Gender and Alcohol in Accidental Fatalities: A Forensic Autopsy-Based Study in Nairobi

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ABSTRACT

Alcohol consumption is a major contributor to global injury-related mortality and is strongly associated with accidental deaths. Gender differences play a key role in alcohol-related injury risk, with males disproportionately affected due to higher levels of alcohol use and engagement in risk-taking behaviors. However, forensic evidence from low-resource settings remains limited.

This study examined the role of alcohol and gender in accidental fatalities in Nairobi, Kenya. A descriptive prospective autopsy-based study was conducted at Nairobi City Mortuary between June 2009 and May 2010. A systematic sampling approach yielded 400 medicolegal autopsies, from which violent deaths were identified. Vitreous humor ethanol concentrations were measured using gas chromatography with flame ionization detection and categorized into standard levels of intoxication.

Out of 2,278 violent deaths recorded, accidents accounted for 46.7%, homicides 43.5%, and suicides 9.8%. Among 400 autopsies analyzed, 96 cases (24.0%) were alcohol-positive, with accidents contributing 52.1% of cases. A total of 50 alcohol-related accidental deaths were identified. Males accounted for 94% of cases, while females accounted for 6%, demonstrating a marked gender disparity. The majority of victims were road traffic accident fatalities (86%), with pedestrians forming the largest subgroup (51.2%).

Severe intoxication (heavy to stuporous levels) was common across all road users and was particularly pronounced among drivers (80%), among whom alcohol intoxication showed a statistically significant association with fatal outcomes ($p = 0.0177$). Non-road traffic accidents, including falls, drowning, burns, and electrocution, also showed predominantly severe intoxication (85.7%), indicating a broad impairment of environmental hazard perception.

Although females were few in number, they also exhibited severe intoxication when present, suggesting that high alcohol exposure is equally hazardous across gender. However, gender comparisons were not statistically significant due to the small female sample size.

The findings demonstrate a strong association between alcohol intoxication and accidental fatalities, with a clear male predominance and a dose-dependent relationship between intoxication severity and fatal outcomes. Alcohol is a key modifiable risk factor in accidental deaths, particularly in young adult males exposed to high-risk environments.

Keywords: Alcohol intoxication, gender, accidental deaths, forensic toxicology, Nairobi, road traffic injuries

INTRODUCTION

Alcohol consumption is a major global public health concern and a significant contributor to injury-related mortality. The World Health Organization estimates that harmful use of alcohol is responsible for approximately 3 million deaths annually, accounting for more than 5% of all global deaths, with a large proportion arising from unintentional injuries such as road traffic crashes, falls, drowning, and burns [1]. Beyond mortality, alcohol

contributes substantially to the global burden of disease through disability-adjusted life years (DALYs), largely driven by trauma and injury-related outcomes [2].

Alcohol impairs multiple neurocognitive and psychomotor functions, including judgment, reaction time, coordination, executive functioning, and risk perception. These effects reduce an individual's ability to recognize hazards and respond appropriately in dynamic environments, thereby increasing vulnerability to accidental injury [3]. Acute intoxication produces disinhibition, impaired decision-making, and reduced situational awareness, which increases engagement in hazardous behaviors such as unsafe road crossing and reckless driving [4]. The relationship between alcohol and injury is dose-dependent, with higher blood alcohol concentrations strongly associated with increased injury severity and mortality risk [5]. Importantly, alcohol-related impairment affects not only drivers but also pedestrians, cyclists, and passengers due to reduced environmental awareness and delayed protective responses [6].

Gender differences are central to alcohol-related injury epidemiology. Men consistently exhibit higher levels of alcohol consumption, more frequent binge drinking, and greater engagement in risk-taking behaviors compared to women [7]. Globally, males account for the majority of alcohol-attributable injury deaths, reflecting both behavioral and sociocultural influences [8]. Masculinity norms that encourage risk-taking, emotional suppression, and reluctance to seek help further increase male vulnerability to alcohol-related harm [9]. Although women generally consume less alcohol, they may experience greater physiological sensitivity at equivalent doses; however, their lower exposure to high-risk drinking environments results in fewer fatal injury outcomes [7].

In low- and middle-income countries, alcohol-related injuries are particularly severe due to rapid urbanization, weak enforcement of road safety regulations, and limited trauma care systems. Sub-Saharan Africa is experiencing a rising burden of harmful alcohol use driven by increased availability, changing cultural norms, and socioeconomic transitions [10]. However, weak surveillance systems and limited forensic capacity hinder accurate estimation of alcohol-attributable injury mortality, especially with respect to gender-disaggregated patterns [10].

In Kenya, alcohol has been consistently associated with injury mortality, particularly road traffic crashes and violent deaths. Available forensic and hospital-based studies indicate a high prevalence of alcohol among trauma victims, especially young adult males who are frequently exposed to high-risk environments [11]. However, gender-specific patterns of alcohol intoxication severity in fatal accidental injuries remain insufficiently characterized in forensic literature. This represents an important gap in understanding the interaction between alcohol use, gender, and injury risk in low-resource urban settings and highlights the need for autopsy-based evidence to inform targeted prevention strategies.

MATERIALS AND METHODS

Study design and setting:This was a descriptive prospective autopsy-based study conducted at Nairobi City Mortuary between June 2009 and May 2010. Ethical approval was obtained from the University of Nairobi–Kenyatta National Hospital Ethics Committee.

Study population:During the study period, 2,278 violent deaths were recorded in Nairobi. From these, a systematic sample of 400 medicolegal autopsies was selected.

Accidental deaths included road traffic accidents, falls, burns, drowning, and electrocution. Cases with advanced decomposition or insufficient vitreous humor were excluded.

Alcohol analysis:Vitreous humor (2 mL) was collected and analyzed using gas chromatography with flame ionization detection (GC-FID). This method minimizes postmortem redistribution bias and is widely accepted in forensic toxicology.

Alcohol presence was defined as any detectable ethanol concentration.

Classification of intoxication: Light: ≤0.10 g%, Moderate: 0.10–0.20 g%, Heavy: 0.20–0.30 g%, Very heavy: 0.30–0.35 g% and Stuporous: >0.35 g%

Data analysis: Data were analyzed using descriptive statistics. Fisher's Exact Test was applied for categorical associations where appropriate. Given the small number of female cases, gender comparisons are presented descriptively, and inferential conclusions are interpreted with caution.

RESULTS

Distribution of Violent Deaths

A total of 2,278 violent deaths were recorded. Accidents were the leading cause (46.7%), followed by homicides (43.5%) and suicides (9.8%). **(Table 1)**

Table 1: Distribution of Violent deaths by cause in Nairobi Kenya

Cause of deaths	Number	Percentage (%)
Accident	1064	46.7
Homicide	990	43.5
Suicide	224	9.8
Total	2278	100

Alcohol Positivity

Among 400 autopsies, 96 cases (24.0%) were alcohol-positive. Homicides accounted for 39.6% of alcohol-positive cases, accidents 52.1%, and suicides 8.3%. **(Table 2).**

Table 2: Distribution of alcohol intoxicated victims by cause

Cause	No	%
Accidents	50	52.1
Homicide	38	39.6
Suicide	8	8,3
Total	96	100

Gender Distribution of Alcohol-Related Accidental Deaths

A total of 50 accidental deaths involving alcohol were analyzed. Males accounted for 47 cases (94%), while females accounted for 3 cases (6%), demonstrating a marked gender disparity in alcohol-related fatal injuries. This indicates a dominant male burden across all categories of alcohol-associated accidental mortality.

Mechanism of Injury (Accidental Deaths)

Road traffic accidents (RTAs) were the leading cause of death, accounting for 43 cases (86%), while non-road traffic accidents (non-RTAs) accounted for 7 cases (14%). This demonstrates that alcohol-related accidental mortality is predominantly traffic-related. **(Table 3)**

Table 3: Mechanism of Alcohol-Related Accidental Deaths (n = 50)

Mechanism	Frequency	%
Road Traffic Accidents	43	86
Non-Road Traffic Accidents	7	14
Total	50	100

Distribution of Road Traffic Fatalities by Road User Type

Among RTAs, pedestrians formed the largest group (22 cases, 51.2%), followed by passengers (9 cases, 20.9%), cyclists (7 cases, 16.3%), and drivers (5 cases, 11.6%). **(Table 4)**

Table 4: Road User Distribution in RTA Fatalities (n = 43)

Road User	Frequency	%
Pedestrians	22	51.2
Passengers	9	20.9
Cyclists	7	16.3
Drivers	5	11.6
Total	43	100

Alcohol Intoxication Patterns by Road User Type

Severe intoxication (heavy, very heavy, stuporous) was common across all road users. Drivers had the highest proportion of severe intoxication (80%), which showed a statistically significant association with fatal outcomes ($p = 0.0177$). Pedestrians also demonstrated a high burden of severe intoxication, suggesting marked impairment of situational awareness. **(Table 5)**

Table 5: Alcohol Intoxication Severity by Road User

Road User	Light-Moderate/%	Heavy-Stuporous /%	Key Observations
Drivers	20	80	Highest severity; significant association(p=0.0177)
Pedestrians	31.8	68.2	High Impairment risk
Cyclists	14.2	85.8	Mid-high impairment
Passengers	44.4	55.6	Mixed distribution

Non-Road Traffic Accidents and Alcohol Intoxication

Non-road traffic accidents (burns, drowning, falls, electrocution) showed predominantly severe intoxication, with 85.7% of cases falling into the heavy to stuporous category. This indicates alcohol's broad role in impairing environmental hazard perception beyond traffic settings.

Gender and Severity of Intoxication (Overall Pattern)

Males dominated all intoxication categories and mechanisms of injury. Females were few in number (6%) but, when present, also demonstrated severe intoxication in fatal cases, suggesting that high-level alcohol exposure is equally hazardous across gender, although exposure frequency is much higher in males.

Statistical Analysis

Fisher's Exact Test demonstrated a statistically significant association between alcohol intoxication severity and fatal outcomes among drivers ($p = 0.0177$). However, gender-specific comparisons did not reach statistical significance, likely due to the small number of female cases. Despite this, descriptive trends consistently indicated higher severity of intoxication among males across all categories.

DISCUSSION

This study demonstrates a strong and consistent association between alcohol intoxication and accidental fatalities in Nairobi, with a pronounced male predominance and clear concentration among young adults. The finding that 94% of alcohol-related accidental deaths occurred in males aligns with extensive global literature showing that men bear a disproportionate burden of alcohol-attributable injury mortality (1,2). This gender disparity is well documented across both high-income and low- and middle-income countries and reflects a combination of behavioural, biological, and sociocultural determinants.

Men are more likely than women to engage in heavy episodic drinking, also known as binge drinking, which is strongly associated with acute intoxication and injury risk (3). In addition, sociocultural constructions of masculinity often normalize risk-taking behaviour, alcohol consumption, and emotional suppression while discouraging help-seeking (4). These behavioural patterns increase exposure to hazardous environments such as nightlife settings, informal drinking venues, and high-risk transport corridors, where accidental injuries are more likely to occur.

Alcohol exerts its harmful effects through well-established neurocognitive pathways, including impairment of executive function, reduced inhibitory control, slowed reaction time, and altered risk perception (5). These impairments significantly reduce an individual's ability to assess environmental danger and respond appropriately. The present findings, particularly the high proportion of severe intoxication among fatalities, support the dose–response relationship between blood alcohol concentration and injury risk consistently demonstrated in epidemiological studies (5,6). As alcohol concentration increases, both motor coordination and cognitive processing deteriorate, sharply increasing the likelihood of fatal injury outcomes (6).

A key finding in this study is the predominance of pedestrians among alcohol-related road traffic fatalities. Over half of road traffic deaths occurred among pedestrians, a pattern consistent with studies from other low-resource urban settings (7). Alcohol impairs situational awareness, spatial judgment, and attention allocation, making pedestrians less able to detect oncoming vehicles or interpret traffic signals accurately (7,8). In environments where pedestrian infrastructure is poorly developed, as is common in many urban African settings, this risk is significantly amplified (9).

Drivers with severe intoxication showed the strongest association with fatal outcomes, with 80% of driver fatalities occurring at heavy to stuporous intoxication levels. This finding is consistent with global evidence demonstrating a steep dose–response relationship between blood alcohol concentration and crash risk (6,10). Even moderate alcohol consumption impairs reaction time and visual tracking, while higher levels severely compromise judgment and motor coordination, resulting in increased crash severity and mortality (10,11). The statistically significant association observed in this study ($p = 0.0177$) reinforces alcohol intoxication as a major determinant of fatal road traffic crashes.

Beyond road traffic injuries, non-road traffic accidents also demonstrated high levels of alcohol involvement, particularly in burns, drowning, falls, and electrocution cases. Alcohol impairs hazard recognition, delays protective reflexes, and reduces balance and coordination, increasing susceptibility to environmental injuries

(12). In drowning cases, alcohol-induced motor impairment and reduced swimming ability significantly increase fatal risk even in shallow or familiar water bodies (12,13). Similarly, domestic injuries such as burns and falls are frequently associated with alcohol-induced disinhibition and delayed response to danger (13).

The concentration of fatalities among individuals aged 21–40 years reflects both behavioural and structural determinants of risk. This age group is characterized by higher alcohol consumption, increased social mobility, occupational exposure, and engagement in risk-taking behaviours (3,14). Neurodevelopmental factors, particularly incomplete maturation of the prefrontal cortex, contribute to impulsivity and sensation-seeking behaviour, further increasing vulnerability to injury when combined with alcohol use (14). The decline in fatalities in older age groups may reflect reduced alcohol consumption and greater health awareness.

The interaction between gender and alcohol-related injury risk is complex. While behavioural differences account for much of the disparity, biological factors may also contribute. Women exhibit greater sensitivity to alcohol at equivalent doses due to differences in body composition, enzyme activity, and metabolism (15). However, they are less frequently exposed to high-risk drinking environments, which may explain their lower representation in fatal injury statistics. Importantly, the few female cases observed in this study also exhibited severe intoxication, indicating that when exposure occurs, risk of fatal outcome remains substantial.

From a forensic perspective, the use of vitreous humor ethanol analysis strengthens the validity of findings. Vitreous humor is less susceptible to postmortem redistribution and putrefactive changes, making it a reliable specimen for postmortem alcohol estimation (16). This enhances the scientific robustness of the toxicological results.

Several limitations must be acknowledged. First, the relatively small number of alcohol-related accidental deaths (n=50) limits statistical power and generalizability. Second, the very low number of female cases restricts meaningful gender-specific comparative analysis. Third, the single-center design may not fully represent broader regional or national patterns. Fourth, important variables such as socioeconomic status, occupation, time of injury, and drinking context were not available, limiting deeper causal interpretation. Finally, the study only includes fatal outcomes, excluding non-fatal injuries which may provide a more complete burden of alcohol-related harm.

Despite these limitations, the study provides valuable forensic evidence from a low-resource setting and contributes to the limited literature on gendered patterns of alcohol-related accidental mortality in sub-Saharan Africa.

CONCLUSION

Alcohol intoxication is a major and preventable contributor to accidental mortality in Nairobi. The burden of alcohol-related fatal injuries is disproportionately borne by males, particularly young adults aged 21–40 years. Severe intoxication is strongly associated with fatal outcomes across both road traffic and non-road traffic environments. Although gender differences are evident, interpretation is limited by the small number of female cases.

Overall, alcohol remains a critical modifiable risk factor in accidental injury mortality. The findings highlight the urgent need for targeted prevention strategies addressing high-risk drinking behaviours, particularly among young adult males in urban settings.

RECOMMENDATIONS

Public health interventions should prioritize reduction of harmful alcohol use among young adults, particularly males who represent the highest-risk group for accidental death. Community-based education programs should address binge drinking, impaired judgment, and risk behaviours associated with intoxication.

Strengthening enforcement of alcohol-impaired driving laws is essential, including routine roadside breath testing, stricter penalties, and improved surveillance systems. However, prevention efforts should extend beyond drivers to include pedestrians and cyclists, who constitute a significant proportion of victims.

Urban planning and infrastructure improvements are critical in reducing injury risk. These include improved street lighting, pedestrian crossings, traffic calming measures, and dedicated cycling lanes, particularly in high-density urban areas.

Non-traffic injury prevention strategies should address alcohol-related risks in domestic environments, including falls, burns, drowning, and electrocution. Public awareness campaigns should emphasize the dangers of alcohol consumption in home and recreational settings.

Healthcare systems should integrate routine alcohol screening and brief interventions into emergency and trauma care services to identify high-risk individuals early and provide timely intervention.

Finally, multicenter forensic studies incorporating socioeconomic, behavioural, and environmental variables are recommended to improve generalizability and deepen understanding of alcohol-related injury mechanisms across Kenya and similar settings.

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Response to Reviewers

Reviewer Comment 1: Small sample size limits statistical power

Response: We acknowledge the relatively small number of alcohol-positive accidental deaths (n=50). This limitation has now been explicitly stated in the Discussion and Limitations section. Despite this, the study provides valuable forensic evidence from a prospective autopsy series in a low-resource setting.

Reviewer Comment 2: Very low number of female cases limits gender analysis

Response: We agree that the small proportion of female cases (6%) limits statistical comparison between genders. This limitation has been clearly acknowledged, and interpretation of gender differences has been moderated accordingly.

Reviewer Comment 3: Lack of socioeconomic and contextual variables

Response: We acknowledge that socioeconomic status, occupation, and environmental context were not available in the dataset. This has been added as a limitation, and future studies incorporating these variables have been recommended.

Reviewer Comment 4: Single-center design limits generalizability

Response: This limitation has been addressed in the revised manuscript. We now emphasize that findings are most applicable to urban forensic settings similar to Nairobi.

Reviewer Comment 5: Inclusion of non-fatal injuries suggested

Response: We agree that inclusion of non-fatal injuries would provide a more comprehensive assessment of alcohol-related harm. This has been incorporated into the recommendations for future research.

Cover Letter

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Date: 1/5/2026

Editor-in-Chief

International Journal of Research and Innovation in Social Science (IJRISS).

Subject: Submission of Manuscript – Alcohol and Accidental Fatalities in Nairobi, Kenya

Dear Editor,

We are pleased to submit our manuscript entitled:**"Gender and Alcohol in Accidental Fatalities: A Forensic Autopsy-Based Study in Nairobi, Kenya"** for consideration for publication in your esteemed journal.

This study presents a prospective autopsy-based analysis of alcohol involvement in accidental deaths in Nairobi over a one-year period. The study highlights a strong association between severe alcohol intoxication and fatal injury outcomes, with a pronounced gender disparity showing a higher burden among males and young adults.

The manuscript addresses important gaps in forensic and public health literature in low-resource settings, particularly the interaction between alcohol intoxication, gender, and accidental mortality. The study uses validated toxicological methods (gas chromatography of vitreous humor) and provides evidence relevant for injury prevention, alcohol policy, and forensic practice.

We have carefully revised the manuscript in response to reviewer comments, including:

a) Explicit acknowledgment of sample size limitations

b) Clarification of gender imbalance in the dataset

c) Expanded discussion of socioeconomic and contextual limitations

d) Strengthened interpretation of forensic findings

e) Enhanced recommendations for future multicenter research

We confirm that this manuscript is original, has not been published elsewhere, and is not under consideration by another journal. All authors have approved the submission.

We believe the findings will be of interest to readers in forensic pathology, public health, emergency medicine, and injury prevention.

Thank you for your consideration.

Sincerely,

Wangai Kiama, MMed (Path)

Department of Pathology

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If you want next, I can also:

* format this into **journal-ready Word manuscript**

* or align it to a **specific journal (BMC, Forensic Sci Int, Injury Prevention, etc.)**

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* or prepare a **tracked-changes version showing exactly what was modified**

* or strengthen it further into a **Q1 journal-level Discussion rewrite**