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Drug driving: a secondary analysis of factors associated with driving under the influence of cannabis in Jamaica

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ABSTRACT

Objectives To determine the prevalence of cannabis use patterns, the predictive sociodemographic correlates of driving under the influence of cannabis (DUIC) and the association between risk perception and cannabis dependence among vehicle drivers in Jamaica.
Design A secondary data analysis.
Setting This study utilized the Jamaica National Drug Prevalence Survey 2016 dataset.
Participants 1,060 vehicle drivers extracted from the population sample of 4,623. Respondents were randomly selected.
Primary and secondary outcome measures **A**nalysis utilized Pearson's Chi-Square test and logistic regression. Odds ratios and 95% confidence intervals were recorded. A p-value of <0.05 was considered statistically significant.
Results More than 10% of Jamaican drivers admitted to driving under the influence of cannabis in the past year. Approximately 43.3% of drivers who currently use cannabis reported driving under its influence (DUIC) only. Evidently, 86.8% of drivers who DUIC were heavy cannabis users. Approximately 30% of drivers with a high risk perception of smoking cannabis, whether sometimes or often were dependent on cannabis. Notwithstanding, drivers with a low risk perception of smoking cannabis sometimes or often, were more likely to be dependent, which was statistically significant ($p<0.001$ and $p<0.001$, respectively). Logistic regressions highlighted male drivers ($p=0.009$) that were 34 years and under ($p<0.001$) and were the head of the household ($p=0.031$) and operated a machine as part of their job ($p=0.023$) were 4.14, 2.97, 2.22 and 1.87 times more likely respectively, to drive under the influence of cannabis, whilst those who were married ($p=0.004$) and had achieved a tertiary level education ($p=0.031$) were 2.38 and 3.85 times less likely respectively.
Conclusions 2 in 5 drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate policymakers to consider mobile roadside drug testing and amending drug-driving laws to meet international standards.

(Word count 296)

Keywords: Drivers, Cannabis, Jamaica, Prevalence, Dependence, Risk Perception

Article Summary

Strengths and limitations of this study

- The use of the entire dataset population augmented the strength of the analysis.
- The use of logistic regression analysis allows for several sociodemographic factors to be simultaneously assessed to elicit appropriate risk and protective factors.
- The validated Cannabis Abuse Screening Test enhanced the reliability of the findings, given its frequent use in population sample studies.
- DUI information was self-reported, which can be affected by recall bias.
- This study could not establish causal relationships due to the nature of the cross-sectional data.

INTRODUCTION

The World Health Organization (WHO) highlights drug driving as a significant risk factor for road traffic accidents (1). Vehicular crash is among the top ten causes of demise across all age groups and the leading cause of death in young individuals under thirty (2). Accordingly, driving under the influence of drugs represents a massive public health concern for the global community (3–7). While driving under the influence has historically referred to alcohol, cannabis is evidently the most often illicit drug detected among drivers involved in road traffic injuries and fatalities worldwide (8,9). This remains foreseeable, as cannabis continues to be the most widely used illicit drug globally, as stated by the latest World Drug Report (10).

Legislative changes cultivate a growing concern that less restrictive laws might increase the prevalence of cannabis use in the general population and, thereby, its use among vehicle drivers. Several studies have confirmed this trend and denoted that cannabis prevalence amongst the populace is rising, as is the frequency of driving under its influence (11–14). Mounting data suggests that vehicular accidents due to impaired driving will increase (15–17) as more countries decriminalize recreational and medicinal cannabis use. Moreover, the risk of cannabis dependence will likely escalate as a competitive market allows for easier access to more affordable and potent cannabis products (18).

The impact of legalization and decriminalization has also likely contributed to changing risk perceptions regarding cannabis use (19) and the influence it exudes on driving behaviours (20). The misconception that drug driving is not perceived to be risky behaviour (21) and the contrasting belief that cannabis is the safest drug to use and drive (22) as it improves driving capability (23,24), presents a significant challenge in discouraging driving under the influence of cannabis (DUIC).

Despite the accumulated evidence over the preceding four decades, that suggest cannabis use impairs driver reaction time, visual acuity, and spatial awareness and encourages risky decision-making (25–28), cannabis users perceive DUIC as being less dangerous than driving under the influence of alcohol (DUIA) (29,30). Notwithstanding, extant literature highlights cannabis use is associated with higher risks of vehicular crash and fatality (31–33), which is exponentially elevated when used with alcohol (34-37), and is dose-dependent with delta-9-tetrahydrocannabinol (THC), the principal psychoactive constituent of cannabis (38). The increasing potency of cannabis (39) as a consequence of legal liberalization, is likely to amplify the prevalence of DUIC and the potential occurrence of motor vehicle accidents (31,40), giving rise to a substantial public health concern.

In Jamaica, a number of smaller-sized studies have reported an association between victims of vehicular crashes and evidence of cannabis use (41,42). Findings from these studies revealed victims were male drivers and adults predominantly over the age of thirty (41,42). However, the accrued data from these studies would have been prior to the legislative changes in 2015 that decriminalized and permitted the possession of two ounces of cannabis for personal use and the establishment of a legal medicinal cannabis industry (43,44). To date, no studies in the Caribbean have used nationally representative data to determine the cannabis use patterns, the sociodemographic characteristics, and the risk perception of cannabis use and its association with developing dependence in vehicle drivers that may drive under the influence of illegal drugs.

It is suggested that the strong inclination for cannabis use amongst Jamaicans is enhanced due to recent amendments to the island's Dangerous Drugs Act that endorsed decriminalization (45), amongst other factors, including strong socio-cultural practices, and religious beliefs

(46,47). The rapidly evolving legal landscape surrounding cannabis and the resulting shifts in social norms regarding its use necessitates a closer examination of the various factors associated with DUIC.

This study's findings will likely address the knowledge gap and apprise stakeholders regarding the characteristics of drivers who drive under the influence of illicit drugs like cannabis. Furthermore, the data gleaned may provide the groundwork for policy change in reducing driving under the influence of cannabis per established recommendations in other territories that have similarly endorsed decriminalization or legalization (48-52).

OBJECTIVES

1. To determine the prevalence of cannabis use patterns among vehicle drivers, including those who drive under the influence of cannabis (DUIC) and those who are heavy cannabis users that DUIC.
2. To examine the association between developing cannabis dependence and the risk perception of smoking cannabis sometimes and often among drivers.
3. To investigate the sociodemographic factors associated with driving under the influence of cannabis.

METHODS

Study Design, Sample Size and Data Source

This study is a secondary data analysis of the National Household Survey, Jamaica 2016. The target population comprised all respondents that identified as vehicle drivers. The sample analyzed in this study was a subset of 1,060 participants. This research extracted variables relevant to cannabis use patterns, dependence, risk perception, driving under the influence of cannabis and the associated sociodemographic characteristics of DUIC in vehicle drivers. This

study contained no identifying data on respondents, and researchers made no direct or indirect contact with any respondents.

The original study was a cross-sectional survey of a national population sample investigating the prevalence and patterns of drug use among Jamaicans between the ages of 12 and 65 (53). Data were collected between April and July 2016, targeting 357 households per parish, totalling a nationally representative sample of 4,623 dwellings. The data were collected from a standardized questionnaire developed by the Inter-American Drug Abuse Control Commission (CICAD) and the Inter-American Observatory on Drugs (OID) and conducted through a partnership with Jamaica's National Council on Drug Abuse (NCDA).

The survey employed a stratified multi-stage sampling design in which the primary sampling units (PSU) were the Enumeration Areas (EAs). Jamaica comprises 14 parishes and twenty-two (22) EAs per parish. In each EA, systematic random sampling was used to draw 16 households, from which one individual was randomly selected as the survey respondent. Sampling weights were calculated to account for selection probability, non-response, and population distribution and applied to ensure that the weighted sample distribution matched the population distribution of age and sex categories (53).

Study Variables

Cannabis Use Prevalence

Utilizing the target variables, the prevalence of cannabis use was calculated for the periods of lifetime (ever use), past year (chronic) and past month (current) use. Responses were coded as 1=yes and 2=no. For heavy cannabis use, respondents were asked to state how many days they had smoked marijuana over the past 30 days. Responses indicating 20 days or more demonstrate heavy use as defined by the European Monitoring Centre for Drugs and Drug Addiction (54).

Cannabis Dependence

Cannabis use was assessed using the Cannabis Abuse Screening Test (CAST). It is often used for the identification of cannabis use disorder (55). It encompasses a 6-item scale in which a score of less than 3 indicates users with a low risk of dependence, a score of 3 to 6 represents users with a moderate risk of dependence, and a score of 7 or more determines users with a high risk of dependence (56). For this study, the CAST scores were re-categorized into two groups where a score greater than or equal to 7 was defined as a high risk of dependence and a score of less than or equal to 6 was defined as not a high risk of cannabis dependence.

Risk Perception

Risk perception was documented in the initial survey by asking participants to indicate their risk level along a Likert scale continuum - (1) no risk; (2) low risk; (3) moderate risk; (4) high risk, and (5) I don't know the risk. For the secondary analysis, response options were re-categorized to reflect no and low risk as 0=low risk and 1=moderate to high risk. Missing and "I don't know the risk" responses were treated as missing variables.

Driving under the influence

The National Household Survey questionnaire asked respondents, "Have you driven a vehicle in the past 12 months?" and "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" The response options were 1=yes, 2=no. Statistical computations were utilized to extract respondents who were past year (chronic) and past month (current) cannabis users that answered "yes" to the question "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" to determine those who drive under the influence of cannabis (DUIC). The term illegal drugs referred to cannabis, crack, cocaine, heroin and 3,4-Methylenedioxymethamphetamine (MDMA).

Sociodemographic characteristics

Sociodemographic characteristics that might influence illegal drug use in drivers were included as covariates. Respondents were asked to state their gender (1=male, 0=female) and geographical location (re-categorized into 1=urban and 0=rural). Respondents' age was categorized into two groups – 1=34 years and under, representing young adults as suggested by Franssen and colleagues (57) and 0=35 years and over. Respondents were asked "Are you the head of household". The response options were 1=yes, 0=no. Educational status was assessed by asking respondents, "What is the highest educational level that you have achieved?" Ten response options were re-categorized into 1=tertiary level, 0=below tertiary level. The item corresponding to marital status had seven response options re-categorized into two choices: 1=married, 0=unmarried. The respondents were asked to disclose the household's total monthly income from a list of fifteen possibilities. These were re-categorized into 1=JA$50,000 and under or 0=over JA$50,000. The item on religious affiliation had twenty-six response options that were re-categorized as 1=Christian, 0=non-Christian. For occupation, respondents were asked to describe their job from a list of eleven options. These were re-categorized into 1=machine operators or 0=non-machine operators. Missing responses and survey questions with the options "don't know" or "no response" were considered missing variables.

Statistical Analysis

Descriptive statistical analysis was performed to determine the prevalence of cannabis use among vehicle drivers and to describe the associated sociodemographic characteristics. These were represented in frequencies, means and percentages. Bivariate analysis examining the association between the risk perception of smoking cannabis sometimes or often and the risk of dependence among vehicle drivers was done using Pearson's $\chi 2$ test. Logistic regression

analyses were done to identify sociodemographic protective and risk factors and DUIC. Statistical analyses were conducted using R software, version 4.2.0. Multicollinearity between the study variables was explored using variance inflation factor (VIF) (with multicollinearity being defined as VIF >2.5).The Hosmer-Lemeshow statistic tested for goodness of fit of the regression model. The data were presented in the form of tables and text. ORs and 95% CIs were recorded. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

The ethics committee in Jamaica's Ministry of National Security granted permission to conduct the National Drug Use Prevalence Survey. Respondent participation was voluntary. Participants gave informed consent and no personal identifiers were required in maintaining confidentiality. Data were securely stored in a database (53).

RESULTS

Prevalence

Table 1 demonstrates the prevalence of cannabis use in the total population (n=4,623) and among the vehicle driver population (n=1,060). Approximately 1 in 4 individuals was a vehicle driver (23%). Among those in the population who reported lifetime use of cannabis, 60.1% reported use in the past year, and 53.9% reported use in the past month. Of the 1060 vehicle drivers, 125 (11.8%) admitted driving under the influence of illegal drugs (DUI-ID) in the past year. Of those who admitted to DUI-ID, 110 drivers were cannabis users only (92%), indicating that 10.4% of drivers admitted to driving under the influence of cannabis (DUIC) in the past year.

Of the 1060 vehicle drivers, 245 vehicle drivers admitted to being current cannabis users, of which 111 drivers admitted to driving under the influence of illegal drugs. Of the 111 drivers who admitted to driving under the influence of illegal drugs, five persons used drugs other than

cannabis (one person each for heroin, crack and cocaine and two for MDMA). Excluding these five individuals, 106 drivers who admitted driving under the influence of illegal drugs used cannabis only. This is approximately 43.3% and indicates that two in five Jamaicans, who are drivers and are current cannabis users, operate a vehicle under the influence of cannabis only.

Of the 106 drivers who admitted to driving under the influence of cannabis only, 92 were heavy cannabis users (use 20 days or more in a month). This is 86.8% and indicates that nine out of ten Jamaican drivers, who were current cannabis users and admitted to driving under the influence, were heavy users.

Table 1: Cannabis use prevalence among the total population and vehicle drivers

Cannabis Use	Frequency	Percentage
Population Lifetime Use	1307	28.3%
Population Past Year Use	786	60.1%
Population Past Month/Current Use	704	53.9%
Current Users who Drive	245	23.1%
Current Users who DUIC only	106	43.3%
Current & Heavy Users who DUIC only	92	86.8%

Sociodemographic factor findings

Table 2 shows the sociodemographic characteristics of population vehicle drivers. The mean age of respondents was 36.56 years (s.d.±12.582). Most drivers were male (70.6%), employed (72.6%), unmarried (61.0%), of Christian beliefs (72.8%), living in rural areas (54.5%) and with a less than tertiary level education achievement (83.3%).

Table 2: Sociodemographic characteristics of population vehicle drivers and drivers that are current cannabis users who DUIC only

	Vehicle Drivers (Population)	Vehicle Drivers (DUIC)
Variable	**Frequency**	**Frequency**
Gender		
Male	748 (70.6%)	99 (93.4%)
Female	312 (29.4%)	07 (06.6%)

Age		
35 years and under	551 (52.0%)	67 (63.2%)
Over 35 years	509 (48.0%)	39 (36.8%)
Education		
Tertiary level	177 (16.7%)	07 (06.6%)
Below tertiary level	883 (83.3%)	99 (93.4%)
Religion		
Christian	772 (72.8%)	65 (61.3%)
Non-Christian	288 (27.2%)	41 (38.7%)
Employment		
Employed	770 (72.6%)	78 (73.6%)
Unemployed	290 (27.4%)	28 (26.4%)
Marital Status		
Married	413 (39.0%)	29 (27.4%)
Unmarried	647 (61.0%)	77 (72.6%)
Geographic Location		
Urban	482 (45.5%)	47 (44.3%)
Rural	578 (54.5%)	59 (55.7%)
Head of Household		
Yes	700 (66.0%)	82 (77.4%)
No	360 (34.0%)	24 (22.6%)
Household Income		
JA$50,000 and under	416 (45.1%)	46 (51.1%)
Over JA$50,000	507 (54.9%)	44 (48.9%)
Occupation		
Machine Operators	267 (34.6%)	43 (55.1%)
Non-Machine Operators	504 (65.4%)	35 (44.9%)

Table 2 also displays demographics for drivers who admit to being a current cannabis user and driving under the influence of cannabis only. Most were male (93.4%), the head of household (77.4%) and operated machinery (55.1%) as part of their job description. Most drivers had achieved less than tertiary level education achievement (93.4%).

Risk perception and cannabis dependence findings

Table 3 summarizes the risk perception of smoking cannabis sometimes or often and level of use according to the CAST questionnaire among vehicle drivers. Approximately 54% and 29% of drivers reported low risk perception to smoking cannabis sometimes and often respectively.

Forty-four percent (44%) of drivers who reported low risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7), whereas 28% of drivers who reported high risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7). This indicates that drivers with a low risk perception to smoking cannabis sometimes were more likely to be dependent on cannabis and this difference was statistically significant ($p<0.001$).

Fifty-two percent (52%) of drivers who reported low risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥ 7), whereas 30% of drivers who reported high risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥ 7). This indicates that drivers with a low risk perception to smoking cannabis often were more likely to be dependent on cannabis and this difference was statistically significant ($p<0.001$).

Table 3: χ^2 test of independence between the CAST questionnaire and risk perception of smoking cannabis among vehicle drivers

	Smoking Cannabis Sometimes	
	Low Risk Perception	High Risk Perception
CAST ≤ 6	132	147
CAST ≥ 7	103	57
$X^2 = 11.226$, df = 1, $p<0.001^{***}$		
	Smoking Cannabis Often	
	Low Risk Perception	High Risk Perception
CAST ≤ 6	61	218
CAST ≥ 7	67	93
$X^2 = 18.757$, df = 1, $p<0.001^{***}$		

$^{***}p<0.001$.
CAST, Cannabis Abuse Screening Test.

Estimation of odd ratios for sociodemographic factors associated with DUIC

Table 4 shows the results of a logistic regression analysis performed to assess the associations between driving under the influence of cannabis in the past year and select sociodemographic factors. There was no multicollinearity found among the independent variables used in the

analysis. The Hosmer-Lemeshow test shows the p-value at 0.497 (p>0.05), which indicates the model fits the data. The model illustrates statistically significant relationships for several factors.

Drivers 34 years and under were 2.97 times more likely than those 35 years and older to report DUIC in the past year. Drivers who were the head of household and operated machinery as part of their job were 2.22 and 1.87 times more likely to report DUIC in the past year than those who were not the head of household or in non-machinery operated positions. Similarly, male drivers were 4.14 times more likely than females to report DUIC in the past year.

There were statistically significant inverse relationships for two of the factors. Married drivers were 2.38 times less likely than unmarried drivers to report DUIC in the past year. Similarly, drivers who matriculated up to a tertiary level education were 3.85 times less likely to report DUIC in the past year than drivers with less than a tertiary level education. Drivers who were Christian-affiliated and living in a household that earned JA$50,000 or lower per month reduced the risk of DUIC in the past year. These inverse associations were, however, not statistically significant.

Table 4: Logistic regression model of select sociodemographic factors associated with driving under the influence of cannabis in the past year

Variables	Estimate	OR	95% CI	P value
Age (34 years and under)	1.0897	2.97	1.71, 5.29	<0.001***
Occupation (machine operators)	0.6280	1.87	1.09, 3.24	0.023*
Marital Status (married)	-0.8794	0.42	0.22, 0.74	0.004**
Gender (male)	1.4197	4.14	1.59, 14.2	0.009**
Education (tertiary level)	-1.3568	0.26	0.06, 0.76	0.031*
Religion (Christian)	-0.4761	0.62	0.36, 1.08	0.088
Household Income (JA$50,000 and under)	-0.2079	0.81	0.47, 1.40	0.460
Head of household (yes)	0.7962	2.22	1.10, 4.75	0.031*
Geographical location (urban)	0.1294	1.14	0.66, 1.97	0.640

*p<0.05, **p<0.01, ***p<0.001.

DISCUSSION

This study is the first of its kind in the Caribbean region and sheds light on the impact of driving under the influence of cannabis (DUIC) on a national population. The findings reveal that a significant number of Jamaican drivers operate a vehicle under the influence of cannabis, with more than 10% conceding to this unsafe and risky practice. It is worth noting the occurrence is eight times greater than the reported mean prevalence of 1.32% (range 0.0%–5.99%) in general driving populations across thirteen participant countries of The European Union's Driving under the Influence of Drugs, Alcohol and Medicines (DRUID) project (8). The high proclivity towards its use among Jamaicans, no doubt as a result of social and cultural influence (46,47), represents a worrying proposition given that extensive research conclusively demonstrates that cannabis use impairs driving ability, predisposes individuals to a reckless style of driving and increases the risk of a vehicular crash (38,40,58).

The second key finding is that among past-month cannabis users, more than 2 in 5 (43.3%) drivers report driving a vehicle while under the influence of cannabis (DUIC). This represents a marked difference compared to similar respondents in a previous study who admitted to driving under the influence of alcohol (18%) (59). Indeed, in terms of exposure, driving under the influence of cannabis was far more commonplace among the Jamaican driving population than driving under the influence of alcohol. A plausible rationale is that the effects of driving under the influence of cannabis have not received the same level of public awareness as driving under the influence of alcohol. Moreover, current legislation provides minimal legal deterrence to DUIC, lacking an effective roadside drug driving testing strategy and comprising a fine of approximately US$65 for driving under the influence of cannabis that is unlikely to dissuade offender motorists (60).

The third critical finding is that the more frequent cannabis users are more likely to report DUIC. This study denoted that approximately 9 out of 10 Jamaicans who were past-month cannabis users and reported DUIC admitted to being heavy users (use 20 days or more in a month). The compelling significance of this finding is that extant literature has highlighted a dose-dependent relationship between cannabis use and impaired driving ability, with more greater compromise observed among individuals with higher levels of delta-9-tetrahydrocannabinol (THC) (36). Furthermore, a number of studies highlight the increased odds of motor vehicle crashes associated with acute cannabis intoxication (31,32,61), mainly because the psychoactive effects may persist for a significant period of time (62).

The fourth key finding demonstrated a significant association between risk perception and the risk of developing cannabis dependence among vehicle drivers. Expectedly, drivers with low-risk perceptions of smoking cannabis showed higher risks of cannabis dependence. However, a salient finding is that approximately 30% of drivers with a high risk perception of smoking cannabis, whether sometimes or often, were also associated with an increased risk of cannabis dependence. Indeed, it may be beneficial to address the misperception that smoking cannabis is not dangerous among drivers who perceive it as less risky. Additionally, directing drivers who have been convicted or suspended for this behaviour towards a remedial program, similar to those mandated for drunk driving, could prove effective (63). However, the high prevalence of cannabis dependence among drivers who acknowledge smoking cannabis as being harmful further underscores the fact that DUIC is becoming more socially acceptable (64), normative (65) and less perceived as a risky behaviour (21).

Finally, this study also revealed several sociodemographic factors associated with DUIC. Regression analysis indicated that being a young adult, employed in a job operating machinery,

of the male gender, and the head of the household were predictive of driving under the influence of cannabis, whereas being married and having a tertiary level education were protective factors. Interestingly, the risk factors accrued were similar to those observed for DUIA among Jamaican drivers demonstrated in previous research (59). As such, the opportunity for legislators to include driving under the influence of cannabis as part of an overall DUI interventional effort allow for comprehensive and collaborative efforts that a siloed approach to policymaking is unlikely to foster.

Cumulatively, the findings of this study have heightened concerns regarding driving under the influence of cannabis among Jamaican drivers, particularly in light of the island's increasing annual road fatality rate (66). The legislation regarding drug driving must comply with global benchmarks. International policymakers have sought to model drug-driving laws on those that have proven effective for driving under the influence of alcohol, inclusive of a strategy that encourages roadside drug testing. DUIC can be measured through observed impairment in a Standardized Field Sobriety Test (SFST) (67–69) or Drug Evaluation and Classification (DEC) (70) programme by a police officer or by using point-of-collection testing devices (71). These strict policies use a per se or zero tolerance approach, meaning that if THC is detected at or above a specific concentration in a biological sample, the driver is considered to have committed a DUIC offense, regardless of their level of impairment. Several countries, including Norway, Australia and Denmark (71,72), have adopted per se limits ranging from 2-5 ng/ml THC on oral fluid and blood tests, where studies demonstrate the first indications of impairment occur and establish that a level of 3.7 ng/ml THC is equivalent to the globally accepted legal blood alcohol concentration (BAC) of 0.05 g/dL (73,74). The accumulated literature regarding the impact of roadside drug testing remains in its infancy, given that most countries would have recently

embarked on legislative reform. Notwithstanding, a number of contemporary research have yielded promising results that endorse the importance of roadside testing as part of a DUIC deterrence initiative (75–77).

Driving necessitates a higher level of mental and motor dexterity, making it an intrinsically complex undertaking (78). The misperception that DUIC is not risky and that cannabis use adjunctly improves driving skills (21,23) is further highlighted by this study's prevailing finding that a substantial number of drivers (between 30% and 50%) demonstrated a low risk perception of cannabis smoking. This notable risk tolerance or lack thereof may also represent a concern in the workplace, given that DUIC drivers were predominantly employed in machine-operated jobs. Notwithstanding, cannabis-impaired driving, certainly within the Jamaican context, is likely also influenced by recent decriminalization and medicalization (44) policies as seen elsewhere that have adopted a similar stance (79) and undoubtedly enhanced by socio-cultural acceptance (47), easy access (53) and availability of higher potency products (80). Accordingly, a calculated national initiative should seek to review current cannabis policy, include more robust regulatory mechanisms and disseminate a public education programme on the risks associated with cannabis use and driving as part of an overall prevention and deterrence effort.

One of the study's limitations was that DUI information was self-reported, which can be affected by recall bias. Notably, this research could not establish causal relationships due to the nature of the cross-sectional data. However, one of the study's strengths is that the validated Cannabis Abuse Screening Test enhanced the reliability of the findings given that it is frequently used worldwide in national population sample studies (81). Although the data analyzed in this study were collected in 2016, the findings are of immense value for national policy, providing a

foundation for further research to build on and fill a vital knowledge gap, especially in low-income and middle-income countries (LMICs) where global research is scarce.

CONCLUSION

Two in five drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate stakeholders to consider roadside drug testing in drivers as part of developing evidence-based policy in mitigating the safety risks posed by driving under the influence of cannabis. Moreover, the rising prevalence of cannabis use and availability of higher potency products in a legally and socially tolerant setting, position Jamaica as a key research collaborator in developing policies dissuading cannabis-impaired driving, that may be applicable and replicated in other sister low-income and middle-income countries.

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Patient and public involvement Patients or members of the public were not involved in any aspect of this research, including conceptualization, design, analysis, interpretation of results, and reporting.

Patient consent for publication Not applicable

Ethics approval This study involves human participants. The Ministry of National Security in Jamaica granted approval for the National Drug Use Prevalence Survey. The secondary data analysis was approved by the University of the West Indies Ethics Committee, Mona (Ref: CREC-MN.8,2021/2022).

Data sharing statement Data are available on reasonable request. The data that support the findings of this study are available from the National Council on Drug Abuse, Jamaica, and the Inter-American Drug Abuse Control Commission (CICAD) but restrictions apply to the availability of these data, which were used under licence for the current study and are not publicly available. For access to the database, contact Mrs Uki Atkinson, research analyst, at uatkinson@ncda.org.jm

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STROBE Statement

Checklist of items that should be included in reports of observational studies

Section/Topic	Item No	Recommendation	Reported on Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5,6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5,6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5,6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7,8
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7,8
Bias	9	Describe any efforts to address potential sources of bias	6,9
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6,7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8.9
		(*b*) Describe any methods used to examine subgroups and interactions	8.9
		(*c*) Explain how missing data were addressed	7,8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	N/A

Section/Topic	Item No	Recommendation	Reported on Page No
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	NA/
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13
		(*b*) Report category boundaries when continuous variables were categorized	13
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9-13
Discussion			
Key results	18	Summarise key results with reference to study objectives	14,15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-18
Generalisability	21	Discuss the generalisability (external validity) of the study results	17,18
Other Information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	19

**Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.*

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Drug driving: a secondary analysis of factors associated with driving under the influence of cannabis in Jamaica

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Drug driving: a secondary analysis of factors associated with driving under the influence of cannabis in Jamaica

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ABSTRACT

Objectives To determine cannabis use patterns, the predictive sociodemographic correlates of driving under the influence of cannabis (DUIC) and the association between risk perception and cannabis dependence among vehicle drivers in Jamaica.
Design Secondary data analysis.
Setting Utilized the Jamaica National Drug Prevalence Survey 2016 dataset.
Participants 1060 vehicle drivers extracted from the population sample of 4623.
Primary and secondary outcome measures **A**nalysis utilized Pearson's Chi-Square test and logistic regression. Odds ratios and 95% confidence intervals were recorded. A p-value of <0.05 was considered statistically significant.
Results More than 10% of Jamaican drivers admitted to DUIC in the past year. Approximately 43.3% of drivers who currently use cannabis reported DUIC only. Evidently, 86.8% of drivers who DUIC were heavy cannabis users. Approximately 30% of drivers with moderate to high risk perception of smoking cannabis sometimes or often were dependent on cannabis. Notwithstanding, drivers with no to low risk perception of smoking cannabis sometimes or often, were significantly likelier to be dependent (p<0.001 and p<0.001, respectively). Logistic regression highlighted male drivers (OR: 4.14, 95% CI 1.59 to 14.20, p=0.009) that were 34 years and under (OR: 2.97, 95% CI 1.71 to 5.29, p<0.001) and were the head of the household (OR: 2.22, 95% CI 1.10 to 4.75, p=0.031) and operated a machine as part of their job (OR: 1.87, 95% CI 1.09 to 3.24, p=0.023) were more likely to DUIC, whilst those who were married (OR: 0.42, 95% CI 0.22 to 0.74, p=0.004) and had achieved a tertiary level education (OR: 0.26, 95% CI 0.06 to 0.76, p=0.031) were less likely.
Conclusions 2 in 5 Jamaican drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate policymakers to consider mobile roadside drug testing and amending drug-driving laws to meet international standards.

(Word count 300)

Keywords: Drivers, Cannabis, Jamaica, Prevalence, Dependence, Risk Perception

Article Summary

Strengths and limitations of this study

- The use of the entire dataset population augmented the strength of the analysis.
- The use of logistic regression analysis allows for several sociodemographic factors to be simultaneously assessed to elicit appropriate risk and protective factors.
- The validated Cannabis Abuse Screening Test enhanced the reliability of the findings, given its frequent use in population sample studies.
- DUI information was self-reported, which can be affected by recall bias.
- This study could not establish causal relationships due to the nature of the cross-sectional data.

INTRODUCTION

The World Health Organization (WHO) highlights drug driving as a significant risk factor for road traffic accidents (1). Vehicular crash is among the top ten causes of demise across all age groups and the leading cause of death in young individuals under thirty (2). Accordingly, driving under the influence of drugs represents a massive public health concern for the global community (3–7). While driving under the influence has historically referred to alcohol, cannabis is evidently the second leading drug detected among drivers involved in road traffic injuries and fatalities worldwide (8,9). This remains foreseeable, as it continues to be widely used globally, as stated by the latest World Drug Report (10).

Legislative changes cultivate a growing concern that less restrictive laws might increase the prevalence of cannabis use in the general population and, thereby, its use among vehicle drivers. Several studies have confirmed this trend and denoted that cannabis prevalence amongst the populace is rising, as is the frequency of driving under its influence (11–14). Mounting data suggests that vehicular accidents due to impaired driving will increase (15–17) as more countries decriminalize recreational and medicinal cannabis use. Moreover, the risk of cannabis dependence will likely escalate as a competitive market allows for easier access to more affordable and potent cannabis products (18).

The impact of legalization and decriminalization has also likely contributed to changing risk perceptions regarding cannabis use (19) and the influence it exudes on driving behaviours (20). The misconception that drug driving is not perceived to be risky behaviour (21) and the contrasting belief that cannabis is the safest drug to use and drive (22) as it improves driving capability (23,24), presents a significant challenge in discouraging driving under the influence of cannabis (DUIC).

Despite the accumulated evidence over the preceding four decades, that suggest cannabis use impairs driver reaction time, visual acuity and spatial awareness, and encourages risky decision-making (25–28), cannabis users perceive DUIC as being less dangerous than driving under the influence of alcohol (DUIA) (29,30). Notwithstanding, extant literature highlights cannabis use is associated with higher risks of vehicular crash and fatality (31–33), which is exponentially elevated when used with alcohol (34-37). Contemporary research, however, is less conclusive as it pertains to the dose-response effects of delta-9-tetrahydrocannabinol (THC) on driving skills, with a number of studies showing a positive association between elevated levels of THC and impairment (38,39) whilst others found no clear relationship (40).

In Jamaica, a number of smaller-sized studies have reported an association between victims of vehicular crashes and evidence of cannabis use (41,42). Findings from these studies revealed victims were male drivers and adults predominantly under the age of thirty (41,42). However, the accrued data from these studies would have been prior to the legislative changes in 2015 that decriminalized and permitted the possession of two ounces of cannabis for personal use, and the establishment of a legal medicinal cannabis industry (43,44). It is suggested that the strong inclination for cannabis use amongst Jamaicans is enhanced due to recent amendments to the island's Dangerous Drugs Act that endorsed decriminalization (45), amongst other factors, including strong socio-cultural practices, and religious beliefs (46,47).

That being the case, the rapidly evolving legal landscape surrounding cannabis and the resulting shifts in social norms regarding its use necessitates a closer examination of the various factors associated with DUIC. To date, no studies in the Caribbean have used nationally representative data to determine cannabis use patterns, the sociodemographic characteristics, and

the risk perception of cannabis use and its association with developing dependence in vehicle drivers that may drive under the influence of cannabis.

OBJECTIVES

1. To determine the prevalence of cannabis use patterns among vehicle drivers, including those who drive under the influence of cannabis (DUIC) and those who are heavy cannabis users that DUIC.
2. To examine the association between developing cannabis dependence and the risk perception of smoking cannabis among drivers.
3. To investigate the sociodemographic factors associated with driving under the influence of cannabis.

METHODS

Study design, sample size and data source

This study is a secondary data analysis of the National Household Survey, Jamaica 2016. The target population comprised all respondents that identified as drivers of motorized vehicles. The sample analyzed in this study was a subset of 1060 participants. This research extracted variables relevant to cannabis use patterns, dependence, risk perception and the associated sociodemographic characteristics of DUIC in vehicle drivers. This study contained no identifying data on respondents, and researchers made no direct or indirect contact with any respondents.

The original study was a cross-sectional survey of a national population sample investigating the prevalence and patterns of drug use among Jamaicans between the ages of 12 and 65 (48). Data were collected between April and July 2016, targeting 357 households per parish, totalling a nationally representative sample of 4623 dwellings. The data were collected from a standardized questionnaire developed by the Inter-American Drug Abuse Control

Commission (CICAD) and the Inter-American Observatory on Drugs (OID) and conducted through a partnership with Jamaica's National Council on Drug Abuse (NCDA).

The survey employed a stratified multi-stage sampling design in which the primary sampling units (PSU) were the Enumeration Areas (EAs). Jamaica comprises 14 parishes and twenty-two (22) EAs per parish. In each EA, systematic random sampling was used to draw 16 households, from which one individual was randomly selected as the survey respondent. Sampling weights were calculated to account for selection probability, non-response, and population distribution and applied to ensure that the weighted sample distribution matched the population distribution of age and sex categories (48).

Study variables

Cannabis use prevalence

Utilizing the target variables, the prevalence of cannabis use was calculated for the periods of lifetime (ever use), past year (chronic) and past month (current) use. Responses were coded as 1=yes and 2=no. For heavy cannabis use, respondents were asked to state how many days they had smoked marijuana over the past 30 days. Responses indicating 20 days or more demonstrate heavy use as defined by the European Monitoring Centre for Drugs and Drug Addiction (49).

Driving under the influence of cannabis

The National Household Survey questionnaire asked respondents, "Have you driven a vehicle in the past 12 months?" and "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" The response options were 1=yes, 2=no. Utilizing a method previously described in the literature (50), driving under the influence of cannabis only was defined as an affirmative response to the survey question, "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" (limited to

respondents who reported past year cannabis use and no other illicit drug use). Individuals who reported using cannabis in the past year but did not report any other illegal drug use during that same time period, and also reported driving under the influence of drugs in the past year, were considered to have driven under the influence of cannabis only in the past year. Statistical computations also extracted respondents who were past month (current) cannabis users that answered "yes" to the question "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" to determine those vehicle drivers who were current users that drive under the influence of cannabis (DUIC) only. The term illegal drugs included cannabis, crack, cocaine, heroin and 3,4-methylenedioxymethamphetamine (MDMA).

Cannabis dependence

Cannabis dependence was assessed using the Cannabis Abuse Screening Test (CAST). It is often used for the identification of cannabis use disorder (51). It encompasses a 6-item scale in which a score of less than 3 indicates users with a low risk of dependence, a score of 3 to 6 represents users with a moderate risk of dependence, and a score of 7 or more determines users with a high risk of dependence (52). For this study, the CAST scores were re-categorized into two groups where a score greater than or equal to 7 was defined as a high risk of dependence and a score of less than or equal to 6 was defined as not a high risk of cannabis dependence.

Risk perception

Risk perception was investigated in the initial survey by asking participants, "In your opinion, please indicate the risk level of smoking marijuana sometimes and smoking marijuana often". Participants indicated their risk level along a Likert scale continuum - (1) no risk; (2) low risk; (3) moderate risk; (4) high risk, and (5) I don't know the risk. For the secondary analysis, response options were re-categorized to reflect 0=no risk to low risk and 1=moderate to high risk

to examine respondents who had indicated some level of perceived risk. The option "I don't know the risk" was excluded as an underrepresented category with insufficient frequencies that may introduce variability and bias in interpreting the results (53).

Sociodemographic characteristics

Sociodemographic characteristics that might influence cannabis use in drivers were included as covariates. Respondents were asked to state their sex (1=male, 0=female) and geographical location (re-categorized into 1=urban and 0=rural). Respondents' age was categorized into two groups – 1=34 years and under, representing young adults as suggested by Franssen and colleagues (54) and 0=35 years and over. Respondents were asked "Are you the head of household". The response options were 1=yes, 0=no. Educational status was assessed by asking respondents, "What is the highest educational level that you have achieved?" Ten response options were re-categorized into 1=tertiary level, 0=below tertiary level. The item corresponding to marital status had seven response options re-categorized into two choices: 1=married, 0=unmarried. The respondents were asked to disclose the household's total monthly income from a list of fifteen possibilities. These were re-categorized into 1=JA$50,000 and under or 0=over JA$50,000. The options "don't know" or "no response" was considered missing variables. The item on religious affiliation had twenty-six response options that were re-categorized as 1=Christian, 0=non-Christian. For occupation, respondents were asked to describe their job from a list of eleven options. These were re-categorized into 1=machine operators or 0=non-machine operators.

Statistical analysis

Descriptive statistical analysis was performed to determine the prevalence of cannabis use among vehicle drivers and to describe the associated sociodemographic characteristics. These

were represented in frequencies, means and percentages. Bivariate analysis examining the association between the risk perception of smoking cannabis sometimes or often and the risk of dependence among vehicle drivers was done using Pearson's $\chi 2$ test. Logistic regression analyses were done to identify sociodemographic protective and risk factors for DUIC. Covariates included in the model were age (over 35 years as the reference category), occupation (non-machine operators as the reference category), marital status (unmarried as the reference category), sex (female as the reference category), education (below tertiary level as the reference category), religion (non-Christian as the reference category), household income (over JA$50,000 as the reference category), head of household ("no" responses as the reference category), and geographical location (rural as the reference category). Statistical analyses were conducted using R software, version 4.2.0. Multicollinearity between the study variables was explored using variance inflation factor (VIF) (with multicollinearity being defined as VIF >2.5).The Hosmer-Lemeshow statistic tested for goodness of fit of the regression model. The data were presented in the form of tables and text. ORs and 95% CIs were recorded. A p-value of <0.05 was considered statistically significant.

Ethical considerations

The ethics committee in Jamaica's Ministry of National Security granted permission to conduct the National Drug Use Prevalence Survey. Respondent participation was voluntary. Participants gave informed consent and no personal identifiers were required in maintaining confidentiality. Data were securely stored in a database (48).

RESULTS

Prevalence

Table 1 demonstrates the prevalence of cannabis use in the total population (n=4623) and among the vehicle driver population (n=1060). Approximately 1 in 4 individuals was a vehicle driver (23%). Among those in the population who reported lifetime use of cannabis, 60.1% reported use in the past year, and 53.9% reported use in the past month. Of the 1060 vehicle drivers, 125 (11.8%) admitted driving under the influence of illegal drugs (DUI-ID) in the past year. Of those who admitted to DUI-ID, 110 drivers were cannabis users only (92%), indicating that 10.4% of drivers admitted to driving under the influence of cannabis (DUIC) in the past year.

Of the 1060 vehicle drivers, 245 vehicle drivers admitted to being current cannabis users, of which 111 drivers admitted to driving under the influence of illegal drugs. Of the 111 drivers who admitted to driving under the influence of illegal drugs, five persons used drugs other than cannabis (one person each for heroin, crack and cocaine and two for MDMA). Excluding these five individuals, 106 drivers who admitted driving under the influence of illegal drugs used cannabis only. This is approximately 43.3% and indicates that two in five Jamaicans, who are drivers and are current cannabis users, operate a vehicle under the influence of cannabis only.

Of the 106 drivers who admitted to driving under the influence of cannabis only, 92 were heavy cannabis users (use 20 days or more in a month). This is 86.8% and indicates that nine out of ten Jamaican drivers, who were current cannabis users and admitted to driving under the influence, were heavy users.

Table 1: Cannabis use prevalence among the total population (n=4623) and vehicle drivers (n=1060)

Cannabis Use	Frequency	Percentage
Population Lifetime Use	1307	28.3%
Population Past Year Use	786	60.1%
Population Past Month/Current Use	704	53.9%
Current Users who Drive	245	23.1%
Current Users who DUIC only	106	43.3%
Current & Heavy Users who DUIC only	92	86.8%

Sociodemographic factor findings

Table 2 shows the sociodemographic characteristics of population vehicle drivers. The mean age of respondents was 36.56 years (s.d.±12.582). Most drivers were male (70.6%), employed (72.6%), unmarried (61.0%), of Christian beliefs (72.8%), living in rural areas (54.5%) and with a less than tertiary level education achievement (83.3%).

Table 2: Sociodemographic characteristics of population vehicle drivers (n=1060) and drivers that are current cannabis users who DUIC only (n=106)

	Vehicle Drivers (Population)	Vehicle Drivers (DUIC)
Variable	**Frequency**	**Frequency**
Sex		
Male	748 (70.6%)	99 (93.4%)
Female	312 (29.4%)	07 (06.6%)
Age		
35 years and under	551 (52.0%)	67 (63.2%)
Over 35 years	509 (48.0%)	39 (36.8%)
Education		
Tertiary level	177 (16.7%)	07 (06.6%)
Below tertiary level	883 (83.3%)	99 (93.4%)
Religion		
Christian	772 (72.8%)	65 (61.3%)
Non-Christian	288 (27.2%)	41 (38.7%)
Employment		
Employed	770 (72.6%)	78 (73.6%)
Unemployed	290 (27.4%)	28 (26.4%)
Marital Status		
Married	413 (39.0%)	29 (27.4%)
Unmarried	647 (61.0%)	77 (72.6%)
Geographic Location		
Urban	482 (45.5%)	47 (44.3%)
Rural	578 (54.5%)	59 (55.7%)
Head of Household		
Yes	700 (66.0%)	82 (77.4%)
No	360 (34.0%)	24 (22.6%)
Household Income		
JA$50,000 and under	416 (45.1%)	46 (51.1%)
Over JA$50,000	507 (54.9%)	44 (48.9%)
Occupation		

Machine operators	267 (34.7%)	43 (55.1%)
Non-machine operators	503 (65.3%)	35 (44.9%)

Table 2 also displays demographics for drivers who admit to being a current cannabis user and driving under the influence of cannabis only. Most were male (93.4%), the head of household (77.4%) and operated machinery (55.1%) as part of their job description. Most drivers had achieved less than tertiary level education achievement (93.4%). Household income, is the sole variable where data were not recorded in 137 cases of drivers in the population, and 16 cases of drivers that are current cannabis users who DUIC only.

Risk perception and cannabis dependence findings

Table 3 summarizes the risk perception of smoking cannabis sometimes or often and level of use according to the CAST questionnaire among vehicle drivers. Approximately 54% and 29% of drivers reported low risk perception to smoking cannabis sometimes and often respectively.

Forty-four percent (44%) of drivers who reported low risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7), whereas 28% of drivers who reported high risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7). This indicates that drivers with a low risk perception to smoking cannabis sometimes were more likely to be dependent on cannabis and this difference was statistically significant ($p<0.001$).

Fifty-two percent (52%) of drivers who reported low risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥ 7), whereas 30% of drivers who reported high risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥ 7). This indicates that drivers with a low risk perception to smoking cannabis often were more likely to be dependent on cannabis and this difference was statistically significant ($p<0.001$).

Table 3: χ^2 test of independence between the CAST questionnaire and risk perception of smoking cannabis among vehicle drivers

	Smoking Cannabis Sometimes	
	No to low risk	Moderate to high risk
CAST ≤ 6	132	147
CAST ≥ 7	103	57
$X^2 = 11.226$, df = 1, $p<0.001^{***}$		
	Smoking Cannabis Often	
	No to low risk	Moderate to high risk
CAST ≤ 6	61	218
CAST ≥ 7	67	93
$X^2 = 18.757$, df = 1, $p<0.001^{***}$		

$^{***}p<0.001$.
CAST, Cannabis Abuse Screening Test.

Estimation of ORs for sociodemographic factors associated with DUIC

Table 4 shows the results of a logistic regression analysis performed to assess the associations between driving under the influence of cannabis in the past year and select sociodemographic factors. There was no multicollinearity found among the independent variables used in the analysis. The Hosmer-Lemeshow test shows the p-value at 0.497 (p>0.05), which indicates the model fits the data. The model illustrates statistically significant relationships for several factors.

Drivers 34 years and under were 2.97 times (95% CI 1.71 to 5.29, p<0.001) more likely than those 35 years and older to report DUIC in the past year. Drivers who were the head of household and operated machinery as part of their job were 2.22 times (95% CI 1.10 to 4.75, p=0.031) and 1.87 times (95% CI 1.09 to 3.24, p=0.023) more likely to report DUIC in the past year than those who were not the head of household or in non-machinery operated positions. Similarly, male drivers were 4.14 times (95% CI 1.59 to 14.20, p=0.009) more likely than females drivers to report DUIC in the past year.

The model also indicated that there were statistically significant inverse relationships for two of the factors. Married drivers were 58% less likely than unmarried drivers to report DUIC

in the past year. Alternately, the result can also be interpreted that the odds of DUIC is 2.38 times higher among unmarried drivers. Similarly, drivers who matriculated up to a tertiary level education were 74% less likely to report DUIC in the past year than drivers with less than a tertiary level education. Alternately, the result can also be interpreted that the odds of DUIC is 3.85 times higher among drivers with less than a tertiary education. Drivers who were Christian-affiliated and living in a household that earned JA$50,000 or lower per month reduced the risk of DUIC in the past year. These inverse associations were, however, not statistically significant.

Table 4: Logistic regression model of select sociodemographic factors associated with driving under the influence of cannabis only in the past year

Variables	Estimate	OR	95% CI	P value
Age (over 35 years)		1		
Age (34 years and under)	1.0897	2.97	1.71, 5.29	<0.001***
Occupation (non-machine operators)		1		
Occupation (machine operators)	0.6280	1.87	1.09, 3.24	0.023*
Marital status (unmarried)		1		
Marital Status (married)	-0.8794	0.42	0.22, 0.74	0.004**
Sex (female)		1		
Sex (male)	1.4197	4.14	1.59, 14.2	0.009**
Education (below tertiary level)		1		
Education (tertiary level)	-1.3568	0.26	0.06, 0.76	0.031*
Religion (non-Christian)		1		
Religion (Christian)	-0.4761	0.62	0.36, 1.08	0.088
Household income (over JA$50,000)		1		
Household income (JA$50,000 and under)	-0.2079	0.81	0.47, 1.40	0.460
Head of household (no)		1		
Head of household (yes)	0.7962	2.22	1.10, 4.75	0.031*
Geographical location (rural)		1		
Geographical location (urban)	0.1294	1.14	0.66, 1.97	0.640
*p<0.05, **p<0.01, ***p<0.001.				

DISCUSSION

This study is the first of its kind in the Caribbean region and sheds light on the impact of driving under the influence of cannabis (DUIC) on a national population. The findings reveal that a significant number of Jamaican drivers who use cannabis, operate a vehicle under its influence, with more than 10% conceding to this unsafe and risky practice. It is worth noting the occurrence is eight times greater than the reported mean prevalence of 1.32% (range 0.0%–5.99%) in general driving populations across thirteen participant countries of The European Union's Driving under the Influence of Drugs, Alcohol and Medicines (DRUID) project (8). The high proclivity towards its use among Jamaicans, no doubt as a result of social and cultural influence (46,47), represents a worrying proposition given that extensive research demonstrates that cannabis use while driving, or under its influence, may impair driving ability (55).

The second key finding is that among past-month cannabis users, more than 2 in 5 (43.3%) drivers report driving a vehicle while under the influence of cannabis (DUIC). This represents a marked difference compared to similar respondents in a previous study who admitted to driving under the influence of alcohol (18%) (56). Indeed, in terms of exposure, driving under the influence of cannabis was far more commonplace among the Jamaican driving population than driving under the influence of alcohol. A plausible rationale is that the effects of driving under the influence of cannabis have not received the same level of public awareness as driving under the influence of alcohol. Moreover, current legislation provides minimal legal deterrence to DUIC, lacking an effective roadside drug driving testing strategy and comprising a fine of approximately US$65 that is unlikely to dissuade offender motorists (57).

The third critical finding is that the more frequent cannabis users are more likely to report DUIC. This study denoted that approximately 9 out of 10 Jamaicans who were past-month cannabis users and reported DUIC admitted to being heavy users (use 20 days or more in a

month). The compelling significance of this finding is that a number of studies highlight the increased odds of motor vehicle crashes associated with acute cannabis intoxication (31,32,58), mainly because the psychoactive effects may persist for a significant period of time (59).

The fourth key finding demonstrated a significant association between risk perception and the risk of developing cannabis dependence among vehicle drivers. Expectedly, drivers with no to low risk perceptions of smoking cannabis showed higher risks of cannabis dependence. However, a salient finding is that approximately 30% of drivers with moderate to high risk perception of smoking cannabis, whether sometimes or often, were also associated with an increased risk of cannabis dependence. Indeed, it may be beneficial to address the misperception that smoking cannabis is not dangerous among drivers who perceive it as less risky. Additionally, directing drivers who have been convicted or suspended for this behaviour towards a remedial program, similar to those mandated for drunk driving, could prove effective (60). However, the high prevalence of cannabis dependence among drivers who acknowledge smoking cannabis as being harmful further underscores the fact that DUIC is becoming more socially acceptable (61), normative (62) and less perceived as a risky behaviour (21).

Finally, this study also revealed several sociodemographic factors associated with DUIC. Regression analysis indicated that being a young adult, employed in a job operating machinery, of the male sex, and the head of the household were predictive of driving under the influence of cannabis, whereas being married and having a tertiary level education were protective factors. Interestingly, the risk factors accrued were similar to those observed for DUIA among Jamaican drivers demonstrated in previous research (56). As such, the opportunity for legislators to include driving under the influence of cannabis as part of an overall national DUI interventional effort, allow for comprehensive and collaborative efforts that a siloed approach to policymaking is

unlikely to foster. Accordingly, a further call to improve data collection protocols regarding DUI behaviours and increase sobriety checkpoints in Jamaica, represent replicable and cost-effective strategies that have found favour in other low-income and middle-income countries (LMICs) (63).

Cumulatively, the findings of this study have heightened concerns regarding driving under the influence of cannabis among Jamaican drivers, particularly in light of the island's increasing annual road fatality rate (64). The legislation regarding drug driving must comply with global benchmarks. International policymakers have sought to model drug-driving laws on those that have proven effective for driving under the influence of alcohol, inclusive of a strategy that encourages roadside drug testing. DUIC can be measured through observed impairment in a Standardized Field Sobriety Test (SFST) (65–67) or Drug Evaluation and Classification (DEC) (68) programme by a police officer or by using point-of-collection testing devices (69). These strict policies use a per se or zero tolerance approach, meaning that if THC is detected at or above a specific concentration in a biological sample, the driver is considered to have committed a DUIC offense, regardless of their level of impairment. Several countries, including Norway, Australia and Denmark, alongside a number of states in the US (69-71), have adopted per se limits ranging from 2-5 ng/ml THC on oral fluid and blood tests, where studies demonstrate the first indications of impairment may occur. While some studies establish that a level of 3.7 ng/ml THC is equivalent to the legal blood alcohol concentration (BAC) of 0.05 g/dL accepted in a number of countries (72,73), other studies in the US suggest an absence of a dose-dependent relationship between THC level and driving impairment especially among frequent users where tolerance may be a factor (40,74). Notably, the accumulated literature regarding the impact of roadside drug testing remains in its infancy, given that most countries would have recently

embarked on legislative reform. Notwithstanding, a number of contemporary research have yielded promising results that endorse the importance of roadside testing as part of a DUIC deterrence initiative (75–77).

Driving necessitates a higher level of mental and motor dexterity, making it an intrinsically complex undertaking (78). The misperception that DUIC is not risky and that cannabis use adjunctly improves driving skills (21,23) is further highlighted by this study's prevailing finding that a substantial number of drivers (between 30% and 50%) demonstrated a low risk perception of cannabis smoking. This notable risk tolerance or lack thereof may also represent a concern in the workplace, given that DUIC drivers were predominantly employed in machine-operated jobs. Notwithstanding, cannabis-impaired driving, certainly within the Jamaican context, is likely also influenced by recent decriminalization and medicalization (44) policies as seen elsewhere that have adopted a similar stance (79), and undoubtedly enhanced by socio-cultural acceptance (47), easy access (48) and availability of higher potency products (80). Accordingly, a calculated national initiative should seek to review current cannabis policy, include more robust regulatory mechanisms and disseminate a public education programme on the risks associated with cannabis use and driving as part of an overall prevention and deterrence effort. Furthermore, the data gleaned may provide the groundwork for policy change in reducing DUIC behaviours per established recommendations in other territories that have similarly endorsed decriminalization or legalization (81-85).

One of the study's limitations was that DUI information was self-reported, which can be affected by recall bias. Moreover, the inclination of many of the survey participants to give "socially acceptable" answers and not admit any illegal activities might also introduce a response bias. Notably, this research could not establish causal relationships due to the nature of the cross-

sectional data. However, one of the study's strengths is that the validated Cannabis Abuse Screening Test enhanced the reliability of the findings given that it is frequently used worldwide in national population sample studies (52). Although the data analyzed in this study were collected in 2016, the findings are of immense value for national policy, providing a foundation for further research to build on and fill a vital knowledge gap, especially in low-income and middle-income countries (LMICs) where global research is scarce.

CONCLUSION

Two in five Jamaican drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate stakeholders to consider roadside drug testing of drivers as part of developing evidence-based policy in mitigating the safety risks posed by driving under the influence of cannabis. Moreover, the rising prevalence of cannabis use and availability of higher potency products in a legally and socially tolerant setting, position Jamaica as a key research collaborator in developing policies dissuading cannabis-impaired driving, that may be applicable and replicated in other sister low-income and middle-income countries (LMICs).

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Patient consent for publication Not applicable

Ethics approval This study involves human participants. The Ministry of National Security in Jamaica granted approval for the National Drug Use Prevalence Survey. The secondary data analysis was approved by the University of the West Indies Ethics Committee, Mona (Ref: CREC-MN.8,2021/2022).

Data sharing statement Data are available on reasonable request. The data that support the findings of this study are available from the National Council on Drug Abuse, Jamaica, and the Inter-American Drug Abuse Control Commission (CICAD) but restrictions apply to the availability of these data, which were used under licence for the current study and are not publicly available. For access to the database, contact Mrs Uki Atkinson, research analyst, at uatkinson@ncda.org.jm

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STROBE Statement

Checklist of items that should be included in reports of observational studies

Section/Topic	Item No	Recommendation	Reported on Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8,9
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7,8,9
Bias	9	Describe any efforts to address potential sources of bias	6,10
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6,7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9,10
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	8,9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	N/A

Section/Topic	Item No	Recommendation	Reported on Page No
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	NA/
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7,8,9
		(b) Indicate number of participants with missing data for each variable of interest	N/A
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	14-16
		(*b*) Report category boundaries when continuous variables were categorized	14-16
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11-16
Discussion			
Key results	18	Summarise key results with reference to study objectives	16,17,18
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	16-20
Generalisability	21	Discuss the generalisability (external validity) of the study results	18-20
Other Information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

**Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.*

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Drug driving: a secondary analysis of factors associated with driving under the influence of cannabis in Jamaica

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Drug driving: a secondary analysis of factors associated with driving under the influence of cannabis in Jamaica

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ABSTRACT

Objectives To determine cannabis use patterns, the predictive sociodemographic correlates of driving under the influence of cannabis (DUIC) and the association between risk perception and cannabis dependence among vehicle drivers in Jamaica.
Design Secondary data analysis.
Setting Utilized the Jamaica National Drug Prevalence Survey 2016 dataset.
Participants 1060 vehicle drivers extracted from the population sample of 4623.
Primary and secondary outcome measures **A**nalysis utilized Pearson's Chi-Square test and logistic regression. Odds ratios and 95% confidence intervals were recorded. A p-value of <0.05 was considered statistically significant.
Results More than 10% of Jamaican drivers admitted to DUIC in the past year. Approximately 43.3% of drivers who currently use cannabis reported DUIC only. Evidently, 86.8% of drivers who DUIC were heavy cannabis users. Approximately 30% of drivers with moderate to high risk perception of smoking cannabis sometimes or often were dependent on cannabis. Notwithstanding, drivers with no to low risk perception of smoking cannabis sometimes or often, were significantly likelier to be dependent (p<0.001 and p<0.001, respectively). Logistic regression highlighted male drivers (OR: 4.14, 95% CI 1.59 to 14.20, p=0.009) that were 34 years and under (OR: 2.97, 95% CI 1.71 to 5.29, p<0.001) and were the head of the household (OR: 2.22, 95% CI 1.10 to 4.75, p=0.031) and operated a machine as part of their job (OR: 1.87, 95% CI 1.09 to 3.24, p=0.023) were more likely to DUIC, whilst those who were married (OR: 0.42, 95% CI 0.22 to 0.74, p=0.004) and had achieved a tertiary level education (OR: 0.26, 95% CI 0.06 to 0.76, p=0.031) were less likely.
Conclusions 2 in 5 Jamaican drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate policymakers to consider mobile roadside drug testing and amending drug-driving laws to meet international standards.

(Word count 300)

Keywords: Drivers, Cannabis, Jamaica, Prevalence, Dependence, Risk Perception

Article Summary

Strengths and limitations of this study

- The use of the entire dataset population augmented the strength of the analysis.
- The use of logistic regression analysis allows for several sociodemographic factors to be simultaneously assessed to elicit appropriate risk and protective factors.
- The validated Cannabis Abuse Screening Test enhanced the reliability of the findings, given its frequent use in population sample studies.
- DUI information was self-reported, which can be affected by recall bias.
- This study could not establish causal relationships due to the nature of the cross-sectional data.

INTRODUCTION

The World Health Organization (WHO) highlights drug driving as a significant risk factor for road traffic accidents (1). Vehicular crash is among the top ten causes of demise across all age groups and the leading cause of death in young individuals under thirty (2). Accordingly, driving under the influence of drugs represents a massive public health concern for the global community (3–7). While driving under the influence has historically referred to alcohol, cannabis is evidently the second leading drug detected among drivers involved in road traffic injuries and fatalities worldwide (8,9). This remains foreseeable, as it continues to be widely used globally, as stated by the latest World Drug Report (10).

Legislative changes cultivate a growing concern that less restrictive laws might increase the prevalence of cannabis use in the general population and, thereby, its use among vehicle drivers. Several studies have confirmed this trend and denoted that cannabis prevalence amongst the populace is rising, as is the frequency of driving under its influence (11–14). Mounting data suggests that vehicular accidents due to impaired driving will increase (15–17) as more countries decriminalize recreational and medicinal cannabis use. Moreover, the risk of cannabis dependence will likely escalate as a competitive market allows for easier access to more affordable and potent cannabis products (18).

The impact of legalization and decriminalization has also likely contributed to changing risk perceptions regarding cannabis use (19) and the influence it exudes on driving behaviours (20). The misconception that drug driving is not perceived to be risky behaviour (21) and the contrasting belief that cannabis is the safest drug to use and drive (22) as it improves driving capability (23,24), presents a significant challenge in discouraging driving under the influence of cannabis (DUIC).

Despite the accumulated evidence over the preceding four decades, that suggest cannabis use impairs driver reaction time, visual acuity and spatial awareness, and encourages risky decision-making (25–28), cannabis users perceive DUIC as being less dangerous than driving under the influence of alcohol (DUIA) (29,30). Notwithstanding, extant literature highlights cannabis use is associated with higher risks of vehicular crash and fatality (31–33), which is exponentially elevated when used with alcohol (34-37). Contemporary research, however, is less conclusive as it pertains to the dose-response effects of delta-9-tetrahydrocannabinol (THC) on driving skills, with a number of studies showing a positive association between elevated levels of THC and impairment (38,39) whilst others found no clear relationship (40).

In Jamaica, a number of smaller-sized studies have reported an association between victims of vehicular crashes and evidence of cannabis use (41,42). Findings from these studies revealed victims were male drivers and adults predominantly under the age of thirty (41,42). However, the accrued data from these studies would have been prior to the legislative changes in 2015 that decriminalized and permitted the possession of two ounces of cannabis for personal use, and the establishment of a legal medicinal cannabis industry (43,44). It is suggested that the strong inclination for cannabis use amongst Jamaicans is enhanced due to recent amendments to the island's Dangerous Drugs Act that endorsed decriminalization (45), amongst other factors, including strong socio-cultural practices, and religious beliefs (46,47).

That being the case, the rapidly evolving legal landscape surrounding cannabis and the resulting shifts in social norms regarding its use necessitates a closer examination of the various factors associated with DUIC. To date, no studies in the Caribbean have used nationally representative data to determine cannabis use patterns, the sociodemographic characteristics, and

the risk perception of cannabis use and its association with developing dependence in vehicle drivers that may drive under the influence of cannabis.

OBJECTIVES

1. To determine the prevalence of cannabis use patterns among vehicle drivers, including those who drive under the influence of cannabis (DUIC) and those who are heavy cannabis users that DUIC.
2. To examine the association between developing cannabis dependence and the risk perception of smoking cannabis among drivers.
3. To investigate the sociodemographic factors associated with driving under the influence of cannabis.

METHODS

Study design, sample size and data source

This study is a secondary data analysis of the National Household Survey, Jamaica 2016. The target population comprised all respondents that identified as drivers of motorized vehicles. The sample analyzed in this study was a subset of 1060 participants. This research extracted variables relevant to cannabis use patterns, dependence, risk perception and the associated sociodemographic characteristics of DUIC in vehicle drivers. This study contained no identifying data on respondents, and researchers made no direct or indirect contact with any respondents.

The original study was a cross-sectional survey of a national population sample investigating the prevalence and patterns of drug use among Jamaicans between the ages of 12 and 65 (48). Data were collected between April and July 2016, targeting 357 households per parish, totalling a nationally representative sample of 4623 dwellings. The data were collected from a standardized questionnaire developed by the Inter-American Drug Abuse Control

Commission (CICAD) and the Inter-American Observatory on Drugs (OID) and conducted through a partnership with Jamaica's National Council on Drug Abuse (NCDA).

The survey employed a stratified multi-stage sampling design in which the primary sampling units (PSU) were the Enumeration Areas (EAs). Jamaica comprises 14 parishes and twenty-two (22) EAs per parish. In each EA, systematic random sampling was used to draw 16 households, from which one individual was randomly selected as the survey respondent. Sampling weights were calculated to account for selection probability, non-response, and population distribution and applied to ensure that the weighted sample distribution matched the population distribution of age and sex categories (48).

Study variables

Cannabis use prevalence

Utilizing the target variables, the prevalence of cannabis use was calculated for the periods of lifetime (ever use), past year (chronic) and past month (current) use. Responses were coded as 1=yes and 2=no. For heavy cannabis use, respondents were asked to state how many days they had smoked marijuana over the past 30 days. Responses indicating 20 days or more demonstrate heavy use as defined by the European Monitoring Centre for Drugs and Drug Addiction (49).

Driving under the influence of cannabis

The National Household Survey questionnaire asked respondents, "Have you driven a vehicle in the past 12 months?" and "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" The response options were 1=yes, 2=no. Utilizing a method previously described in the literature (50), driving under the influence of cannabis only was defined as an affirmative response to the survey question, "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" (limited to

respondents who reported past year cannabis use and no other illicit drug use). Individuals who reported using cannabis in the past year but did not report any other illegal drug use during that same time period, and also reported driving under the influence of drugs in the past year, were considered to have driven under the influence of cannabis only in the past year. Statistical computations also extracted respondents who were past month (current) cannabis users that answered "yes" to the question "During the past 12 months, have you driven a vehicle while you were under the influence of illegal drugs?" to determine those vehicle drivers who were current users that drive under the influence of cannabis (DUIC) only. The term illegal drugs included cannabis, crack, cocaine, heroin and 3,4-methylenedioxymethamphetamine (MDMA).

Cannabis dependence

Cannabis dependence was assessed using the Cannabis Abuse Screening Test (CAST). It is often used for the identification of cannabis use disorder (51). It encompasses a 6-item scale in which a score of less than 3 indicates users with a low risk of dependence, a score of 3 to 6 represents users with a moderate risk of dependence, and a score of 7 or more determines users with a high risk of dependence (52). For this study, the CAST scores were re-categorized into two groups where a score greater than or equal to 7 was defined as a high risk of dependence and a score of less than or equal to 6 was defined as not a high risk of cannabis dependence.

Risk perception

Perception of risk associated with frequent or infrequent use of marijuana was investigated in the initial survey by asking participants, "In your opinion, please indicate the risk level of smoking marijuana sometimes and smoking marijuana often". Participants indicated their risk level along a Likert scale continuum - (1) no risk; (2) low risk; (3) moderate risk; (4) high risk, and (5) I don't know the risk. For the secondary analysis, response options were re-categorized to reflect

0=no risk to low risk and 1=moderate to high risk to examine respondents who had indicated some level of perceived risk. The option "I don't know the risk" was excluded as an underrepresented category with insufficient frequencies that may introduce variability and bias in interpreting the results (53).

Sociodemographic characteristics

Sociodemographic characteristics that might influence cannabis use in drivers were included as covariates. Respondents were asked to state their sex (1=male, 0=female) and geographical location (re-categorized into 1=urban and 0=rural). Respondents' age was categorized into two groups – 1=34 years and under, representing young adults as suggested by Franssen and colleagues (54) and 0=35 years and over. Respondents were asked "Are you the head of household". The response options were 1=yes, 0=no. Educational status was assessed by asking respondents, "What is the highest educational level that you have achieved?" Ten response options were re-categorized into 1=tertiary level, 0=below tertiary level. The item corresponding to marital status had seven response options re-categorized into two choices: 1=married, 0=unmarried. The respondents were asked to disclose the household's total monthly income from a list of fifteen possibilities. These were re-categorized into 1=JA$50,000 and under or 0=over JA$50,000. The options "don't know" or "no response" was considered missing variables. The item on religious affiliation had twenty-six response options that were re-categorized as 1=Christian, 0=non-Christian. For occupation, respondents were asked to describe their job from a list of eleven options. These were re-categorized into 1=machine operators or 0=non-machine operators.

Statistical analysis

Descriptive statistical analysis was performed to determine the prevalence of cannabis use among vehicle drivers and to describe the associated sociodemographic characteristics. These were represented in frequencies, means and percentages. Bivariate analysis examining the association between the risk perception of smoking cannabis sometimes or often and the risk of dependence among vehicle drivers was done using Pearson's $\chi 2$ test. Logistic regression analyses were done to identify sociodemographic protective and risk factors for DUIC. Covariates included in the model were age (over 35 years as the reference category), occupation (non-machine operators as the reference category), marital status (unmarried as the reference category), sex (female as the reference category), education (below tertiary level as the reference category), religion (non-Christian as the reference category), household income (over JA$50,000 as the reference category), head of household ("no" responses as the reference category), and geographical location (rural as the reference category). Statistical analyses were conducted using R software, version 4.2.0. Multicollinearity between the study variables was explored using variance inflation factor (VIF) (with multicollinearity being defined as VIF >2.5).The Hosmer-Lemeshow statistic tested for goodness of fit of the regression model. The data were presented in the form of tables and text. ORs and 95% CIs were recorded. A p-value of <0.05 was considered statistically significant.

Ethical considerations

The ethics committee in Jamaica's Ministry of National Security granted permission to conduct the National Drug Use Prevalence Survey. Respondent participation was voluntary. Participants gave informed consent and no personal identifiers were required in maintaining confidentiality. Data were securely stored in a database (48).

RESULTS

Prevalence

Table 1 demonstrates the prevalence of cannabis use in the total population (n=4623) and among the vehicle driver population (n=1060). Approximately 1 in 4 individuals was a vehicle driver (23%). Among those in the population who reported lifetime use of cannabis, 60.1% reported use in the past year, and 53.9% reported use in the past month. Of the 1060 vehicle drivers, 125 (11.8%) admitted driving under the influence of illegal drugs (DUI-ID) in the past year. Of those who admitted to DUI-ID, 110 drivers were cannabis users only (92%), indicating that 10.4% of drivers admitted to driving under the influence of cannabis (DUIC) in the past year.

Of the 1060 vehicle drivers, 245 vehicle drivers admitted to being current cannabis users, of which 111 drivers admitted to driving under the influence of illegal drugs. Of the 111 drivers who admitted to driving under the influence of illegal drugs, five persons used drugs other than cannabis (one person each for heroin, crack and cocaine and two for MDMA). Excluding these five individuals, 106 drivers who admitted driving under the influence of illegal drugs used cannabis only. This is approximately 43.3% and indicates that two in five Jamaicans, who are drivers and are current cannabis users, operate a vehicle under the influence of cannabis only.

Of the 106 drivers who admitted to driving under the influence of cannabis only, 92 were heavy cannabis users (use 20 days or more in a month). This is 86.8% and indicates that nine out of ten Jamaican drivers, who were current cannabis users and admitted to driving under the influence, were heavy users.

Table 1: Cannabis use prevalence among the total population (n=4623) and vehicle drivers (n=1060)

Cannabis Use	Frequency	Percentage
Population Lifetime Use	1307	28.3%
Population Past Year Use	786	60.1%
Population Past Month/Current Use	704	53.9%
Current Users who Drive	245	23.1%

Current Users who DUIC only	106	43.3%
Current & Heavy Users who DUIC only	92	86.8%

Sociodemographic factor findings

Table 2 shows the sociodemographic characteristics of population vehicle drivers. The mean age of respondents was 36.56 years (s.d.±12.582). Most drivers were male (70.6%), employed (72.6%), unmarried (61.0%), of Christian beliefs (72.8%), living in rural areas (54.5%) and with a less than tertiary level education achievement (83.3%).

Table 2: Sociodemographic characteristics of population vehicle drivers (n=1060) and drivers that are current cannabis users who DUIC only (n=106)

	Vehicle Drivers (Population)	Vehicle Drivers (DUIC)
Variable	**Frequency**	**Frequency**
Sex		
Male	748 (70.6%)	99 (93.4%)
Female	312 (29.4%)	07 (06.6%)
Age		
35 years and under	551 (52.0%)	67 (63.2%)
Over 35 years	509 (48.0%)	39 (36.8%)
Education		
Tertiary level	177 (16.7%)	07 (06.6%)
Below tertiary level	883 (83.3%)	99 (93.4%)
Religion		
Christian	772 (72.8%)	65 (61.3%)
Non-Christian	288 (27.2%)	41 (38.7%)
Employment		
Employed	770 (72.6%)	78 (73.6%)
Unemployed	290 (27.4%)	28 (26.4%)
Marital Status		
Married	413 (39.0%)	29 (27.4%)
Unmarried	647 (61.0%)	77 (72.6%)
Geographic Location		
Urban	482 (45.5%)	47 (44.3%)
Rural	578 (54.5%)	59 (55.7%)
Head of Household		
Yes	700 (66.0%)	82 (77.4%)
No	360 (34.0%)	24 (22.6%)
Household Income		

JA$50,000 and under	416 (45.1%)	46 (51.1%)
Over JA$50,000	507 (54.9%)	44 (48.9%)
Occupation		
Machine operators	267 (34.7%)	43 (55.1%)
Non-machine operators	503 (65.3%)	35 (44.9%)

Table 2 also displays demographics for drivers who admit to being a current cannabis user and driving under the influence of cannabis only. Most were male (93.4%), the head of household (77.4%) and operated machinery (55.1%) as part of their job description. Most drivers had achieved less than tertiary level education achievement (93.4%). Household income, is the sole variable where data were not recorded in 137 cases of drivers in the population, and 16 cases of drivers that are current cannabis users who DUIC only.

Risk perception and cannabis dependence findings

Table 3 summarizes the risk perception of smoking cannabis sometimes or often and level of use according to the CAST questionnaire among vehicle drivers. Approximately 54% and 29% of drivers reported low risk perception to smoking cannabis sometimes and often respectively.

Forty-four percent (44%) of drivers who reported low risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7), whereas 28% of drivers who reported high risk perception to smoking cannabis sometimes had a high risk of cannabis dependence (CAST ≥ 7). This indicates that drivers with a low risk perception to smoking cannabis sometimes were more likely to be dependent on cannabis and this difference was statistically significant ($p<0.001$).

Fifty-two percent (52%) of drivers who reported low risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥ 7), whereas 30% of drivers who reported high risk perception to smoking cannabis often had a high risk of cannabis dependence (CAST ≥

7). This indicates that drivers with a low risk perception to smoking cannabis often were more likely to be dependent on cannabis and this difference was statistically significant (p<0.001).

Table 3: χ^2 test of independence between the CAST questionnaire and risk perception of smoking cannabis among vehicle drivers

	Smoking Cannabis Sometimes	
	No to low risk	Moderate to high risk
CAST ≤ 6	132	147
CAST ≥ 7	103	57
$X^2 = 11.226$, df = 1, $p<0.001^{***}$		
	Smoking Cannabis Often	
	No to low risk	Moderate to high risk
CAST ≤ 6	61	218
CAST ≥ 7	67	93
$X^2 = 18.757$, df = 1, $p<0.001^{***}$		

$^{***}p<0.001$.
CAST, Cannabis Abuse Screening Test.

Estimation of ORs for sociodemographic factors associated with DUIC

Table 4 shows the results of a logistic regression analysis performed to assess the associations between driving under the influence of cannabis in the past year and select sociodemographic factors. There was no multicollinearity found among the independent variables used in the analysis. The Hosmer-Lemeshow test shows the p-value at 0.497 (p>0.05), which indicates the model fits the data. The model illustrates statistically significant relationships for several factors.

Drivers 34 years and under were 2.97 times (95% CI 1.71 to 5.29, p<0.001) more likely than those 35 years and older to report DUIC in the past year. Drivers who were the head of household and operated machinery as part of their job were 2.22 times (95% CI 1.10 to 4.75, p=0.031) and 1.87 times (95% CI 1.09 to 3.24, p=0.023) more likely to report DUIC in the past year than those who were not the head of household or in non-machinery operated positions. Similarly, male drivers were 4.14 times (95% CI 1.59 to 14.20, p=0.009) more likely than females drivers to report DUIC in the past year.

The model also indicated that there were statistically significant inverse relationships for two of the factors. Married drivers were 58% less likely than unmarried drivers to report DUIC in the past year. Alternately, the result can also be interpreted that the odds of DUIC is 2.38 times higher among unmarried drivers. Similarly, drivers who matriculated up to a tertiary level education were 74% less likely to report DUIC in the past year than drivers with less than a tertiary level education. Alternately, the result can also be interpreted that the odds of DUIC is 3.85 times higher among drivers with less than a tertiary education. Drivers who were Christian-affiliated and living in a household that earned JA$50,000 or lower per month reduced the risk of DUIC in the past year. These inverse associations were, however, not statistically significant.

Table 4: Logistic regression model of select sociodemographic factors associated with driving under the influence of cannabis only in the past year

Variables	Estimate	OR	95% CI	P value
Age (over 35 years)		1		
Age (34 years and under)	1.0897	2.97	1.71, 5.29	<0.001***
Occupation (non-machine operators)		1		
Occupation (machine operators)	0.6280	1.87	1.09, 3.24	0.023*
Marital status (unmarried)		1		
Marital Status (married)	-0.8794	0.42	0.22, 0.74	0.004**
Sex (female)		1		
Sex (male)	1.4197	4.14	1.59, 14.2	0.009**
Education (below tertiary level)		1		
Education (tertiary level)	-1.3568	0.26	0.06, 0.76	0.031*
Religion (non-Christian)		1		
Religion (Christian)	-0.4761	0.62	0.36, 1.08	0.088
Household income (over JA$50,000)		1		
Household income (JA$50,000 and under)	-0.2079	0.81	0.47, 1.40	0.460
Head of household (no)		1		
Head of household (yes)	0.7962	2.22	1.10, 4.75	0.031*
Geographical location (rural)		1		
Geographical location (urban)	0.1294	1.14	0.66, 1.97	0.640

*p<0.05, **p<0.01, ***p<0.001.

DISCUSSION

This study is the first of its kind in the Caribbean region and sheds light on the impact of driving under the influence of cannabis (DUIC) on a national population. The findings reveal that a significant number of Jamaican drivers who use cannabis, operate a vehicle under its influence, with more than 10% conceding to this unsafe and risky practice. It is worth noting the occurrence is eight times greater than the reported mean prevalence of 1.32% (range 0.0%–5.99%) in general driving populations across thirteen participant countries of The European Union's Driving under the Influence of Drugs, Alcohol and Medicines (DRUID) project (8). The high proclivity towards its use among Jamaicans, no doubt as a result of social and cultural influence (46,47), represents a worrying proposition given that extensive research demonstrates that cannabis use while driving, or under its influence, may impair driving ability (55).

The second key finding is that among past-month cannabis users, more than 2 in 5 (43.3%) drivers report driving a vehicle while under the influence of cannabis (DUIC). This represents a marked difference compared to similar respondents in a previous study who admitted to driving under the influence of alcohol (18%) (56). Indeed, in terms of exposure, driving under the influence of cannabis was far more commonplace among the Jamaican driving population than driving under the influence of alcohol. A plausible rationale is that the effects of driving under the influence of cannabis have not received the same level of public awareness as driving under the influence of alcohol. Moreover, current legislation provides minimal legal deterrence to DUIC, lacking an effective roadside drug driving testing strategy and comprising a fine of approximately US$65 that is unlikely to dissuade offender motorists (57).

The third critical finding is that the more frequent cannabis users are more likely to report DUIC. This study denoted that approximately 9 out of 10 Jamaicans who were past-month

cannabis users and reported DUIC admitted to being heavy users (use 20 days or more in a month). The compelling significance of this finding is that a number of studies highlight the increased odds of motor vehicle crashes associated with acute cannabis intoxication (31,32,58), mainly because the psychoactive effects may persist for a significant period of time (59).

The fourth key finding demonstrated a significant association between risk perception and the risk of developing cannabis dependence among vehicle drivers. Expectedly, drivers with no to low risk perceptions of smoking cannabis showed higher risks of cannabis dependence. However, a salient finding is that approximately 30% of drivers with moderate to high risk perception of smoking cannabis, whether sometimes or often, were also associated with an increased risk of cannabis dependence. Indeed, it may be beneficial to address the misperception that smoking cannabis is not dangerous among drivers who perceive it as less risky. Additionally, directing drivers who have been convicted or suspended for this behaviour towards a remedial program, similar to those mandated for drunk driving, could prove effective (60). However, the high prevalence of cannabis dependence among drivers who acknowledge smoking cannabis as being harmful further underscores the fact that DUIC is becoming more socially acceptable (61), normative (62) and less perceived as a risky behaviour (21).

Finally, this study also revealed several sociodemographic factors associated with DUIC. Regression analysis indicated that being a young adult, employed in a job operating machinery, of the male sex, and the head of the household were predictive of driving under the influence of cannabis, whereas being married and having a tertiary level education were protective factors. Interestingly, the risk factors accrued were similar to those observed for DUIA among Jamaican drivers demonstrated in previous research (56). As such, the opportunity for legislators to include driving under the influence of cannabis as part of an overall national DUI interventional effort,

allow for comprehensive and collaborative efforts that a siloed approach to policymaking is unlikely to foster. Accordingly, a further call to improve data collection protocols regarding DUI behaviours and increase sobriety checkpoints in Jamaica, represent replicable and cost-effective strategies that have found favour in other low-income and middle-income countries (LMICs) (63).

Cumulatively, the findings of this study have heightened concerns regarding driving under the influence of cannabis among Jamaican drivers, particularly in light of the island's increasing annual road fatality rate (64). The legislation regarding drug driving must comply with global benchmarks. International policymakers have sought to model drug-driving laws on those that have proven effective for driving under the influence of alcohol, inclusive of a strategy that encourages roadside drug testing. DUIC can be measured through observed impairment in a Standardized Field Sobriety Test (SFST) (65–67) or Drug Evaluation and Classification (DEC) (68) programme by a police officer or by using point-of-collection testing devices (69). These strict policies use a per se or zero tolerance approach, meaning that if THC is detected at or above a specific concentration in a biological sample, the driver is considered to have committed a DUIC offense, regardless of their level of impairment. Several countries, including Norway and Denmark, alongside a number of states in the US (69-70), have adopted per se limits ranging from 2-5 ng/ml THC on oral fluid and blood tests, where studies demonstrate the first indications of impairment may occur, while other nations like Australia endorse the de-facto zero-tolerance approach (71). While some studies establish that a level of 3.7 ng/ml THC is equivalent to the legal blood alcohol concentration (BAC) of 0.05 g/dL accepted in a number of countries (72,73), other studies in the US suggest an absence of a dose-dependent relationship between THC level and driving impairment, especially among frequent users where tolerance may be a factor

(40,74). Notably, the accumulated literature regarding the impact of roadside drug testing remains in its infancy, given that most countries would have recently embarked on legislative reform. Notwithstanding, a number of contemporary research have yielded promising results that endorse the importance of roadside testing as part of a DUIC deterrence initiative (75–77).

Driving necessitates a higher level of mental and motor dexterity, making it an intrinsically complex undertaking (78). The misperception that DUIC is not risky and that cannabis use adjunctly improves driving skills (21,23) is further highlighted by this study's prevailing finding that a substantial number of drivers (between 30% and 50%) demonstrated a low risk perception of cannabis smoking. This notable risk tolerance or lack thereof may also represent a concern in the workplace, given that DUIC drivers were predominantly employed in machine-operated jobs. Notwithstanding, cannabis-impaired driving, certainly within the Jamaican context, is likely also influenced by recent decriminalization and medicalization (44) policies as seen elsewhere that have adopted a similar stance (79), and undoubtedly enhanced by socio-cultural acceptance (47), easy access (48) and availability of higher potency products (80). Accordingly, a calculated national initiative should seek to review current cannabis policy, include more robust regulatory mechanisms and disseminate a public education programme on the risks associated with cannabis use and driving as part of an overall prevention and deterrence effort. Furthermore, the data gleaned may provide the groundwork for policy change in reducing DUIC behaviours per established recommendations in other territories that have similarly endorsed decriminalization or legalization (81-85).

One of the study's limitations was that DUI information was self-reported, which can be affected by recall bias. Moreover, the inclination of many of the survey participants to give "socially acceptable" answers and not admit any illegal activities might also introduce a response

bias. Notably, this research could not establish causal relationships due to the nature of the cross-sectional data. However, one of the study's strengths is that the validated Cannabis Abuse Screening Test enhanced the reliability of the findings given that it is frequently used worldwide in national population sample studies (52). Although the data analyzed in this study were collected in 2016, the findings are of immense value for national policy, providing a foundation for further research to build on and fill a vital knowledge gap, especially in low-income and middle-income countries (LMICs) where global research is scarce.

CONCLUSION

Two in five Jamaican drivers, who currently smoke cannabis, drive under its influence, with over 85% engaging in heavy use. Public health implications necessitate stakeholders to consider roadside drug testing of drivers as part of developing evidence-based policy in mitigating the safety risks posed by driving under the influence of cannabis. Moreover, the rising prevalence of cannabis use and availability of higher potency products in a legally and socially tolerant setting, position Jamaica as a key research collaborator in developing policies dissuading cannabis-impaired driving, that may be applicable and replicated in other sister low-income and middle-income countries (LMICs).

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STROBE Statement

Checklist of items that should be included in reports of observational studies

Section/Topic	Item No	Recommendation	Reported on Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1,2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3,4,5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5,6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5,6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	5,6
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6,7,8
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6,7,8
Bias	9	Describe any efforts to address potential sources of bias	6,9
Study size	10	Explain how the study size was arrived at	5,6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6,7,8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	9
		(*b*) Describe any methods used to examine subgroups and interactions	9
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	N/A

Section/Topic	Item No	Recommendation	Reported on Page No
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	N/A
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	NA/
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	7,8,9
		(b) Indicate number of participants with missing data for each variable of interest	12
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	10-12
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-14
		(*b*) Report category boundaries when continuous variables were categorized	10-14
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	10-14
Discussion			
Key results	18	Summarise key results with reference to study objectives	15,16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18,19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	17-19
Other Information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	20

**Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.*

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.