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Road Traffic Injuries Involving Illegal Blood Alcohol Levels and Psychoactive Drug Use in Côte d'Ivoire: A Hospital-based Study

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Abstract In Côte d'Ivoire alcohol and drugs consumption in the general population is a serious issue. However, their role in Road Traffic Accidents (RTAs) has never been investigated. Our study aimed to estimate the prevalence of alcohol-impaired road users at the time of the RTA and report psychoactive drug use, in various categories of casualties, and in various circumstances of the crash. We conducted a cross-sectional study including 893 casualties involved in fatal or non-fatal RTAs and admitted at the Emergency Room or the Forensic Institute from March to September 2012. Blood alcohol dosage (BAC) and urine drug screening were carried out, and results were linked with hospital and police crash report data. The mean BAC in positive cases indicated heavy drinking before the crash: drivers (1.9 g/L), pedestrians (2.1 g/L), passengers (1.5 g/L). The prevalence of alcohol-impairment was significantly higher in drivers (41%) and riders (27%) compared to pedestrians (17%) and passengers (13%). Over 75% of casualties that tested positive for alcohol had a BAC largely above the legal limit. Psychoactive drug use was twice more prevalent in alcohol-impaired drivers than in sober drivers (20% vs 10%). Binge drinking is an emerging issue in African countries, which should be taken into account in the management or prevention of road traffic injuries.

Keywords Blood Alcohol Concentration, Drug Screening, Road Traffic Accident, Injuries, Prevalence, Côte d'Ivoire

1. Introduction

Injuries and deaths due to Road Traffic Accidents (RTAs) are considered as the silent epidemic of the African continent. According to the World Health Organization, road traffic injuries are increasing notably in African countries, where rates are twice those in high-income countries. The mortality rate due to RTAs in Africa is the highest one with 24.1per 100,000 population, while in Europe this rate is the lowest one with 10.3 per 100,000 population [1].

Unfortunately, the paucity of data on casualties' characteristics, as well as the lack of studies on main risk factors involved in RTAs in African countries, especially in the sub-Saharan area, leads to uncertainties and probably to a major under-estimation of the size of the problem [2].

For example, the role of alcohol or psychoactive drugs consumption by road users in the occurrence of RTAs and the severity of subsequent injuries has not systematically been studied in this part of Africa. However, in many countries from sub-Saharan Africa alcohol and drugs consumption is a serious issue[3, 4].

In Côte d'Ivoire, adult per capita consumption for drinkers is estimated at 28 litres of pure alcohol, which is almost two times the consumption in France with 15 litres of pure alcohol [5]. Since 2000, Côte d'Ivoire has also been known as a major transit and traffic country for narcotic drugs in West Africa[6].

The increased risk of road traffic injuries associated with alcohol intake by drivers and pedestrians has been well-documented in recent studies conducted in populations from high-income countries[7-9]. However, the relation between Blood Alcohol Concentration (BAC) and RTAs has not systematically been studied in Côte d'Ivoire, where the national drink-driving limit is 0.8 g/L, even though W.H.O. strongly recommends reducing this threshold to 0.5 g/L[1]. Specifically, the contribution of alcohol-impairment and of psychoactive drug use to RTA occurrence remains unknown.

This knowledge gap concerning two main factors involved in the occurrence of injuries due to RTAs, could represent a significant obstacle to an efficient and consistent road safety policy. Although the conditions of roads and vehicles might be a significant factor in the African region, psychoactive substances use is a factor that could be prevented using affordable strategies regarding the economic context in a low income country.

We conducted a cross-sectional study, based on various sources linking hospital data, police crash reports and toxicological findings, in an effort to gather the maximum of relevant and accurate information on casualties involved in fatal or non-fatal RTAs in Abidjan (Côte d'Ivoire).

The aim of this preliminary study was to estimate the prevalence of alcohol-impaired road users at the time of the RTA and report psychoactive drug use, in various categories of road crash casualties admitted at the Emergency Room (ER) or the Forensic Institute, and in various circumstances of the crash.

2. Materials and Methods

2.1. Settings and Study Population

From March 1st to September 30th 2012, consecutive RTA casualties attending the Emergency Roomat the Teaching Hospital of Yopougon in Abidjan (non-fatal injuries) and National Institute of Forensic Medicine (fatal injuries) were enrolled.

Four-wheel motor drivers were included in our study if they were 18 years old and more according to the traffic law in Côte d'Ivoire. For the same reasons, we included two-wheel motor riders if they were 14 years old and over. Finally, for homogeneity and comparability concerns, we included all the other road users (pedestrian, cyclist, passenger), who are not submitted to age restriction by the traffic law, as from the age of 14. Swendsen (2012) reported that the median age for onset of abuse of either alcohol or illicit drugs was 14 years in US adolescents [10].

The accident in which the victim was involved in should have taken place on a traffic lane and have involved at least one vehicle.

Patients admitted to the ER more than six hours after the accident occurred were excluded for alcohol or drugs evaluation. This six-hour crash-to-sampling interval was set based on the well-established kinetic of ethanol elimination in human body (Widmark curve), which shows a quasi complete elimination of ethanol 6 hours after the last drink. Beyond this timeframe, we would not be able to assess if a victim with a BAC = 0 was sober at the time of the accident or if he/she was positive to alcohol at the time of the RTA but had already totally eliminated alcohol at the time of the blood sampling in Emergency Room. However, if death had occurred at the crash site, casualties sent to the Institute of Forensic Medicine were all included regardless of the delay between the road traffic crash and admission.

2.2. Data Collection

2.2.1. Emergency Room Data and Police Reports

For each subject, comprehensive information related to sociodemographic profile, road user profile, clinical features, availability of biological samples and circumstances of the crash, was prospectively collected using a structured questionnaire administered by trained physicians in the Emergency Room 24/7.

Adherence to protocol was regularly checked by the project coordinator, meeting with medical staff every week to ensure completeness of information.

Additional information on the crash circumstances was retrieved from Police or Gendarmerie reports to compensate for unreported data in ER questionnaire. When a discrepancy was observed between Emergency and Police data, we gave the priority to Police data considered to be more reliable.

2.2.2. Determination of Blood Alcohol Concentration (BAC)

Blood samples were drawn from each consenting subject shortly after admission in the ER, and before any administration of medication or liquid infusion. The delay between admission and blood sampling was recorded. For forensic samples, peripheral blood was taken preferably from a femoral vein and if this was not possible from the heart.

Quantification of blood alcohol was achieved by Gas Chromatography coupled with Flame Ionization Detector (GC-FID) by a trained toxicologist according to a validated procedure at the National Laboratory of Public Health. A Shimadzu GC 14A was used with a 180 x 0.2 cm column packed with 100/120 mesh porapak Q. Sample was injected together with n-propanol as internal standard. The analytical procedure validation demonstrated a good linearity for calibration curve (r = 0.997), precision and accuracy were also good (RSD = 4% and 2,5%), LOD was 0.045 g/L and LOQ was 0.146 g/L.

2.2.3. Psychoactive Drugs Screening

In addition, urine samples were taken in order to perform amulti-drugs screening by immunoenzymatic technique (EMIT, OnSight^{TM} DOA-10 DipSan, ref. 4410-25-SU, Amgenix International, Ca, USA).The following substances were tested: amphetamines (AMP), methamphetamines (MET), 3,4-Methylenedioxymethamphetamines (MDMA), tetrahydrocannabinol (THC), cocaine (COC), opiates (OPI) , barbiturates (BAR), benzodiazepines (BZO), tricyclic antidepressant (TCA), methadone (MTD).

2.2.4. InformedConsent and Confidentiality

The study was carried out according to the Helsinki

Declaration and approved by the Hospital and the local ethical committee. Informed consent was obtained by patients or close relatives before samples collection. All nominative data was removed from the database to insure confidentiality.

2.3. Statistical Analysis

Statistical analyses were performed running SAS version 9.3 software. Mean values, standard deviations and frequencies were used to describe data distribution. The main outcomes in our study were positive BAC and positive drug testing. Comparisons between subgroups were carried out using Chi-square or Fisher test. A p-value less than 0.05 was considered for statistical significance.

Table 1. Characteristics of the study populations

	Eligible victims selected in the study (N = 893)		**BAC analysis (N = 672) (Sub-group 1)**			**Psychoactive drugs analysis (N=340) (Sub-group 2)**		
	Mean (range)	**SD**	**N[e]**	**Mean (range)**	**SD**	**N[e]**	**Mean (range)**	**SD**
Age (year)N = 831	32.14 (14-80)	11.9	623	31.99 (14 - 80)	11.75	322	32.2 (14 - 79)	11.78
	Frequency (N[e])	**Percentage (%col)**	**N[e]**	**% col[f]**	**% row[g]**	**N[e]**	**% col[f]**	**% row[g]**
Gender Male	606	67.9	468	69.6	77.2	219	64.4	36.1
Female	287	32.1	204	30.4	71.1	121	35.6	42.2
Socio-Professional Category								
High executive officer	9	1.0	7	1.0	77.8	3	0.9	33.3
Middle civil officer	120	13.4	94	14.0	78.3	48	14.1	40.0
Trader	178	19.9	134	19.9	75.3	74	21.8	41.6
Informal worker[c]	233	26.1	172	25.7	73.8	93	27.3	39.9
Farmer	30	3.4	24	3.6	80.0	12	3.5	40.0
Unemployed	207	23.2	165	24.5	79.7	79	23.2	38.2
Factory worker	90	10.1	61	9.1	67.8	26	7.6	28.9
Police & Army	13	1.4	7	1.0	53.8	3	0.9	23.1
Other	13	1.4	8	1.2	61.5	2	0.6	15.4
Road User Type								
Pedestrian	246	27.6	204	30.4	82.9	86	25.3	34.9
2 wheels[d]	96	10.8	70	10.4	72.9	27	7.9	28.1
Light 4 wheels	193	21.7	143	21.3	74.1	68	20.0	35.2
Bus / Minibus	340	38.2	241	36.0	70.9	152	44.7	44.7
Heavy track	13	1.5	10	1.5	76.9	6	1.7	46.1
Other	2	0.2	2	0.3	100	1	0.3	50.0
Position in the vehicle								
Driver	146	22.9	110	23.9	75.3	36	14.2	24.6
Passenger	492	77.1	351	76.1	71.3	218	85.8	44.3
Casualty outcome								
Discharged	632	72.1	476	71.5	75.3	267	78.7	42.2
Hospitalized	218	24.9	167	25.1	76.6	64	18.9	29.3
Deceased	27	3.1	23	3.4	85.2	8	2.3	29.6
Road type(where RTA took place):								
Highway	392	44.0	292	43.6	74.5	158	46.5	40.3
County/Departmental road	135	15.2	86	12.8	63.7	53	15.6	39.2
Municipal Road	347	38.9	277	41.3	79.8	120	35.3	34.6
Unpaved Road	15	1.7	15	2.2	100	9	2.6	60.0
Time of the crash								
6:01AM-12:00AM	295	34.3	219	33.7	74.2	128	39.4	43.4
12:01PM-18:00PM	303	35.2	232	35.7	76.6	98	30.1	32.3
18:01PM-00:00PM	238	27.6	179	27.6	75.2	92	28.3	38.6
00:01AM-6:00AM	25	2.9	19	2.9	76.0	7	2.1	28.0
Weekday of the crash								
Working day	434	48.9	318	47.5	73.3	171	50.7	39.4
Weekend	453	51.1	351	52.5	77.5	166	49.2	36.6

[c]**informal worker** =out of the legal working system according to the laws in Côte d'Ivoire (underground economy)
[d]**2 wheels** = motorized 2 wheels and bicycles - [e]**N**total may vary for each studied variable due to missing data
% col[f] =column percentage (calculated from column total for each variable), **% row[g]** = row percentage (calculated from row total)

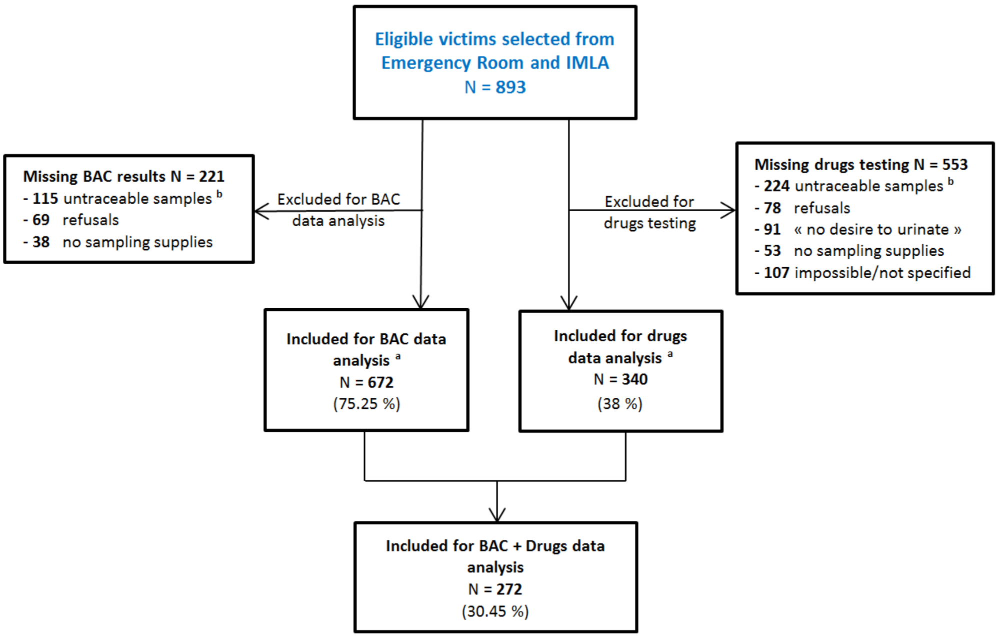

Figure 1. Process of casualties' inclusion in alcohol and/or psychoactive drugs data analysis

3. Results

3.1. Description of RTA Casualties Admitted at the Emergency Room (Table 1)

Except from psychoactive substance testing results, the response rate to the questionnaire was high with relatively few missing data (ranging from 0% for gender to 7% for age).

Overall, 893 patients admitted to the ER met our inclusion criteria. Mean age of casualties was 32 ± 12 years and the male-to-female sex ratio was 2:1; 16% were drivers, 28% pedestrians and 56% passengers. Regarding the profession of casualties, 26% were informal workers, 23% were unemployed, 20% were trader, 13% were middle civil officers and only 1% was high executive officers. The great majority of casualties were discharged from hospital after medical care and a short observation period (72%), 25% required hospitalization, and 3% were deceased. In 44% casualties, the crash had occurred on a highway and in 39 % on a municipal road. More than half of crashes happened during the weekend and in daylight. The drivers were predominantly male (109 out of 110), relatively older than the other road users (mean age: 35 ± 11 years), with a greater proportion of high executive or middle civil officers (25%). Pedestrians were male in 70% of cases, relatively younger than drivers (mean age: 31 ± 13 years), and only 10% were high executive or middle civil officers. Passengers included a lower proportion of male (60%),mean age was 31 ± 11 years with 15% of high executive or middle civil officers.

3.2. Characteristics of the Study Sub-Populations

We included in our analysis only casualties who had completed a BAC analysis (75%) or drug screening (38%). When considering testing for both BAC and drugs, the rate dropped to 30%. The whole process of patients' inclusion in data analysis, participating rate and reasons for non-inclusion are detailed in fig.1.

Main characteristics of casualties included in our study for BAC data analysis (sub-group 1) and psychoactive drugs data analysis (sub-group 2) are described in table 1.

Each sub-group was compared to non-participants (no results for both alcohol and drugs testing), and no significant difference was observed, except for road user type and patient outcome distributions which differed significantly.

The participating rate for each category of the studied variables was studied for sub-groups 1and 2 (% row, table1). Police and Military officers were less likely to be included in alcohol and drug analyses compared to other professions. Drivers and 2-wheel riders were underrepresented in the drug analysis sub-group. Hospitalized and deceased casualties were less likely to be included for drug analysis compared to discharged patients. Finally, there were fewer patients having a drug testing when the RTA occurred between 00:00-06:00AM.

3.3. RTA Casualties' and Alcohol Consumption

3.3.1. Alcohol Impairment Definition

The delay between the RTA and blood sample collection varied across the casualties, ranging from 45 to 360 min, with an average of 182 min and a standard deviation of 101.5 min.

A reverse extrapolation and BAC correction were made to approach the theoretical BAC at the time of crash. We applied a metabolizing factor of 0.15 g/L/h during the first four hours following the crash, and then 0.10 g/L/h during the two following hours. Correction was made only when measured BAC was greater than 0.20 g/L which represented our positivity threshold[11-13].We used two cut-off values for corrected BAC to identify/classify casualties under the influence of alcohol, based on W.H.O. recommendation (0.5 g/L) and national legal limit (0.8 g/L). Although those limits are designed for drivers, we considered that they could be applied to pedestrians and passengers regarding cognitive impairments toward traffic danger, loss of self-protection reflex and risk-taking attitude related to these alcohol levels.

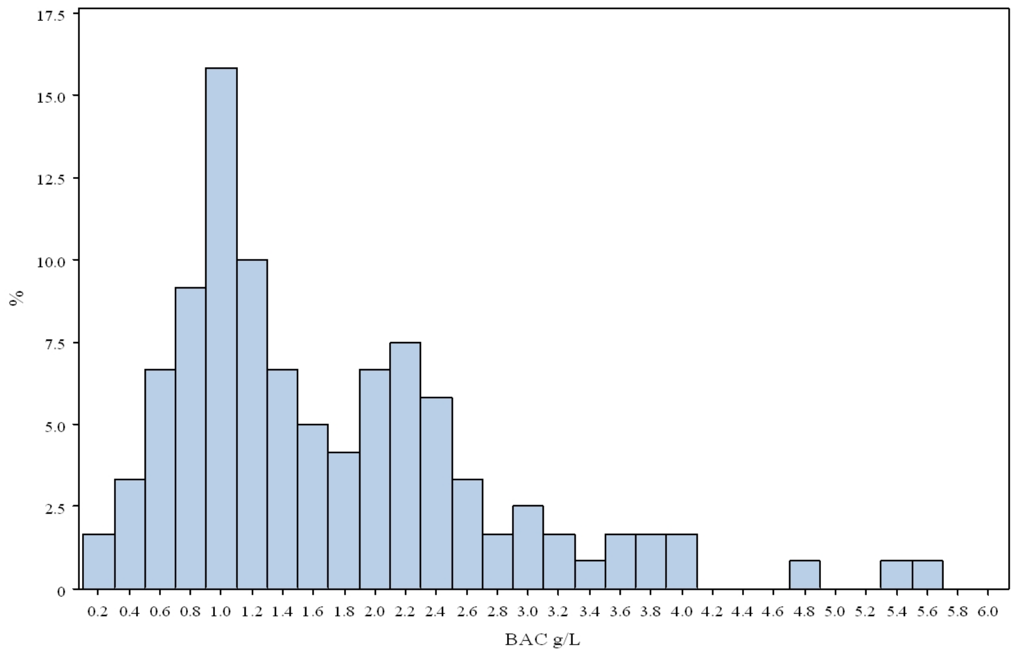

Figure 2. Relative frequency distribution of Blood Alcohol Concentrations in casualties admitted in the Emergency Room and IMLA after a RTA (N =126 with BAC ≥ 0.2 g/L).

Table 2. Prevalence of casualties with BAC above recommended (0.5g/L) or legal(0.8g/L) limits in relation to characteristics and circumstances of the crash

	BAC > 0.5 g/L			BAC > 0.8 g/L		
	N	%	p-value	N	%	p-value
Age category (in year)						
< 30	41	13.4		35	11.44	
30-40	39	21.91		36	20.22	
40-50	16	20.51	0.0979	13	16.67	0.0870
> 50	11	22.92		10	20.83	
Unknown	7	14.29		7	14.29	
Gender						
Male	96	20.51	0.0007	87	18.59	0.0004
Female	20	9.80		16	7.84	
Road user type						
Driver	33	30.00		30	27.27	
Pedestrian	35	17.16	0.0002	34	16.67	<0.0001
Passenger	45	12.82		37	10.54	
Socio-professional category						
High-medium income	27	26.73		24	23.76	
Intermediate income	54	16.02	0.0227	48	14.24	0.0365
Low income & unemployed	35	14.96		31	13.25	
Patient outcome						
Less severely injured *	79	16.60	0.3767	69	14.50	0.2733
Severely injured **	37	19.47		34	17.89	
Time of the crash						
Day	63	13.97	0.0008	53	11.75	0.0002
Night	49	24.75		46	23.23	
Moment of the crash						
Week day	41	12.89	0.0051	37	11.64	0.0134
Weekend	74	21.08		65	18.52	
Total	116	17.26		103	15.33	

*Casualties discharged after medical care and a short observation period
**Hospitalized and deceased casualties

Table 3. Prevalence of victims with BAC above recommended (0.5 g/L) or legal (0.8 g/L) limits in relation to gender androad user category

	Low impairment (BAC > 0.5 g/l)			High impairment (BAC > 0.8 g/l)		
Road user types	No/Total	%	p-value	No/Total	%	p-value
Drivers	33/110	30.00		30/110	27.27	
Male	33/109	30.28	-	30/109	27.52	-
Female	0/1	0		0/1	0	
Pedestrians	35/204	17.16		34/204	16.67	
Male	28/143	19.58	> 0.05	27/143	18.88	> 0.05
Female	7/61	11.48	(NS)	7/61	11.48	(NS)
Passengers	45/351	12.82		37/351	10.54	
Male	32/210	15.24	> 0.05	28/210	13.33	< 0.05
Female	13/141	9.22	(NS)	9/141	6.38	
In total	116/672	17.26		103/672	15.33	
Male	96/468	20.51	< 0.005	87/468	18.59	
Female	20/204	9.80		16/204	7.84	< 0.005

3.3.2. Blood Alcohol Concentration in Positive Cases

The mean BAC in alcohol positive cases (N = 126) was 1.71 g/L (range 0.2-5.6 g/L) and 25th and 75th percentiles of 0.95 and 2.2g/L. Specifically, the mean BAC in drivers was 1.9 g/L (range 0.44-5.44 g/L, 25th and 75th percentiles of 1.05 and 2.2 g/L), exceeding 2.4 times the legal limit of 0.8 g/L. In pedestrians the mean BAC was2.1 g/L (range 0.4-5.6 g/L, 25e and 75 percentiles: 1.1 and 2.9 g/L), that is 2.6 times the legal limit. Regarding vehicle passengers, the mean BAC was1.5 g/L (range 0.2-3.9 g/L, 25th and 75th percentiles: 0.8 and 1.8 g/L). The distribution of BAC in casualties tested positive for alcohol is shown on Fig.2.

3.3.3. Prevalence of Casualties under Alcohol Influence

Overall, the prevalence of road users under the influence of alcohol was 17.3% for BAC >0.5 g/L and 15.3% for BAC >0.8 g/L.

Specifically, the prevalence of casualties exceeding the 0.5 and 0.8 g/L limits was 30.0% and 27.3% for drivers, 17.2% for pedestrians, 12.8% and 10.5% for passengers. Prevalence of alcohol-impaired light 4-wheel drivers was 40.8% and 34.7% compared to 2-wheel riders with 27.1%. No alcohol impairment was observed for bus/minibus or heavy truck drivers.

Stratification by gender revealed that men were largely more often under alcohol influence than women for both levels of impairment. This difference was mainly attributable to male drivers with BAC above the limit (Table 3). Even restricted to men, the prevalence of alcohol-impaired was higher in drivers compared to pedestrians and passengers.

The prevalence of casualties with illegal BAC was not significantly influenced by age.

Regarding the socio-professional status, the prevalence of patients with BAC above the limit was significantly higher for "high executive and middle civil officers" patients. This difference was due to the significant contribution of drivers to the prevalence of alcohol in high-middle income category. Severity of injury didn't show any significant influence on the prevalence of patient under the influence of alcohol, regardless of the road user status.

The prevalence of patients exceeding the 0.5 or 0.8 g/L limits was significantly higher in night time accidents compared to daytime accidents.

Similarly, the prevalence was almost two times higher in patients involved in an accident at weekend compared to week day accident, with the exception of pedestrians for whom no significant difference was observed between the two periods (Table 2).

3.3.2. Psychoactive Substance Use amongst Casualties

Positive detection of at least one substance was observed in 38 out of 340 casualties tested (11%). Prevalence of positive drugs findings was 22% among drivers, 14% among pedestrians and 8% among passengers.

Regarding illegal drugs, cannabinoids (THC) was the class of drug the most frequently detected (21 out of 38 positive urine testing, i.e. 55%)followed by opiates in 6 cases out of 38 (16%).Of the 672 casualties who had results for BAC, 272 had undergone a multidrug testing as well. Screening was positive in 8 alcohol-impaired casualties out of 40 (20%) in contrast with 24 positive testing out of 232 non-alcohol-impaired casualties (10%).

4. Discussions

4.1. BAC Correction

We used retrograde extrapolation of measured BAC to estimate the blood alcohol levels at the time of crash. The elimination rate applied was 0.15 g/L/h, which is a conservative correction factor and can be applied to a wide diversity of people including Caucasians as well as Asians and Africans[11]. In our series, the mean BAC after reverse extrapolation was 1.70 g/L corresponding to a measured BAC in positive cases of 1.3 g/L. Only 13 cases out of 598 switched to BAC above 0.8 g/L after correction, which did not introduce a significant change in the results.

4.2. BAC Levels among RTA Casualties

The average BAC in injured drivers who tested positive for alcohol in our study was high (1.90 g/L) but consistent with BAC reported for apprehended drunk drivers in most developed countries (1.50 to 1.80 g/L) [14]. This value was even higher in injured pedestrians with a mean BAC reaching 2 g/L.

Such high levels of BAC in road users are not totally surprising given the alcohol consumption pattern in the general population of Côte d'Ivoire.

The adult alcohol consumption is twice the consumption in France, where alcohol is clearly recognized as contributing to road safety problems. More significantly, in Côte d'Ivoire, 25% of alcohol consumers are binge drinkers and the Pattern of Drinking Score (PDS) is 3 (medium risk) compared to France with 8.5% of binge drinkers and a PDS of 1 (lowest risk) [5]. The high average BAC observed in our study suggests that injured drivers or pedestrians may be regular drinkers and likely to be dependent on alcohol. An occasional drinker would not be able to tolerate the amounts of alcohol necessary to reach such a high BAC without ill-effects, such as nausea and vomiting [11].According to the World Health Organization, more than 6 drinks on any single occasion for men and 4 drinks for women is considered as a hazardous pattern of drinking, and is associated with increasing risk of diseases, neuropsychological troubles, trauma, negative social effects, etc. [15]. Consumption of 6 drinks within 2 hours translates in approximately 1 g/l of alcohol in blood for a man weighing 75 kg. The levels of BAC reached in injured road users suggest that a majority of them may be binge drinkers. Consequently, the medical staff should take into account alcohol related problems in the management of these specific patients in the Emergency Room.

4.3. Prevalence of Alcohol-Impaired Casualties

Our results indicate that alcohol use (BAC > 0.5 g/L) amongst RTA casualties involves not only light car drivers (41%) or riders (27%), but also pedestrians (17%) and passengers (13%). Interestingly, the prevalence of alcohol-impaired casualties was significantly higher in drivers and riders (who are directly in control of a vehicle) compared to pedestrians and passengers (not in control of a vehicle).

An Australian hospital-based study, showed that 24.3% of drivers, 11.04% of riders and 55.8% of pedestrians injured in a RTA were above the 0.5 limit [16]. The lower prevalence of impaired drivers in the Australian study probably reflects the effectiveness of drink-driving law enforcement in high-income countries. Very few studies examining the relation between BAC and RTA injuries have been conducted in Africa. The drunk-driving prevalence in our study (35%-41%) is consistent with that reported in South Africa so far well known for being in pole position regarding injured drivers with BAC exceeding the legal limit (26% to 52%) [17, 18].

4.4. Profile of Alcohol-Impaired Casualties

Male drivers were predominantly involved in alcohol-related crashes compared to women, and this trend is confirmed in many studies all over the world [19, 20]. In addition, drivers from the middle-to-high economic class(middle civil to high executive officers) tend to be more frequently involved in alcohol-related RTA in Côte d'Ivoire.

Our results suggest that this profile of road users have a distinct exposure to RTA risks.

In developing countries, the choice of mode of transport is largely influenced by socioeconomic factors, especially income [21, 22]. High income earners usually travel in private cars, while for lower income earners the most affordable options are minibus, bus, cycling and walking. Very likely, high-middle income male drivers, under the influence of alcohol, are more exposed to traffic risk compared to pedestrians and passengers. They are more often on the road after heavy alcohol consumption, at night when they are tired and the road is poorly lit on, the weekend when traffic is fluid so they could speed, etc.

Kockelman et al [23], in a large study on drivers' behaviors in the USA, showed that high-income and educated drivers were more likely to drive faster, and to drive after drinking.

Weekends and nights were critical periods for RTA involving drinking road users in Abidjan, as previously observed in many studies [24, 25].

Road safety prevention strategies should target this profile of road users and high risk periods.

Surprisingly, no professional driver (minibus, heavy truck) was under alcohol influence in our sample. We hypothesized that these drivers are usually not seriously injured and/or avoid hospital settings, especially when they are responsible for a RTA resulting in many severely injured casualties.

4.5. Recommended Versus Actual Drink-Driving Limits

We tested two levels of BAC in order to assess whether a reduction of the current national limit from 0.8 g/L to 0.5 g/L would have an impact on the prevalence of RTA involving alcohol consumption. Only 2.7% of drivers had a BAC between 0.5 g/L and 0.8 g/L, which is consistent with observation made in the French study with 2.2% of drivers being in this range[26]. More importantly, over 75% of casualties that tested positive for alcohol had a mean BAC above 1 g/L. These findings demonstrate the low level of the current drink-driving law enforcement and the urgent need for prevention campaigns on the risk of traffic injury associated with excessive alcohol drinking targeting all types of road users.

4.6. Psychoactive Drug Use

In our study, positive detection of substances in injured drivers urine was almost twice that of the French study SAM, with respectively 22.2% and 12.7% [27].

Drug use was much more frequent in casualties tested positive for alcohol compared to those tested negative.

However, literature on the concomitant use of alcohol and drugs among drivers is inconsistent [19, 28].

In the light of these preliminary findings, we recommend a more in-depth study based on substances blood measurement, to assess the relation between drug impairment and RTA in Côte d'Ivoire.

4.7. Study Limitations

Our final sample size was lower than expected, probably because we missed some cases during the recruitment in ER. Regarding fatally injured cases, we also missed many cases due to unavailability or busy schedule of forensic scientists who were in charge of autopsies.

Due to the poor quality of admission records, we could not ascertain the number of lost eligible cases. Nevertheless, we can reasonably make the assumption that all the cases were randomly missed and therefore did not significantly influence the final result.

The global alcohol testing rate in our study was high (75%) and consistent with the broad French study SETRA, which showed an availability of BAC results in 78.7% of casualties [29]. However, in Côte d'Ivoire, casualties were recruited on a voluntary basis and the refusal rate for alcohol testing was 8%. This could have biased our results towards non-alcohol-impaired casualties, and hence potentially resulted in under reporting of the prevalence of alcohol-impaired road users.

5. Conclusions

This study presents new data and a broad picture of the influence of alcohol and drugs on road traffic injury in relation to crashes characteristics in an African sub-Saharan country.

Alcohol was found at concentrations largely above the legal driving limit in more than 75% of injured alcohol-impaired drivers, clearly calling for a stricter enforcement of the current drink-driving low. Drivers and riders were predominantly represented in crashes involving illegal blood alcohol levels, especially at night and during the weekend. The use of cannabis among casualties was relatively frequent and often in relation with alcohol consumption.

Binge drinking is an emerging issue in African countries, which should not be neglected in injuries prevention, management and road safety policies.

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