.7)	

Table 1. Characteristics of the participants.

and exposed groups concerning several covariates namely, the region, residence, level of education, literacy levels, and labor status (all p < 0.05).

Distribution of outcomes before and during the COVID-19 pandemic among adolescents and adults in Uganda

Table 2 summarizes the distribution of the study outcomes. The proportion of smoking less than daily was 1.4% before the COVID-19 pandemic compared to 1.2% during the pandemic, and that for daily smoking was 4.2% before the COVID-19 pandemic compared to 3.3% during the pandemic (p < 0.001). There were slightly more daily alcohol consumers before the COVID-19 pandemic compared to during the pandemic (14.9% vs. 14.5%), and more daily alcohol consumers before the pandemic (5.3%) compared to 4.3% during the pandemic (p < 0.001). The proportion of substance use, either less than daily or daily, was largely identical both before and during the COVID-19 pandemic (p = 0.524).

Covariate balance before and after propensity-score weighting

Table 3 shows the distribution of covariates before and after propensity score weighting for both the exposed and unexposed groups. Before propensity score weighting, there were slight differences in the distribution of covariates between the two groups, which resolved after the weighting as both groups became identical. The back-to-back histogram (Fig. 1) confirms the identical propensity score distribution between the two groups—confirming good covariate balance.

Effect of the COVID-19 pandemic on smoking, alcohol consumption, and substance use

Table 4 shows the results for the overall and sub-group analyses. The overall analysis showed a statistically significant decline in the frequency of smoking (weighted pOR 0.13, 95% CI 0.07–0.25), alcohol consumption

Variables	Levels	All (n = 34,312)	COVID-19 unexposed (n = 16,042)	COVID-19 exposed (n = 18,270)	
		n (%)	n (%)	n (%)	P-value
Smoking	None	32,601 (95.0)	15,150 (94.4)	17,451 (95.5)	< 0.001
	Less than daily	442 (1.3)	217 (1.4)	225 (1.2)	
	Daily	1269 (3.7)	675 (4.2)	594 (3.3)	
Alcohol consumption	None	27,622 (80.5)	12,803 (79.8)	14,819 (81.1)	< 0.001
	Less than daily	5046 (14.7)	2389 (14.9)	2657 (14.5)	
	Daily	1644 (4.8)	850 (5.3)	794 (4.3)	
Substance use	None	34,115 (99.4)	15,942 (99.4)	18,173 (99.5)	0.524
	Less than daily	121 (0.4)	61 (0.4)	60 (0.3)	
	Daily	76 (0.2)	39 (0.2)	37 (0.2)	

Table 2. Distribution of outcomes before and during the COVID-19 pandemic among adolescents and adults in Uganda.

	Covariate distribution before propensity-score weighting n = 34,312					Covariate distribution after propensity-score weighting n = 34,312				
	Exposed to COVID-19		Unexposed to COVID-19			Exposed to COVID-19		Unexposed to COVID-19		
Variables	Mean	SD	Mean	SD	SMD	Mean	SD	Mean	SD	SMD
District	66.40	37.60	67.51	36.58	− 0.030	67.27	37.79	67.21	36.78	0.002
Region	2.51	1.07	2.53	1.05	− 0.027	2.53	1.05	2.53	1.04	− 0.007
Sub-region	7.68	4.26	7.79	4.14	− 0.025	7.76	4.16	7.79	4.13	− 0.007
Mountainous area	1.90	0.30	1.89	0.31	0.021	1.90	0.31	1.90	0.31	− 0.001
Sex	1.54	0.50	1.53	0.50	0.010	1.54	0.50	1.54	0.50	0.000
Age group	1.76	0.63	1.75	0.63	0.008	1.76	0.63	1.76	0.63	− 0.003
Residence	0.31	0.46	0.19	0.39	0.300	0.20	0.40	0.20	0.40	0.002
Internet user	1.11	0.38	1.13	0.44	− 0.058	1.11	0.38	1.11	0.39	0.001
Phone user	1.48	0.51	1.45	0.50	0.065	1.45	0.50	1.45	0.50	− 0.001
Marital status	1.90	0.80	1.88	0.79	0.015	1.89	0.79	1.89	0.79	− 0.002
Literacy status	1.28	0.55	1.30	0.48	− 0.029	1.30	0.52	1.30	0.48	0.000
Labor status	2.28	1.04	2.23	1.04	0.044	2.27	1.00	2.26	1.03	0.005
Wealth quantile	1.15	0.39	1.15	0.39	0.000	1.15	0.38	1.15	0.39	− 0.001
Educational level	1.88	1.48	1.74	1.43	0.099	1.76	1.42	1.76	1.44	− 0.003

Table 3. Covariate balance before and after propensity-score weighting. *SD* standard deviation, *SMD* standardized mean difference; SMD < 0.1 means the covariate is balanced.

(weighted pOR 0.36, 95% CI 0.26–0.48), and substance use (weighted pOR 0.04, 95% CI 0.01–0.29) during the COVID-19 pandemic compared to the pre-pandemic levels.

Sub-group analysis shows variation in the distribution of significant and non-significant findings. In men as well as women, smoking, alcohol consumption, and substance use were lower during the COVID-19 pandemic compared to the pre-pandemic period. In rural areas, substance use was higher, but smoking and alcohol consumption were lower. In urban settings, there were no significant changes in smoking and alcohol consumption as the frequencies remained comparable to the pre-pandemic levels. However, substance use in the urban areas was significantly lower during the pandemic compared to the pre-pandemic period.

Findings of robustness checks and sensitivity analysis

Supplementary Table 1 shows the unweighted ordered logistic regression analysis results, both the unadjusted and adjusted results. For all ordered logistic regression analyses, the test statistic for the Brant Test was insignificant suggesting that the parallel regression assumption was not violated.

Discussion

We evaluated the effect of the COVID-19 pandemic on the frequency of smoking, alcohol consumption, and substance use among Ugandans aged ≥ 15 years using a nationally representative dataset. Our findings show that the frequency of smoking, alcohol consumption, and substance use lowered during the COVID-19 pandemic period compared to the pre-pandemic period. We observed reductions in smoking, alcohol consumption, and substance use in men as well as in women. Although there was a decline in rural areas, the frequency of smoking in urban areas during the COVID-19 pandemic was not different from the pre-pandemic period. We found
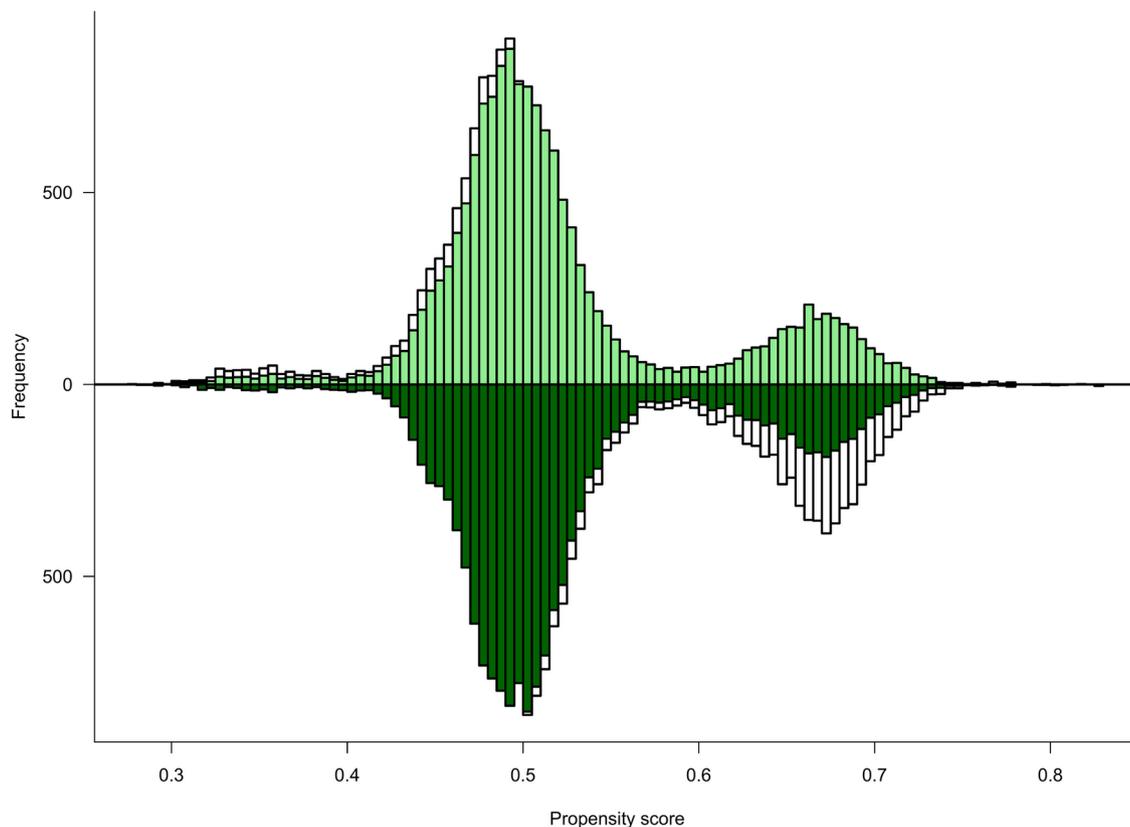
Fig. 1. Back-to-back propensity score histogram. The upper section of the histogram (light green) shows the distribution of propensity scores in the unexposed group while the lower section (dark green) depicts the propensity score in the exposed group after weighting. The white sections on both sides of the graph shows the distribution of propensity scores before weighting in the unexposed (upper section) and exposed (lower section) groups.

Variable	Level	Smoking Weighted pOR (95% CI)	Alcohol consumption Weighted pOR (95% CI)	Substance use Weighted pOR (95% CI)
Overall analysis				
	Before COVID-19	1	1	1
	During COVID-19	0.13*** (0.07–0.25)	0.36*** (0.26–0.48)	0.04** (0.01–0.29)
Sub-group analysis				
Sex	Male	0.17*** (0.08–0.35)	0.35*** (0.23–0.51)	0.03** (0.03–0.31)
	Female	0.07*** (0.18–0.25)	0.39*** (0.24–0.63)	0.15 (0.001–16.85
Residence	Rural	0.83** (0.75–0.93)	0.94 (0.88–1.00)	1.02 (0.75–1.38)
	Urban	0.90 (0.70–1.14)	0.97 (0.86–1.71)	0.49** (0.25–0.97)

Table 4. Weighted proportional odds ratios showing the effect of the COVID-19 pandemic on smoking, alcohol consumption, and substance use (n = 34,312). Weighted Proportional Odds ratios (pOR) are the exponentiated coefficients; 95% confidence intervals in brackets; All weighted pOR have been adjusted for propensity-score weights; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

that alcohol consumption levels did not differ between urban and rural settings before or during the pandemic. However, substance use decreased in urban areas during the pandemic compared to before, while it remained unchanged in rural areas.

The finding that the frequency of smoking[6], alcohol consumption[6,23], and substance use[24] was lower during the COVID-19 pandemic compared to the pre-pandemic period is consistent with the findings of previous studies in Uganda. Our finding may be explained by the lack of access to alcoholic beverages, cigarettes, and drugs during the COVID-19 pandemic as a result of the strict enforcement and implementation of the lockdown measures countrywide. Another plausible reason is a decline in income levels, including the loss of jobs during the COVID-19 pandemic period, therefore reducing disposable income to buy cigarettes, alcohol, and drugs.

One study conducted in a slum setting in Kampala, Uganda found that daily income and wages declined during the COVID-19 pandemic, including loss of employment[25]. The negative economic effects of the COVID-19 pandemic affected the majority of Ugandans which could have led to reducing the frequency of smoking, alcohol consumption, and substance use as reported in this study. Research conducted in the United Kingdom showed that the risk of COVID-19 infection is nearly four-fold higher among current smokers than ex-smokers[26]. Smoking has serious health consequences and one study reports that health risks resulting from tobacco use are one of the reasons for quitting smoking[27]. Therefore, the increased risk of COVID-19 among smokers might have contributed to the reduction in smoking frequency.

Our study has implications for the control of alcohol, smoking, and substance use initiatives in Uganda considering that the alcohol consumption levels in the country are higher than normal. Uganda's annual per capita alcohol consumption is currently 12.2 liters, making it one of the highest in Africa and exceeding the regional average of 6.3 liters[28].

In 2018, the World Health Organization (WHO) in collaboration with international partners started the SAFER initiative—a technical package with the potential to support governments in reducing harmful alcohol use and related health, social and economic consequences—that focuses on framing multi-stakeholder communications, advocacy campaigns, and inclusive monitoring systems[28]. The SAFER initiative focuses on the most cost-effective and urgent interventions like strengthening restrictions on alcohol availability, advancing and enforcing drunk-driving countermeasures, facilitating access to screening for alcohol, brief interventions, and treatment, enforcing bans or comprehensive restrictions on alcohol advertising, sponsorship, and promotion, and raising prices on alcohol through excise taxes and pricing policies[26]. Our study findings are attributable to the limited access to alcohol during the COVID-19 pandemic restrictions. The findings imply that testing similar restrictive measures such as restricted opening or early closure of bars might regulate alcohol consumption levels. The use of modified restrictions such as hours of sale that restrict access to alcohol may have the potential to reduce its use in Uganda and should therefore be investigated.

Strengths and limitations of the study

One strength of this study is the analysis of nationally representative data and the large sample size compared to previous studies. Therefore, the study provides large-scale evidence regarding the effect of the COVID-19 pandemic on smoking, alcohol consumption, and substance use nationally. We utilized a rigorous analytical approach to reduce systematic differences between the exposed and unexposed groups thereby improving the accuracy of the effect estimates. Important limitations included self-reported assessment of alcohol and substance use, potentially leading to social desirability bias and under-reporting[29]. There was also a lack of data on the sustained effect of the COVID-19 pandemic on the frequency of smoking, alcohol consumption, and substance use following the lifting of the lockdown. As data were ordered, we used the proportional odds model. Here, the relationship between the lowest measure (none) and the next highest measure (less than daily) was assumed to be the same as those between the next highest (less than daily) and the overall highest (daily) level.

Dichotomizing continuous data like age results in information loss and statistical inefficiency[30,31], potentially obscuring patterns in substance use behavior. Additionally, some categorical variables may have been measured inappropriately but could not be adjusted due to survey design constraints. For example, measuring substance use as "daily" or "less than daily" may oversimplify the behavior, as some participants may reduce daily consumption but still engage in occasional use, which this classification would not capture. Also, the survey captured behaviors only during specific periods (before and during the COVID-19 pandemic), missing long-term trends and external factors like public health interventions or economic influences. Therefore, longitudinal data are necessary to track individuals' behavior over time and more accurately assess the pandemic's causal impact. Lastly, there are unmeasured and unknown confounders although the findings remained robust in sensitivity analysis. These limitations should be considered in the interpretation of the findings.

Conclusions and recommendations

The frequency of smoking, alcohol consumption, and substance use in Uganda was lower during the COVID-19 pandemic period compared to the pre-pandemic levels. Our findings provide evidence for testing modified restrictions that mimic pandemic measures to reduce alcohol use in Uganda. Future studies should examine if the reductions in the frequency of smoking, alcohol consumption, and substance use during the pandemic period are sustained following the lifting of the lockdown.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author upon reasonable request.

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Author contributions

JI and SA conceptualized the study; JI, EMN, SA, and FB designed the study; JI and SA acquired the data; JI analyzed the data. JI, EMN, SA, and FB interpreted the findings; JI, EMN, SA, and FB drafted the initial and final manuscripts; JI, EMN, and FB performed critical revisions of the manuscript. All authors (JI, EMN, AS, and FB approved the final version of the manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

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