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Research Article

Drink-Driving Violation Rate and Associated Factors in an Indian Metropolis: A Cross-Sectional Study

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Abstract

Introduction: Nearly 2.2% of officially reported road crash fatalities in India are attributed to Driving Under the Influence (DUI), however, this figure is underreported. Fatalities resulting from DUI are influenced by the prevalence and severity of drink-driving; however, evidence from India on this issue remains limited. **Aim:** To assess the prevalence of drink-driving violations among randomly checked drivers/riders in Bengaluru city; Describe Blood Alcohol Concentration (BAC) levels among violators and assess driver and vehicle-related factors associated with drink-driving violations in Bengaluru city. **Methods:** This cross-sectional study was conducted in 52 randomly selected roads in Bengaluru city during March 2023. Police randomly stopped vehicles, conducted two-phase alcohol breath testing. Field data collectors observed the process and collected data using hand-held devices. Statistical analysis was done using SPSS v25 and STATA. **Results:** Around 10726 drivers/riders were screened. Prevalence of drink-driving violation (BAC more than 30mg%) was 2.98% (95% CI 2.7-3.3) with median BAC levels of 69 mg per 100 ml of blood. Odds of drink drive violation were higher among motorized two-wheelers, private vehicles, and riders traveling alone. **Discussion:** Though drink-driving violation rates are relatively less, intoxication levels are higher as the median BAC levels among tested are nearly twice the legally prescribed limits. **Conclusion:** The study recommends conducting periodic random drink-driving assessments to determine the prevalence of drink-driving and to evaluate the effectiveness of interventions aimed at reducing it in the city. It also suggests capacity building for the police department to carry out visible, random, uniform, and periodic population-based drink-drive and establish BAC surveillance in Bengaluru.

Keywords: Driving under the influence; Blood Alcohol Concentration; Breath testing; Prevalence; Surveillance; Bengaluru

Introduction

India accounts for 11% of global road traffic fatalities. In 2022, 2.5% of the officially reported 1,68,491 road fatalities in India were due to driving under the influence (DUI) [1]. Hospital-based research suggests a higher prevalence with alcohol linked to 10-43% of Road Traffic Injuries (RTIs) and 7-20% of RTI fatalities, indicating significant under-reporting in official data [2]. Data from Karnataka indicates that only 1% of fatalities are attributed to drink-driving [3]. Apart from under-reporting, significant variations in drink-driving prevalence is expected between Indian states, due to differences in alcohol regulation, enforcement policies, socio-economic status and cultural norms [4,5].

Reducing drink-driving is crucial to achieving the UN decadal target for road safety, aiming for a 50% reduction in road deaths and serious injuries by year 2030 [5]. Drink-driving patterns reflect the prevailing alcohol policies, manufacture, sales, cultural norms, consumption patterns and the enforcement ecosystem [6,7]. It is proven that enacting and enforcing a nationwide legislation for drink-driving through uniform, random and visible enforcement methods is successful in reducing drink-driving, irrespective of different socio-cultural situations [2,6-9].

The legal age for alcohol consumption varies by state, from 18 to 25 years (18 years in the study city) [6]. Under Section 185 of the Motor Vehicle Act 1988, drink-driving is legally defined as Blood Alcohol Concentration (BAC) levels exceeding 30mg per 100 ml of blood, as measured by a breathalyser [10]. The Motor Vehicles (Amendment) Act in 2019, increased the penalty for drink-driving violation from INR 1000 to INR 10000 for the first offence and INR 20000 for the second conviction [11]. Though the amendments are expected to deter drink-driving, it is not objectively measured. Although traffic police regularly compile information on number of drink-driving violations, it is an indicator of enforcement and not of drink-driving prevalence in the population. Periodic assessment of drink-driving prevalence is better indicator of effectiveness of drink-driving countermeasures. This data remains limited in the Indian context.

Bengaluru, the capital of Karnataka state and home to nearly 13 million people [12], accounted for 20% of Karnataka's sales of Indian Made Liquor (IML), totalling 66.1 million carton boxes in year 2021-22 [13]. The Bengaluru traffic police reported 5343, 4144, and 26371 cases of drink-driving violations in the year 2020, 2021 and 2022 respectively [14], amounting to 197 drink-driving violations per 100,000 population in the year 2022. Studies from year 2009 in Bengaluru indicated that 4% of road crash fatalities and 22% of RTIs were linked to alcohol [2]. Since then, changes in access to alcohol, drinking patterns, motorisation and enforcement mechanisms highlight the need for updated data on drink-driving prevalence and its associated factors in Bengaluru city.

In response, Department of Epidemiology, WHO Collaborating Centre for Injury prevention and safety promotion at the National Institute of Mental Health and Neurosciences (NIMHANS) and Johns Hopkins International Injury Research Unit (JH-IIRU),, with support from Bengaluru Traffic Police (BTP) conducted an assessment to

• Assess prevalence of drink-driving violation among randomly checked drivers/riders in Bengaluru city.

• Describe Blood Alcohol Concentration levels among drink-drive violators.

• Assess driver and vehicle-related factors associated with drink-driving violation in Bengaluru city.

Methodology

Bengaluru, the capital of Karnataka state, is India's fifth most populous urban agglomeration [12] and has approximately 11 million registered vehicles [15]. This cross-sectional assessment of drink-driving was conducted in Bengaluru from March 4 to March 31, 2023. Each day, drink-driving checks and data collection were performed on two randomly selected roads, with each road conveniently sampled from two different police station jurisdictions. The Bengaluru Traffic Police assigned two Police Inspectors to coordinate data collection. The assessment ultimately covered 52 randomly selected roads across all 48 police station jurisdictions in the city.

Before data collection on each randomly selected road, traffic wardens (a formal volunteer force) and police personnel from the designated traffic police station were briefed on the study's purpose, the procedure for stopping vehicles, setting up zig-zag checkpoints, conducting screening and confirmatory tests for BAC levels. Police personnel randomly stopped vehicles for testing and conducted both screening and confirmatory breathalyser tests. Traffic wardens assisted with traffic management, randomly stopping vehicles for testing, and apprehending vehicles attempting to evade checkpoints. Field data collectors from NIMHANS observed the process and gathered observational data.

The drink-driving assessment and data collection took place between 10 p.m. and 12 am in sampled road. Police stopped vehicles randomly near the checkpoint, aiming to test as many vehicles as possible. In the first step, each stopped driver/rider was asked to blow into the breathalyser for three seconds (screening

test). Those who screened positive (indicated by a red band in the device reading "positive") were asked to pull over for a roadside quantitative/confirmatory test, conducted by the Sub-inspector of police. For the confirmatory test (step two), the screened-positive individuals were informed of the process and asked to blow into the breathalyser for 10 seconds. Blood Alcohol Concentration (BAC) levels were recorded, and any driver/rider with a BAC level above 30 mg per 100 ml of blood was classified as a 'drink-driving violator' [10]. The assessment used the MSIPL breath alcohol analyser A8080TC, calibrated using wet bath method, which is routinely used by traffic police for enforcement.

A team of trained Field Data Collectors (FDCs) from NIMHANS, consisting of one observer and one recorder, observed the entire assessment process and collected data by observation, using an observational checklist developed by NIMHANS and JH-IIRU. Review of literature, expert consultation and pilot testing in one location was completed before finalising the study instrument. The finalized instrument was then uploaded to the KOBO Collect application (version 2021.2.4) and installed on a handheld tablet (4GB RAM, 64GB ROM, Android OS) for data collection.

FDCs collected observational data on vehicle type (sedan/saloon, pick up/light truck, truck or large truck, bus, minibus/minivan, SUV, three-wheeler, motorcycle and others), vehicle ownership (personal, commercial, taxi, ride share), whether it was weekend or weekday, driver age (<18, 18-24, 25-59, ≥60), driver sex, number of occupants, presence of child occupant, helmet use, seat belt use and mobile phone use while driving/riding. This data was recorded for all vehicles stopped and screened by police. Information on screening test results (positive/negative for alcohol) and BAC levels in mg% was collected from the police.

To ensure data quality and minimise bias, comprehensive training sessions were conducted for data collectors and traffic personnel prior to data collection. Faculty from NIMHANS and coordinators from Bengaluru Traffic Police monitored data collection bi-weekly. Data was reviewed weekly for consistency, coding accuracy, and overall quality. The variables used in the observational check-list is pre-validated and tested as it is used across multiple cities and countries by JH-IIRU, where roadside observational studies are conducted as part of the Bloomberg Initiative for Global Road Safety.

Statistical analysis was done using SPSS v. 25 and STATA. Prevalence of drink-driving positivity and drink-drive violation is presented per 100 drivers/riders tested, along with 95% Confidence intervals. Drink-drive positivity is defined as any driver/rider testing positive for alcohol in the quantitative test, but the BAC level is less than or equal to 30 mg per 100 ml of blood. A drink-driving violation is defined as any driver/rider testing positive in quantitative test for alcohol and BAC levels exceeding 30 mg per 100 ml of blood [10]. The specific prevalence of drink-driving violations is further presented by age, sex, type of vehicle, weekend versus weekday, and by helmet, seat-belt, and mobile phone use.

Chi-square test was applied to test for univariate associations between drink-drive violation, vehicle types, weekend/weekday periods, vehicle ownership, and road safety risk factors like helmet, seat-belt and mobile phone use. Multivariate binary logistic regression analysis was conducted to estimate risk for drink-driving violation. Crude and Adjusted Odds ratios are provided. The goodness of fit was assessed using the Wald test and model prediction was assessed by Nagelkerke's r' square.

Ethics clearance was obtained from the institutional ethics committee, NIMHANS [No. NIMHANS/IEC (BS&NS DIV.)/2020-21] and IERB, Johns Hopkins International Injury Research Unit (IRB No.13638). Permission was obtained from Bengaluru Traffic Police.

Results

Sociodemographic distribution of the participants

The distribution of study subjects describes the sociodemographic details of the vehicle users. A total of 10810 vehicles were stopped randomly of which 10726 drivers/riders were screened for breath alcohol. Nearly 84 drivers either evaded testing or their observational data was unable to be captured by field data collectors amid busy data collection sessions. They are likely to be drivers screened negative and would be let off quickly. Around 2.6% of drivers/riders were aged 18-24 years, 98% were males, and around 44% of vehicles stopped were cars (Table 1).

Variables	Frequency (%)
Driver Age (in years)	
<18	7(0.1)
18-24	170(1.6)
25-59	10472(96.9)
60 or older	160(1.5)
Non-observable	1(0.0)
Driver sex	
Female	189(1.7)
Male	10583(97.9)
Non-observable	38(0.4)
Type of vehicle	
Sedan/Saloon	4728(43.7)
Pick up/light truck	428(4)
Truck/large truck	492(4.6)
Bus	65(0.6)
Minibus/minivan	89(0.8)
SUV	863(8)
Three-wheeler	484(4.5)
Motor Cycle	3654(33.8)
Others	7(0.1)
Vehicle ownership type	
Commercial	1431(13.2)
Taxi	929(8.6)
Ride-share	48(0.4)
Other	8402(77.7)

Table 1: Distribution of study subjects.

Prevalence and specific prevalence rate of drink-driving

During the assessment, 471(4.4%) screened positive for alcohol during the screening test and were subjected to a confirmatory test. The prevalence of drink-driving positivity is 4.4% (positive for alcohol in confirmatory test) and prevalence of drink-driving violation (positive and BAC level more than 30 mg%) is 2.98% (95% CI 2.7, 3.3) (Table 2).

Variables	Stopped	Drink-drive positive n (%) (positive but BAC <30 mg%)	Drink-drive violation n (%) (BAC >30mg%)	95%CI for drink-drive violation
Overall	**10810**	**441(4.1)**	**320(2.9)**	**2.7-3.3**
Driver age (in years)				
18-24	170	10(5.9)	7(4.1)	1.81, 7.9
25-59	10472	426(4.0)	309(3.0)	2.63, 3.28
60 or older	160	5(3.1)	4(2.5)	0.79, 5.9

Non-observable	8	0	0	0
Driver sex				
Female	189	5 (2.6)	3 (1.6)	0.4, 4.2
Male	10583	119 (4.1)	316 (3.0)	2.67, 3.32
Non-observable	38	1 (2.6)	1 (2.6)	0.13, 12.3
Type of vehicle				
Sedan/Saloon	4728	285(6.0)	114(2.4)	2.0, 2.8
Pick up/light truck	428	8(1.9)	7(1.6)	0.71, 3.20
Truck/large truck	492	11(2.2)	11(2.2)	1.18, 3.85
Bus	65	0(0)	0 (0)	0
Minibus/minivan	89	1(1.1)	1(1.1)	0.05, 5.41
SUV	863	33 (37.0)	19(2.2)	1.37, 3.35
Three-wheeler	484	6 (1.2)	5(1.0)	0.379, 2.27
Motor Cycle	3654	211(5.8)	163(4.5)	3.827, 5.16
Others	7	0	0(0)	0
Driver using a hand-held phone				
Not using a hand-held phone	10343	426(4.1)	312(3.0)	2.69, 3.36
Using hand-held phone	449	14(3.1)	8(1.8)	0.83, 3.35
Non-observable	18	1(5.6)	0	0
Driver using seat belt (n=6665)				
Not wearing a seat belt	1546	58(3.8)	50(3.2)	2.43, 4.20
Wearing seat belt	5083	166(3.3)	**102 (2.0)**[*]	1.64,2.42
Non-observable	36	0	0	0
Helmet usage (n=3654)				
Incorrect helmet usage	2471	153(6.2)	121(4.9)	4.097, 5.802
Correct helmet usage	1183	58(4.9)	42(3.6)	2.603, 4.724
[*]chi-square value= 15.155 and p-value 0.004 at 95% CI				

Table 2: Prevalence of drink-drive positivity and drink-drive violation in Bengaluru (N=10810).

Specific prevalence of drink-driving violation is higher among persons aged 18-24 years (4%; 95% CI 1.81, 7.9), motorcycle riders (4.5%; 95% CI 3.83, 5.17) and 3% were males (CI 2.67, 3.32). Prevalence of drink-driving violation among drivers using with hand-held phones is 1.8% (95% CI 0.83, 3.35), not wearing a seat belt is 3.2% (95% CI 2.43, 4.20) and not using a correct helmet is 4.9% (95% CI 4.10, 5.80). A statistically significant association was found between not wearing a seatbelt while drink driving (Chi-square value 15.55 p value=0.004).

(Average BAC Levels among drink-drive violators) Median BAC levels among drink drive violators are 69 mg%, and the mean is 94.8 ± 78.2 (Table 3). The median BAC levels were higher among persons aged 18-24 years (139 mg%), males (69 mg%), motorcycle riders (78 mg%), drivers using handheld phones (80 mg%), wearing seat belts (61mg%) and Incorrect helmet usage (80 mg%).

Variables	N	Mean± SD BAC Levels (mg%)	Median BAC Levels (mg%)	25th percentile	75th percentile
Overall	**320**	**94.8 ±78.2**	**69**	**47**	**75**
Driver age (in years)					
18-24	7	117.3±53.1	139	59	165
25-59	309	94.1±78.9	68	47	106
60 or older	4	112±57.6	130	51	154
Driver sex					
Female	3	52±15.9	48	39	
Male	316	95.4±78.5	69	47	110.25
Non-observable	1	37	37	37	37
Type of vehicle					
Sedan/Saloon	114	83.7± 64.8	63	42	98.7
Pick up/light truck	7	75.1± 60.1	49	37	111
Truck/large truck	11	90 ± 69.2	57	47	106
SUV	19	73.2±62.6	52	44	73
Three-wheeler	5	64±32.1	49	38	98.5
Motor Cycle	163	105.6±86.6	78	50	131
Driver using a hand-held phone					
Not using a hand-held phone	312	94.6±77.9	68.5	47	110.3
Using hand-held phone	8	104±94.5	80.5	50.3	106.8
Driver using seat belt (n=6665)					
Not wearing a seat belt	50	93.7±85.5	60	47.8	106
Wearing seat belt	102	79.7±56.8	61.5	41.8	95
Helmet usage (n=3654)					
Incorrect helmet usage	121	109.3±89.1	80	50.5	136
Correct helmet usage	42	95±78.7	72	47.8	106.8

*Only one drink driving violation among minibus driver was found and the BAC levels were 353 mg/100ml of blood and no drink drive violations was found among bus drivers.

Table 3: Average BAC Levels among drink-drive violators.

Variable	Frequency (%)
Distance remaining to travel in Kilometres (n=428)	
0	3(0.7)
1-5	227(53.0)
6-10	123(28.7)
11-15	39(9.1)
16-20	11(2.6)
>20	25(5.8)
Number of occupants including driver	
1	5186(48.0)
2	3268(30.2)
3	1779(16.5)
>4	577(5.3)
Vehicles with at least one child occupant	458(4.2)

Table 4: Distance to travel, number of occupants.

Factors associated with drink-driving violations. Univariate and multivariate analysis of risk factors with drink driving represents the univariate and multivariate logistic regression analysis results for factors associated with drink-driving violation. The odds of drinkdriving violations were 2.43 times among motorised two-wheelers (95% CI 1.45, 5.07) as against other types of vehicle users. Risk for drink-driving violation is significantly higher when travelling alone as against travelling with another person in the vehicle (OR= 0.735, 95% 0.58, 0.93). Risk is 17% higher for drink-driving violation when travelling solo as against travelling with a companion (Table 5).

Variables		Drink driving exceeding the limit (n=10810)	
		Positive (n=320)	Negative (n=10490)
		COR	**AOR**
Type of vehicle	**Others**	Reference	
	Car	**1.565 (1.009, 2.425)**	1.577(0.756, 3.290)
	Motor Vehicle	**2.998 (1.945, 4.621)**	**2.413(1.1472, 5.077)**
Vehicle ownership type	**Commercial**	Reference	
	Taxi	0.734 (0.356, 1.512)	0.551(0.219, 1.382)
	Rideshare	1.302 (0.172, 9.849)	0.924(0.111, 7.657)
	Others	**2.149 (1.400, 3.300)**	1.229(0.585, 2.582)
Age (in years)	**>25**	Reference	
	<25	1.358 (0.632, 2.915)	0.869(0.403, 1.873)
Concomitant road safety risk factors (incorrect helmet use/no seatbelt use/ mobile phone use)	**No risk factor**	Reference	
	At least any one risk factor	1.120 (0.880, 1.426)	1.102(0.849, 1.431)

Number of occupants	Only driver/rider	Reference	
	Accompanying driver/rider	0.639 (0.510, 0.801)	0.735(0.579, 0.933)

Table 5: Univariate and multivariate analysis of risk factors with drink driving.

Vehicle ownership, type of vehicles, age, concomitant risk factors (incorrect helmet use/no seatbelt use/ mobile phone use) and number of occupants were not statistically significant with drink-driving violation in Bengaluru.

Discussion

We randomly tested 10,726 drivers/riders and estimated the prevalence of drink-driving violations (BAC>30 mg%) at 2.98% (95% CI: 2.7–3.3), with a median BAC level of 69 mg%. The odds of drink-driving violations were higher among motorized two-wheeler riders, those traveling alone, and drivers of private vehicles.

This drink-driving assessment is one of the largest population-based studies conducted over a consecutive month, covering all police station jurisdictions (n=48) in Bengaluru city. The study exemplifies intersectoral collaboration among police, health, civic authorities, and academia for road safety research. As population-based drink-driving studies are limited in India, this study provides valuable evidence on drink-driving violation rates and patterns among urban drivers/riders.

We estimated drink-driving violation rate of approximately 3% in Bengaluru in 2023. Previously, roadside studies in Bengaluru in 2002 indicated that 37% of tested drivers were driving under the influence of alcohol during suspicion checks and 13% during random checks [2]. Although sample sizes and methods varied between 2002 and 2023, drink-driving violations appear to have declined by 2022. This reduction may be attributed to improved enforcement activities, greater driver and public awareness, higher penalties for drink-driving offences introduced in 2019 [11], and the availability of safer travel options (cab aggregators like Ola, Uber, etc, driver apps like Drive U) to reach back home safely after drinking.

Drink-driving violation cases booked by Bengaluru traffic police decreased from 60973 cases among 4,476,170 vehicle users in 2012 to 26371 cases among 10,778,134 users in year 2022 [14]. This decline underscores the cumulative effect of interventions aimed to reduce drink driving in Bengaluru over the years.

In our study, drink-driving violations were higher (4.1%) among younger drivers (18-24 years). In the Youth Behavioural Health Survey conducted in the nearby Kolar district, self-reported drink-driving prevalence was 11% among youth aged 21-25 years [16]. Other studies in India have also reported higher prevalence among younger populations [17], highlighting the need for youth-specific drink-driving countermeasures and targeted interventions. International studies report varying drink-driving prevalence: 19% in China [18], 1.29% in Spain [19], 1.4% in Perth, Australia [20], 15.9% in Brazil [21], 7.3% in Cameron [22] and 5.5% in Ghana [23]. However, methodologies and criteria for drink-driving assessment varied across studies, with BAC thresholds varying between 30 mg to 80 mg per 100 ml of blood.

Reports from Bengaluru Traffic Police indicate that 26371 drink-driving cases were booked in the year 2022 [14], with vehicle population in Bengaluru city at 1.9 million [15]. Assuming 50% registered vehicles are active on the road, this reflects a drink-drive enforcement rate of 4.8 cases per 1000 vehicles in the year 2022. For comparison, the rate was 13.62 cases per 1000 vehicles in year 2012 and 8.8 cases per 1000 vehicles in year 2016. A decadal comparison shows that the number of drink-driving cases booked were 26371 in year 2022 as against 60973 in year 2012 (a decrease by 83%) [14]. A significant in cases was reported in years 2020 (5343 cases) and 2021 (4144 cases) due to COVID19 pandemic [14]. Evidence from research and reported enforcement data, both indicate a decrease in drink-driving in Bengaluru city.

The high prevalence of drink-driving among two-wheeler riders (4.5%) is concerning, as it increases the risk of crashes, particularly with behaviours like speeding, reckless driving, and non-standard helmet use being higher among the 18-24 age group. Hospital-based studies show higher drink driving prevalence among motorcyclists (24). Data from seven hospitals in Bangalore showed that 16% of hospitalised Road Traffic Injury (RTI) patients tested positive for alcohol at admission; among them, two-wheeler users were at higher risk for severe injuries, brain trauma, fatalities, and post-traumatic disabilities [25]. Similar studies from other Indian cities report that 17-21% of RTI cases involved blood alcohol content, with nearly half being two-wheeler drivers [26,27]. Since motorised two-wheelers account for 70% of vehicles on the road, it is crucial to implement drink-driving countermeasures specifically for two-wheeler users and youth [8].

Approximately 72% of drivers with positive screening results had BAC levels exceeding 30 mg% during the confirmatory test, indicating that BAC levels among screened positives tend to be higher. The average BAC level among drink-driving violators was 69 mg%, nearly twice the legal limit. Additionally, 30.6% of these

drivers had BAC levels over 100 mg per 100 ml of blood, which correlates with impairments such as poor muscle coordination, reduced speed control, impaired perception, and substantial difficulty with vehicle control and processing visual and auditory information [28].

A mortuary study in Amritsar of 100 RTI fatalities found that 57% had BAC levels between 100 mg% and 149 mg% [26]. A review of 20 hospital-based studies showed that 18% to 23% of RTI admissions involved alcohol at the time of the crash. A study in Bangalore, involving data from seven hospitals, reported that approximately 16% of hospitalised RTI cases were under the influence of alcohol, with most being motorised two-wheeler riders [2]. Furthermore, a review of 23 hospital-based studies in India found that 2% to 33% of injured and 6% to 48% of fatal RTI victims had consumed alcohol or drugs [29]. A hospital-based study in Tamil Nadu found that 19.8% of drivers arriving at the emergency room had BAC levels above the legal limit [30]. In a prospective hospital-based study of 100 living and 60 deceased road traffic crash victims, 38.2% had BAC levels above the legal limit (>30 mg%) [17].

Nearly 98% of our study sample were male, likely due to the higher probability of males driving during the assessment period and the limited participation of female police personnel in the process. This aligns with findings from other studies, which also report predominantly male samples [27,31-33].

Approximately 52% of drink-driving violators had at least one occupant in the vehicle, exposing them to similar risks of road traffic crashes; notably, around 4.2% of these occupants were children. Interestingly, the presence of occupants in the vehicle showed a statistically significant reduction in the odds of drink-driving, as indicated by the adjusted odds ratio. This suggests that not traveling alone is associated with a lower likelihood of engaging in drink-driving. Additionally, more than half of the drink-driving violators had to travel an additional 5-10 km to reach their intended destination, which constitutes a high-risk travel exposure for themselves and other road users.

In our present study, the odds of drink-driving violations were 2.43 times higher among motorized two-wheelers (95% CI 1.45, 5.07) compared to other vehicles. These findings are consistent with a retrospective study conducted in Tamil Nadu, which also found a significant association between positive blood alcohol concentration (BAC) levels and the use of two-wheelers [30].

Our study indicates that, although drink-driving violation rates are lower, the intoxication levels are higher, with median BAC levels among tested, nearly twice the legally prescribed limit. This highlights the need for both population and high-risk interventions to reduce median BAC levels in Bengaluru, including targeted

interventions for youth.

Our study paves the way for further research to explore drink-driving violation rates beyond midnight or during extended assessment hours (9 PM to 2 AM), prevalence among female drivers, multiple risk factor prevalence, and the connection between population drink-driving data and fatalities and road traffic injuries. More importantly, there is potential for piloting the feasibility of a BAC surveillance system in major cities to assess intoxication levels among drink-drivers.

It is widely acknowledged that reported cases of drink-driving crashes in India are significantly underestimated due to various factors, including potential underreporting influenced by sympathy for family members and motivations related to insurance claims. Data from the Ministry of Road Transport and Highways revealed that 2.5% of road traffic fatalities in 2022 were attributed to drink driving [1]. However, the Global Status Report on Alcohol and Health 2018 indicates that alcohol-related deaths attributable to road traffic crashes in India are around 35% [8], while hospital-based studies suggest drink driving prevalence ranges from 13-55%. There is a significant gap between research evidence and official reporting [29,34]. Our study focused solely on drink-driving violations within the general population, underscoring the necessity of investigating the correlation between drink-driving violations and both fatal and non-fatal injuries at the national level.

This assessment was carried out exclusively between 10 pm and 12 am and shortage of female police deterred stopping and testing of female drivers, contributing to lesser female sample in the study.

Conclusion

This assessment outlines the methodology, formats, and analysis techniques used to estimate the prevalence of drink-driving violations in an urban setting. Our findings indicate that the prevalence of drink-driving violations is approximately 3%, with average BAC levels nearly twice the legally prescribed limit. The risk of drink-driving is notably higher among car and two-wheeler users, as well as younger drivers. To enhance the effectiveness of drink-driving enforcement, the study recommends to

• Increase involvement and capacity building of female police officers to conduct drink-driving assessments

• Conduct uniform-periodic-random drink-drive violation assessments to monitor trends in prevalence and BAC levels in the city, involving traffic wardens and researchers. Assessment time to extend beyond 12am as well.

• Implement evidence-based drink-drive counter measures specific for motorised two-wheeler riders and younger drivers

• Develop a multi-sectoral action plan to reduce drink-

driving involving sectors of police, transport, municipal corporation and health. Implement capacity-building programs to implement tasks delineated to specific sectors in the action-plan.

• Establish a routine BAC surveillance system in the city.

Declarations

Ethics Approval and Consent to Participate

Ethics clearance was obtained from the institutional ethics committee, NIMHANS [No. NIMHANS/IEC (BS and NS DIV.)/2020-21] and IERB, Johns Hopkins International Injury Research Unit (IRB No.13638). Permission was obtained from Bengaluru Traffic Police. There is no consent to participate because it is an observational study.

Availability of Data and Materials

The data that support the findings of this study are available from John Hopkins Injury Research Unit and National Institute of Mental Health and Neuro Sciences but restrictions apply to the availability of these data, which were used under license for the current study, and are not publicly available. Data are available from the corresponding author upon reasonable request, and with permission of John Hopkins Injury Research Unit and National Institute of Mental Health and Neuro Sciences.

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Authors' Contributions

All authors made substantial contributions at each stage of the manuscript's development, including the conceptualisation of the study, methodology design, data acquisition, analysis, and interpretation.

Acknowledgments

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