

Hong Kong Journal of Orthopaedic Research

(An Open Access Journal for Orthopedics and Trauma Research)

Research Article

Hong Kong J Orthop Res
ISSN (e): 2663-8231
ISSN (p): 2663-8223
2019; 2(2): 06-12
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A retrospective cohort study of five-year admission rates in alcohol intoxicated trauma patients in a level 1 trauma centre

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Abstract

Background: Previous studies have shown that alcohol has a significant correlation with trauma admissions. Worldwide there are approximately 5.2 million deaths from injuries attributed to alcohol every year and non-fatal injuries account for approximately 10% of the global burden of disease. The aim of this study was to therefore investigate the difference in demographics and mechanism of alcohol-related injury over the last five years in a United Kingdom (UK) inner city level 1 trauma centre. **Methods:** We performed a retrospective cohort study of alcohol intoxicated patients, (BAC>0.01 g %), admitted to a level 1 trauma center in London from 2014 to 2019. We recorded the number of patients, the length of stay, mechanism of injury and day of admission. Clinical outcomes after 30 days were recorded. **Results:** We identified 728 alcohol intoxicated patients; 559 males and 169 females aged 16-89 (median 46) years. No change was detected in the number of cases admitted yearly (135 – 156 per year, p>0.50) or in Injury Severity Score (ISS) distribution with the majority being >15 (58%). Head injury was the commonest cause of mortality (91%). This trend did not change over time. Whilst male admissions were more common (ratio 3:1), this reduced from 2017 to 2019 with an increase in female admissions. Forty-three percent of admissions were on weekends, with no increase in admissions on national Bank Holidays. The proportion of long bone fractures also increased with time (p<0.01). **Conclusion:** With no change in admission rates to a level 1 trauma center in the UK, alcohol intoxication is still a major burden to healthcare. More effective campaigns are required to decrease alcohol related injuries. With the increase in females with alcohol related injuries, health education policies and public health policy should be targeting this patient group.

Keywords: Alcohol, Injury severity score, Mechanism of trauma, Outcome, Injuries.

INTRODUCTION

Although alcohol is a legal drug, it is associated with an increased risk of trauma especially in intoxicated patients [1-3]. Both acute and chronic alcohol abuse is associated with a reduction in physiological response in the trauma setting. Intoxication with alcohol and other drugs increases the complications and worsens the outcome following trauma [4-9]. Plurad *et al* [10] reported that over 40% of trauma-related deaths have a positive alcohol, drug or other substance screen test. According to the World Health Organization (WHO), non-fatal injuries with alcohol intoxication account for about one-tenth of the global burden of disease [11].

The National Health Service (NHS) defines (hazardous alcohol consumption) as more than 21 units per week for men and more than 14 units for women [12]. The United Kingdom (UK) has seen an increase in both the number of people drinking alcohol and the number of people drinking in excess of the recommended daily limit [13]. Many reasons have been suggested, including easy access to cheap alcohol, changes in licensing laws and the [10, 12, 13]. In response, government campaigns have been conducted in the UK to improve knowledge of the effects of alcohol, its safe levels and to decrease its hazardous effects on the incidence of trauma if consumed unsafely. A review of the literature has shown a variation in the specific aim of these campaigns. Two of the campaigns aimed to change beliefs or attitudes [15, 16], two aimed to reduce consumption [17, 18] and one aimed to promote treatment seeking and improve knowledge [19].

Mass media campaigns may directly or indirectly lead to health behaviour change in populations. However their success may depend on the behaviour targeted by such a campaign. Whilst, these campaigns have succeeded in reducing drink driving, there is a little evidence that they have reduced alcohol-related road

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accidents or related injuries and deaths [20]. Consequently, the aim of this study was to determine the epidemiology (incidence, severity of injuries, mechanism of injury and outcome) of trauma patients admitted to a Level 1 trauma centre in the UK between 2014-2019.

PATIENTS AND METHODS

We performed a retrospective study of intoxicated trauma patients admitted to a major level 1 trauma center (St George's University Hospitals NHS Foundation Trust, London, UK) in the period between January 2014 to January 2019. Our data was obtained from the Trauma Audit and Research Network (TARN) office. St George's Hospital is a level 1 trauma center which serves a population of 1.3 million across southwest London and is one of the UK's largest teaching hospitals. St George's Hospital receives and treats approximately 120 patients every month as a result of trauma.

The date and time of trauma, arrival to the emergency department and date and time of discharge were recorded. We classified the length of hospital stay (LOS) into three categories, below 21 days, between 21–60 days and more than 60 days. All trauma injuries were recorded. These were classified by anatomical location into six groups (head, chest, abdomen, bones, pelvis, spine).

Mechanism of injury was classified into falls (less than or greater than two meters), road traffic accidents (RTAs), blunt trauma, stabbings, shootings and burns. The mechanism type was classified as either penetrating or blunt trauma. The outcome after 30 days, whether alive

or dead, was also recorded. The injury severity score (ISS) was classified into three groups (<8, 8-15,>15). All patients had a confirmed blood alcohol test (BAC) at the time of arrival in hospital. We defined alcohol positive cases as those with a BAC >0.01 g% [21]. We also recorded whether admission was on a weekend or a national holiday.

Data Analysis

The demographic characteristics of the cohort were reported using descriptive statistics (mean and standard deviation). The distribution of the dataset was assessed using a Shapiro-Wilks test and histograms. This indicated a normally distributed dataset. Based on this, differences in continuous outcomes over time were assessed using an analysis of variance (ANOVA) test whilst categorical data was analysed using a Chi-squared test. Statistical significance was determined as $p < 0.05$. Statistical analyses were undertaken on SPSS (version 25.0; IBM, New York, USA).

RESULTS

Patients under the influence of alcohol and other substances

From the 760 identified patients, 665 were intoxicated with alcohol alone (88%), 63 cases (8%) were intoxicated with both alcohol and other substances. Thirty-two patients (4%) were under the effect of other drugs and substances without alcohol involvement and these were excluded from the study. Total cases included were therefore 728 patients (*Table 1*).

Table 1: Data analysis of the cases involved in the study; number of alcohol intoxicated trauma patients admitted to St George's hospital between January 2014 to January 2019 regarding the anatomical region of, the mechanism of injury, mechanism type, timing, outcome, injury severity score (ISS) and length of stay in hospital

		Number of cases
Injury	Head	435
	Chest	227
	Abdomen	45
	Spine	229
	Bone	201
	Pelvis	74
Mechanism of injury	Blunt	704
	Penetrating	74
Timing	Weekend	312
	Weekday	416
sex	Male	559
	Female	169
Length of hospital stay	< 21 days	592
	21 – 60 days	120
	>60 days	15
Mechanism of injury	Fall < 2 meters	248
	Fall > 2 meters	212
	Motor vehicle impacts	160
	Blow	80
	Stab	20
	Burn	1
	Shoot	1
	Others	3
outcome	Dead	44
	Alive	684
Injury severity score (ISS)	1 – 8	90
	8 – 15	214
	More than 15	424

Differences in demographics and injury severity score (ISS)

Among the 728 alcohol intoxicated patients, there was no difference in the number of cases admitted every year ($N=135 - 156$ admissions per year, $p=0.18$), and in injury severity score (ISS) distribution with the majority being > 15 ($N=424$; 58%; $p=0.28$) (*Figure 1*; *Table 2*). There was no difference in the median age between the years (46.4 years; $p=0.99$).

There were more intoxicated males than females ($N=559$ males versus 169 females; ratio=3.3:1), however, a decrease in this ratio was noticed in the last two years (4:1) in 2014 – 2016 compared to (ratio=2.9:1) in 2017 to 2019 which reflected an increasing trend in female alcohol related injuries (*Table 2*). There was no change in alcohol and drug intoxicated injuries with time ($p=0.46$ and $p=0.87$ respectively). The

majority of patients stayed in hospital less than 21 days (N=592; 81%). This percentage increased in 2018 and 2019 to 89% (p<0.01; Table 1).

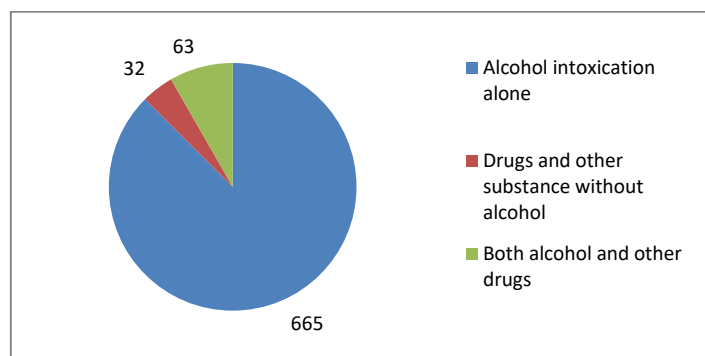


Figure 1: Trauma patients intoxicated by alcohol, substance and both; all intoxicated patients admitted to St George’s university hospital, London after being involved in trauma. 665 cases were under alcohol alone, 32 cases only intoxicated by drugs and substances without alcohol, and 63 cases under both alcohol and other drugs and substances.

Outcomes

Overall mortality rate was 6.1% (44/728). The commonest cause of mortality was a head injury (40 deaths; 91%). There was no difference in the overall mortality in the five years studied (p=0.43; Table 2). The rate of mortality in males was 6.7% (34 dead cases out of 506), while that in females was 3.7% (6 cases out of 159 cases). There was no difference found in mortality rate when taking gender into consideration (p=0.20).

Mechanisms of injury

The most common mechanism of injury was a fall (N=460; 63%), followed by RTA (N=160; 22%) with high-energy falls being the most

common (36 %) up to 2017 when low energy falls (<2 meters; 40–45%) became the most common. The most common injury was to the head (N=435; 60%) then chest (N=227; 31%) and spine (N=229; 31%) (Table 3). Blunt trauma was the most common mechanism (N = 705; 97%) (Table 2).

The most common three mechanisms of injury in alcohol intoxicated patients with head injury (whether isolated head injury or combined with other injuries) were high-energy falls (>2m), low-energy falls (<2m) and vehicle accidents, respectively in 2014-2016. The ratio between high-energy and low-energy remained static until 2016. Since 2017 however, low-energy falls have become the most common mechanism of head injury (Figure 2).

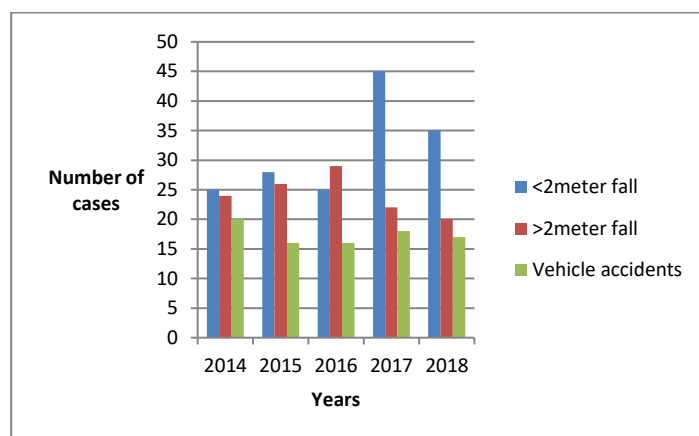


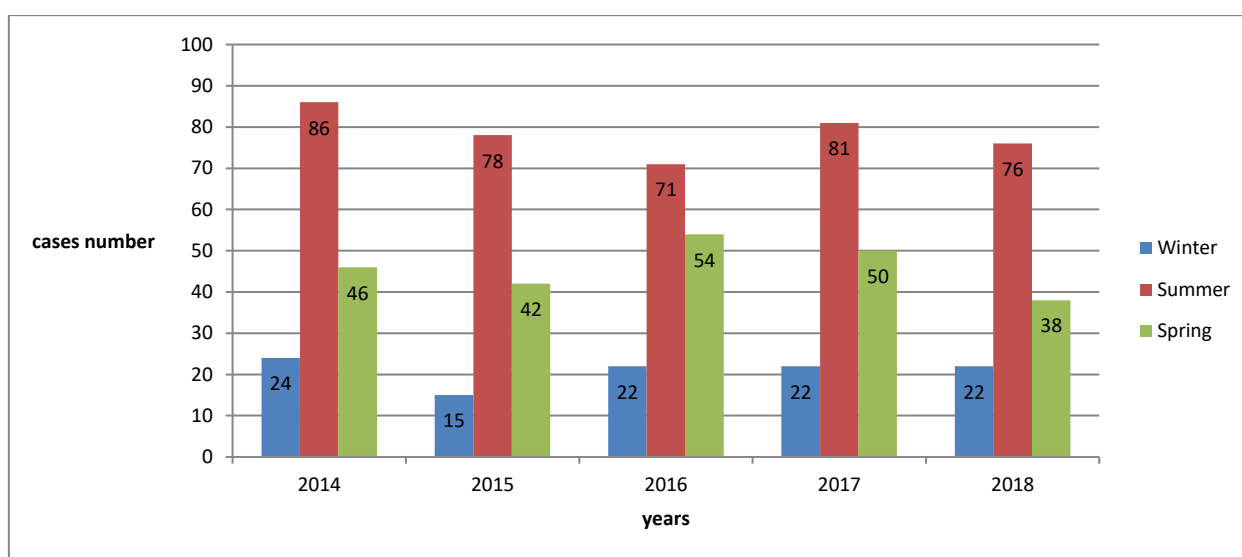
Figure 2: Mechanisms of injury in head injured patients; the most common mechanisms involve in head injury cases, falls (less and more than 2 meters and motor vehicle accidents) with variations in incidence between 2014 and 2018.

Table 2: Variations in yearly admitted cases; alcohol intoxicated trauma patients admitted to St George’s hospital between January 2014 to January 2019 showing the number of cases in each year regarding the anatomical region of injury, the mechanism of injury, mechanism type, timing, outcome, injury severity score (ISS) and length of stay in hospital

Years	2014		2015		2016		2017		2018		
Number of cases	156		135		147		153		137		
Length of hospital stay	< 21 day	118 (75.6%)	108 (80%)	121 (82.3 %)	123 (80.3%)	122 (89 %)					
	21 – 60	38 (24.3)	21 (15.5 %)	22 (14.96 %)	27 (17.6 %)	12 (8.7 %)					
	>60 day	0 (0 %)	6 (4.4 %)	4 (2.7 %)	3 (1.9 %)	33 (2.1 %)					
mechanism	Fall <2 meters	46	38	40	62	62					
	Fall >2 meters	48	47	53	37	27					
	Motor vehicle accident	43	28	32	30	27					
	Blow	15	15	15	16	19					
	Stab	3	6	6	4	1					
	Burn	0	1	0	0	0					
	Shoot	0	0	1	0	0					
	Others	1	0	1	4	1					
Injury severity score (ISS)	1 -8	21 (13.4%)	12 (8.8%)	18 (12.2%)	18 (11.7 %)	21 (15.3%)					
	8 -15	51 (32.6 %)	39 (28.8%)	50 (34%)	45 (29.4%)	29 (21.1 %)					
	>15	84 (53.8%)	84 (62.2%)	79 (53.7%)	90 (58.8%)	87 (63.5%)					
Outcome	Death	5	11	8	11	9					
	Alive	151	124	139	142	128					
injuries	Head	84	83	81	99	88					
	Chest	50	37	46	53	41					
	Abdomen	8	9	10	10	8					
	Spine	56	34	45	54	40					
	Bones	57	44	48	26	26					
	Pelvis	21	16	9	18	10					
Mechanism type	Blunt	153	129	140	147	136					
	Penetrating	3	6	7	6	1					
Incidence date	Weekdays	96	75	92	81	72					
	Weekends(sat/sun)	60	60	55	72	65					
sex	Male	121	Ratio	108	Ratio	114	Ratio	114	Ratio	102	Ratio
	Female	35	3.4:1	27	4:1	33	3.5:1	39	2.9:1	35	2.9:1

Table 3: Admissions in holidays; cases of alcohol intoxication admitted to St George's Hospital between January 2014 and January 2019 in national bank holidays

	2014	cases	2015	cases	2016	cases	2017	cases	2018	cases
New Year's Day	1 / 1	2	1 / 1	1	1/1	2	1/1	2	1/1	0
			2 / 1	0	2/1	0	2/1	0		
					4/1	0				
Good Friday	18/4	0	3 / 4	1	25/3	2	14/4	2	30/3	0
Easter Monday	21/4	0	6 / 4	0	28/3	2	17/4	0	2/4	1
May Day	5 / 5	0	4 / 5	0	2/5	1	1/5	1	7/5	1
Spring bank	26 / 5	0	25/5	0	30/5	1	29/5	1	26/5	0
August bank	25 / 8	4	3 / 8	2	29/8	2	28/8	2	27/8	2
Christmas Day	25/12	1	25/12	1	25/12	1	25/12	1	25/12	0
Boxing Day	26/12	0	26/12	2	26/12	1	26/12	0	26/12	0
			27/12	0	27/12	0				
			28/12	0	28/12	0				

**Figure 3:** Seasonal variations in alcohol intoxicated trauma patients; number of trauma cases intoxicated by alcohol admitted to St George's Hospital in summer, winter and spring in the last 4 years

Seasons and weekends

416 cases (57%) were injured on weekdays (Monday to Friday) with a median of 83 cases per day, however, the number of cases on weekends (Saturday and Sunday) was 312 cases with a median of 156 per day. This reveals the significant increase in number of cases during weekend days ($p < 0.01$).

As seen in *Table 3*, there was no correlation with national holidays. The majority of injury admissions occurred in the summer ($N=392$; 54%), followed by spring ($N=230$; 32%) and finally the winter season ($N=105$; 14%) ($p < 0.01$) (*Figure 3*).

Differences between poly-trauma and single anatomical region affection

There was a marked variation in ISS and rate of death regarding whether this injury was an isolated system injury or in association with other system injuries. In poly-trauma patients, the most common ISS was > 15 , but when taking isolated injuries into consideration, the most common ISS was (8 – 15) except in head injuries where the most common ISS was > 15 and in pelvis injuries where the most common ISS was < 8 (*Table 4*).

In isolated region injuries, deaths occurred only in patients with head ($N=24$; 3%) and chest ($N=2$; 0.2%) injuries and no deaths were recorded in all other system injuries. In general involvement of the anatomical region, the rate of death is still highest with head involvement (9%) followed by the chest (6%) then the spine (5%) (*Table 4*).

Isolated anatomical region injuries, outcome, mechanisms, and ISS

When analyzing the data of alcohol intoxicated patients with isolated injuries throughout the five years of the study, there was no difference in the yearly incidence except for long bone fractures which showed an increased proportion of all injuries with time ($p < 0.001$; *Table 5*).

The number of cases with isolated injuries were 409 cases (56 % of all cases intoxicated by alcohol) from which, head injury cases were the most common ($N=232$; 57%). In all injuries, the most common mechanism of injury was fall less than 2 meters except isolated spine injury cases in which the most common mechanism was falls more than 2 meters (48%) and isolated abdomen injury cases in which the most common mechanism was RTA(41%). In all cases the most common type of trauma was the blunt type except abdominal injuries in which both blunt and penetrating injuries were equal.

In all isolated injury cases, the most common ISS was the (8-15) group except isolated head injury patients, in which the most prevalent ISS was (> 15) (81%) and isolated pelvis injuries in which the most common ISS was < 8 (88%) (*Table 5*).

Table 4: Deaths and ISS in different anatomical areas; the number of deaths and ISS cases (< 8, between 8 – 15 and > 15) in every year between 2014 to 2018 in patients intoxicated by alcohol admitted to St George’s hospital with trauma involving head, chest, abdomen, bones, spine and pelvis

			2014	2015	2016	2017	2018
Head	Deaths		5	9	8	11	7
	ISS	<8	6	4	6	7	7
		8-15	17	13	12	20	15
		>15	61	66	63	72	66
Chest	deaths		1	3	4	4	2
	ISS	<8	5	0	4	0	3
		8-15	14	10	16	13	16
		>15	31	27	26	40	28
Abdomen	Deaths		0	1	0	1	0
	ISS	<8	1	1	2	0	2
		8-15	2	4	4	3	3
		>15	5	4	4	7	3
Spine	Deaths		2	2	2	5	0
	ISS	<8	8	4	7	7	5
		8-15	21	11	18	14	12
		>15	27	19	20	33	23
Bones	Deaths		1	0	1	0	1
	ISS	<8	8	4	6	0	3
		8-15	24	19	18	15	9
		>15	25	21	24	11	14
Pelvis	Deaths		0	0	2	0	0
	ISS	<8	4	5	6	7	4
		8-15	4	2	2	5	2
		>15	13	9	9	6	4

Table 5: Isolated anatomical region injury; number of cases intoxicated by alcohol who have isolated head, chest, abdomen, pelvis, spine and bone injuries

Injury	No	ISS			Mortality		Length of stay			mechanism						
		<8	8-15	>15	Alive	Dead	<21	21 - 60	<60	car	<2m fall	>2m fall	blow	stab	shoot	others
Head	232	12	32	188	208	24	186	39	7	17	115	38	57	2	0	3
Chest	41	6	19	16	39	2	37	4	0	8	17	6	3	6	0	1
Abdomen	17	4	7	6	17	0	15	2	0	7	0	1	1	5	0	3
Pelvis	16	14	0	2	16	0	14	2	0	1	10	4	0	1	0	0
Spine	52	20	25	7	52	0	48	4	0	6	21	25	0	0	0	0
Bones	51	4	47	0	51	0	41	10	0	13	22	11	1	3	0	0

DISCUSSION

The findings from this study report no change in hospital length of stay or mortality in trauma patients intoxicated by alcohol from 2014 to 2019. Head injury is the greatest risk to mortality in this group, with falls being the most common mechanism. There has been a switch in low-energy falls (<2m) being now more common than high energy falls (>2m) for admission in intoxicated adults. There has also been an increase in the percentage of females intoxicated with alcohol in the trauma setting and in long bone fractures from 2018 to 2019. Although weekends have the highest number of admissions of intoxicated patients, there was no correlation with national holidays.

Cowperthwaite and Burnett [22] reported that alcohol consumption before injury may lead to a 15% higher risk of infective complications with associated longer hospital length of stay. There is limited literature on length of hospital stay in alcohol intoxicated patients [22, 23]. Our data reported a decrease in the hospital length of stay over time; the percentage of patients admitted < 21 days was 81% before 2018 compared to 89% after 2018; p<0.01.

Numerous studies have reported a high association between ISS and alcohol consumption before the incidence of trauma [25, 26]. Stubbing *et al* [27] reported that 47% who tested positive had significantly higher ISS and a higher risk of mortality than the BAC negative group. However, others have suggested that BAC may not impact on outcomes [28]. We did not compare ISS in trauma patients intoxicated and not intoxicated

by alcohol, our data was only limited to the alcohol intoxicated group, and this may be an area for further study.

Regarding the relation between alcohol and mortality, some reports have suggested improved survival [29, 30-33]. However, other studies have shown no correlation between alcohol exposure and mortality [34-37]. Cunningham and colleagues [33] provided some evidence through a study which showed that RTA patients with acute alcohol intoxication are over twice as likely to have more severe head injuries compared to non-intoxicated trauma patients. In our study regarding the outcome, the overall mortality rate was six percent. The most common cause of mortality was a head injury (N=40; 91%). Our study has found that mortality remained the same over the five years of the study (p=0.43). We did not compare this with the severity in non-intoxicated groups, however.

Previous literature has reported that lower limb injuries are common in intoxicated patients. Johnston *et al* showed that injured patients with a blood alcohol level of 2–2.5g/L comprised mostly severe lower limb fractures which required admission for fixation [37]. There has been a wealth of evidence that fracture healing time is delayed in alcoholics and smokers. This disruption is mainly due to suppression of new bone formation along with relatively small changes (increase or decrease) of bone resorption [39, 40]. A significantly higher frequency of complications of fracture healing also occurs in patients with a history of alcohol abuse compared with non-alcoholic patients [41]. From our

results, we found a recent increase in long bone fractures in trauma patients intoxicated by alcohol. Therefore we suggest conducting more research on the physiological effects of alcohol on long bone fracture patterns and healing process, and more studies on the effect of alcohol withdrawal programs.

Mass media campaigns are aimed at changing health behaviour in populations, whether directly or indirectly. The existing evidence varies depending on the type of health behaviour targeted [42-45]. Most campaigns aimed at improving knowledge on alcohol and substance abuse and injury have been proven to be effective especially in areas where knowledge was initially low such as the relation between alcohol and cancer and of unit consumption guidelines. However, most studies found no impact on alcohol consumption [45]. We suggest conducting more research on mobile booze buses which have been considered as one of the effective methods recently applied in UK to treat drunken revelers to reveal its effectiveness on reducing emergency department admissions [46].

From a review of the literature of the effect of alcohol on trauma admissions in females, in one study [47] conducted on high school students, they found higher rates of dating violence victimization (e.g., shoving, kicking, or punching) in students who used alcohol when compared to non-drinking students. Regarding traffic accidents, although women are less likely than men to drive after drinking [48], women have a higher relative risk of driver fatality than men at similar blood alcohol concentrations [49]. This may be the reason why women may be more vulnerable than men to alcohol-induced brain damage [50].

From our study, we found a recent change in the percentage of female trauma proven to be intoxicated with alcohol but we have not detected any change in mortality rate when we compared men and women ($p=0.20$). We therefore recommend more targeting of women by effective campaigns to increase the awareness of the dangerous effects of alcohol on them taking their body physiology into consideration.

CONCLUSION

Alcohol intoxication remains a major cause of hospital admissions to level 1 trauma center, with head injury being the commonest cause of mortality and no reduction in admission numbers between 2014 to 2019 in this cohort. Further research is required to explore the physiological effect of alcohol on long bones and fractures, severity, injury patterns and healing on long term follow-up. More effective campaigns need to be conducted to decrease alcohol related RTA and falls, being the most common two mechanisms of injury.

Acknowledgements

With thanks to the St George's Hospital TARN office for providing the data search.

Conflicts of interest

There are no conflicts of interest.

Source of funding

Not applicable.

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