

Original Research Article

ALCOHOL AND ITS IMPACT ON DEATH: A RETROSPECTIVE STUDY OF INTOXICATION-RELATED FATALITIES

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ABSTRACT

Background: Alcohol consumption is a major public health and forensic concern worldwide and is associated with a wide range of accidental, suicidal, homicidal, and natural deaths. Determination of Blood Alcohol Concentration (BAC) plays a crucial role in establishing the contribution of alcohol to mortality and understanding patterns of intoxication-related fatalities.

Objectives: To evaluate the relationship between alcohol concentration and mortality, analyze the demographic profile of alcohol-positive cases, and assess the distribution of Blood Alcohol Concentration (BAC) across different manners of death.

Materials and Methods: A retrospective study was conducted at Belagavi Institute of Medical Sciences, Belagavi, analyzing medicolegal autopsies performed between January and December 2024. Out of 856 autopsies conducted during the study period, 437 cases were referred to the Forensic Science Laboratory for alcohol analysis. Blood alcohol concentration results, demographic details, and manner of death were reviewed and analyzed.

Results: Among the 437 cases analyzed, 79 cases tested positive for alcohol. Blood alcohol concentrations ranged from 40 mg/100 ml to 590 mg/100 ml. Road Traffic Accidents (RTA) constituted the largest proportion of alcohol-positive fatalities (27 cases, 33.1%), followed by suicides (23 cases, 25.7%), sudden deaths (18 cases, 20.1%), and homicides (11 cases, 21.1%). All alcohol-positive cases were males. The majority of cases belonged to the 21–30 years age group (31.6%), followed by the 31–40 years age group (27.8%). Rural residents accounted for 53.2% of cases. The most frequently observed BAC range was 100–150 mg/100 ml, followed by 150–200 mg/100 ml. Extremely high BAC levels (>400 mg/100 ml) were observed only in homicide and suicide cases.

Conclusion: Alcohol intoxication was identified as a significant contributory factor in medicolegal mortality, particularly in road traffic accidents, suicides, and homicides. Young adult males constituted the most affected population. The findings emphasize the importance of routine toxicological evaluation, stricter enforcement of alcohol-related laws, and targeted public health interventions to reduce alcohol-related deaths.

Keywords: Alcohol intoxication, Blood Alcohol Concentration, BAC, Road Traffic Accidents, Suicide, Homicide, Medicolegal Autopsy, Forensic Toxicology.

INTRODUCTION

Alcohol is one of the most widely consumed psychoactive substances in the world and has been used for centuries in various cultural, social, and religious settings. Ethyl alcohol (ethanol), the active constituent of alcoholic beverages, acts primarily as a central nervous system depressant and possesses intoxicating, toxic, and dependence-producing properties. In forensic practice, alcohol assumes great significance because of its association with accidental, suicidal, homicidal, and natural deaths, either as a direct cause or as a contributory factor.¹ According to the World Health Organization (WHO), in 2019, alcohol consumption led to an estimated 2.6 million deaths, of which 1.6 million were attributed to non-communicable diseases, 700,000 to injuries, and 300,000 to communicable diseases. The impact of alcohol is significantly higher in men, accounting for 2 million deaths compared to 600,000 deaths in women. Alcohol use disorders affect 400 million people, or 7% of the global population over the age of 15, with 209 million suffering from alcohol dependence.^{2,3}

Data from the National Crime Records Bureau (NCRB) continue to demonstrate the impact of alcohol on fatal injuries in India. According to recent NCRB data, 3,375 deaths due to road traffic accidents in 2024 were attributed to driving under the influence of alcohol or drugs, accounting for approximately 1.9% of all road accident fatalities. These figures likely underestimate the true burden of alcohol-related deaths because alcohol may contribute indirectly to many fatal incidents involving trauma, violence, drowning, burns, poisoning, and other unnatural deaths.^{9,10}

From a Forensic perspective, alcohol intoxication is frequently encountered during medicolegal autopsies. Fatalities may occur due to acute alcohol poisoning, aspiration of gastric contents, alcohol-related road traffic accidents, falls from height, drowning, burns, exposure to environmental hazards, and violent crimes. Determination of blood alcohol concentration (BAC) and interpretation of toxicological findings therefore constitute an essential component of forensic death investigation. Accurate assessment of alcohol's contribution to

death assists in establishing the cause and manner of death and provides valuable epidemiological data for preventive strategies.^{4,5,6}

Despite the recognized association between alcohol consumption and mortality, the epidemiological characteristics of intoxication-related deaths vary considerably according to age, sex, socioeconomic status, geographical region, and manner of death. Detailed analysis of alcohol-related fatalities is therefore essential for understanding the prevailing patterns of mortality and identifying high-risk populations. Such information is valuable for public health planning, policy formulation, law enforcement, and forensic practice.

The present study aims to comprehensively evaluate intoxication-related fatalities, analyze demographic and epidemiological characteristics, determine the manner and cause of death, and assess the role of alcohol intoxication in medicolegal deaths. The findings may contribute toward the development of targeted preventive measures and evidence-based interventions aimed at reducing alcohol-related mortality.

Aims and Objectives

1. Correlation Between Alcohol Consumption (alcohol concentration) and the impact on Mortality
 - Explore the relationship between levels of alcohol consumption and mortality in different manner of death.
2. To Analyse concentration of alcohol and its demographic profile
 - Quantify the proportion of deaths that can be directly or indirectly attributed to alcohol consumption.

MATERIALS AND METHODS

In this study analysis was done on autopsied cases conducted between January and December, 2024 at tertiary care centre, Belagavi Institute of Medical Sciences, Belagavi, where in some cases alcohol intoxication significantly contributed to the cause of death.

1. The blood alcohol concentration (BAC) levels in each case will be measured. BAC ranges will be categorized as follows:

Here's how different percentages of blood alcohol concentration (BAC) can affect you physically and mentally.^[4]

BAC (mg/100ml)	BAC (%)	Clinical Effects
0–50	0.00–0.05%	Mild euphoria, relaxation, slight impairment of judgment and coordination.
50–100	0.05–0.10%	Impaired motor coordination, delayed reaction time, reduced inhibitions.
100–150	0.10–0.15%	Slurred speech, poor balance, impaired judgment, significant motor impairment.
150–200	0.15–0.20%	Marked ataxia, nausea, emotional instability, risk of blackouts.
200–250	0.20–0.25%	Confusion, dizziness, severe motor impairment, memory blackouts.
250–300	0.25–0.30%	Stupor, vomiting, near unconsciousness, possible alcohol poisoning.
300–350	0.30–0.35%	Unconsciousness, respiratory depression, possible death.
350–400	0.35–0.40%	Coma, high risk of death due to respiratory failure.
>400	>0.40%	Lethal level for many individuals; coma, respiratory arrest, death.

Data Collection

Post-Mortem Examination: Autopsy Reports:

Detailed reports from the autopsies will be reviewed, including medical history, physical injuries, and cause of death and FSL reports quantifying the alcohol concentration.

RESULTS

Total of 856 medicolegal autopsies were conducted during the year 2024. Analysis of 437 cases

submitted to the Forensic Science Laboratory for suspected alcohol involvement revealed 79 alcohol-positive results. The detected blood alcohol concentrations spanned from 40 mg/100 ml to 590 mg/100 ml, with the upper range predominantly linked to homicide incidents. The breakdown of fatalities is as follows:

- **Road Traffic Accidents (RTA):** 27 cases
- **Suicides:** 23 cases
- **Sudden deaths:** 18 cases
- **Homicide:** 11 cases

Table 1: Incidence of Alcohol-Positive Fatalities Among Total Autopsies

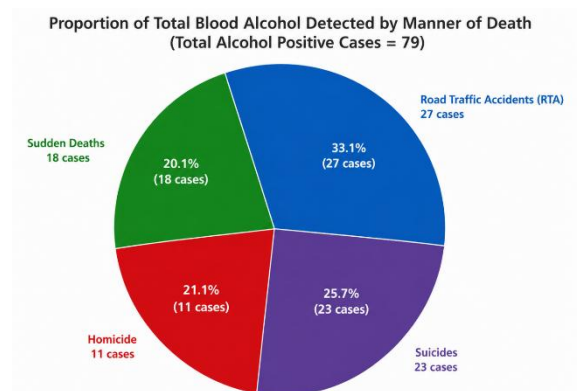
Category	Number of Cases	Percentage (%)
Total Autopsies Conducted	856	100.0
Alcohol-Positive Cases	79	9.2
Alcohol-Negative / Not Detected Cases	777	90.8
Total	856	100.0

The incidence of alcohol-positive cases among all medicolegal autopsies conducted during the study period was 9.2%. Out of 856 autopsies performed in 2024, 79 cases were found to be positive for alcohol. This indicates that nearly one out of every eleven

autopsied cases had evidence of alcohol intoxication. The finding highlights the substantial role of alcohol as a contributing factor in medicolegal deaths and underscores the importance of routine toxicological analysis in forensic investigations.

Table 2: Distribution of cases with Manner of death

Manner of Death	Number of Cases	Percentage (%)
Road Traffic Accidents (RTA)	27	33.1
Suicide	23	25.7
Homicide	11	21.1
Sudden Deaths	18	20.1
Total	79	100.0



Analysis of 437 cases submitted to the Forensic Science Laboratory for suspected alcohol involvement revealed 79 alcohol-positive cases (33.3%). Among these alcohol-positive fatalities,

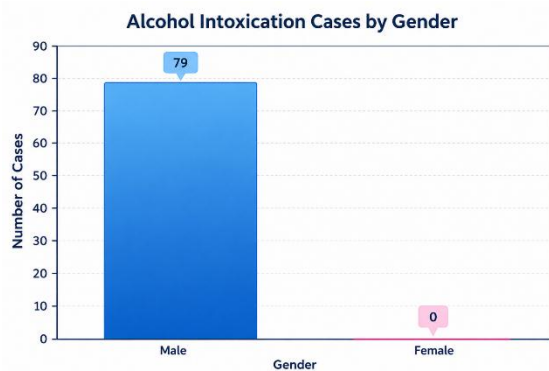
Road Traffic Accidents (RTA) constituted the largest proportion with 27 cases (33.1%), followed by Suicides with 23 cases (25.7%), Homicides with 11 cases (21.1%), and Sudden Deaths with 18 cases (20.1%).

The findings indicate that alcohol was most frequently associated with road traffic accident fatalities, highlighting its significant role in accidental deaths. However, a considerable proportion of alcohol-positive cases were also observed in suicides, homicides, and sudden deaths, demonstrating the broad medicolegal impact of alcohol intoxication across different manners of death.

Overall, RTA cases accounted for the highest share of alcohol-related fatalities, while sudden deaths represented the lowest proportion among the alcohol-positive cases studied.

Table 3: Gender-wise Distribution of Alcohol-Positive Cases

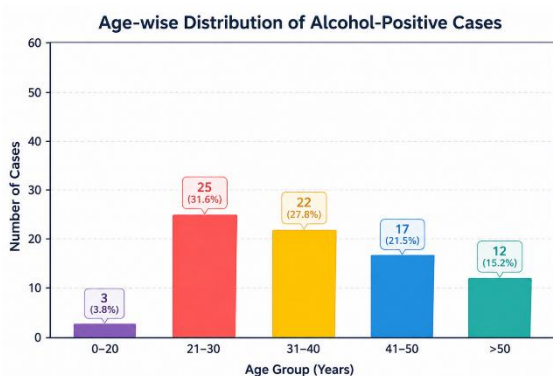
Gender	Number of Cases	Percentage (%)
Male	79	100.0
Female	0	0.0
Total	79	100.0



The bar chart depicts the distribution of alcohol intoxication cases according to gender. Out of the 79 alcohol-positive cases, all cases (100%) were males, while no female cases were identified during the study period. The chart demonstrates an overwhelming predominance of alcohol intoxication among males in the study population.

Table 4: Age-wise Distribution of Alcohol-Positive Cases

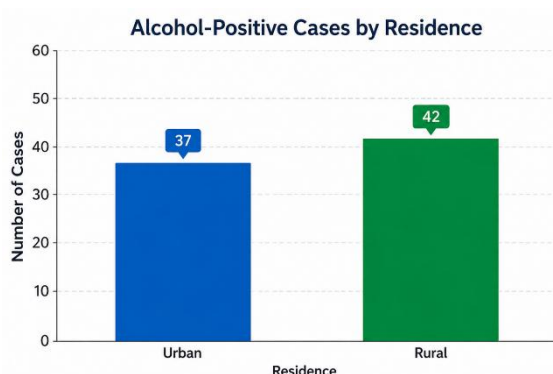
Age Group (Years)	Number of Cases	Percentage
0–20	3	3.8%
21–30	25	31.6%
31–40	22	27.8%
41–50	17	21.5%
>50	12	15.2%
Total	79	100%



The age-wise distribution of alcohol-positive cases revealed that the majority of victims belonged to the 21–30 years age group (25 cases, 31.6%), followed by the 31–40 years age group (22 cases, 27.8%). Together, these economically productive age groups accounted for nearly 60% of all alcohol-positive cases. The 41–50 years age group contributed 17 cases (21.5%), while 12 cases (15.2%) were observed among individuals aged above 50 years. The lowest frequency was recorded in the 0–20 years age group, with only 3 cases (3.8%).

Table 5: Distribution of Alcohol-Positive Cases by Residence

Residence	Number of Cases	Percentage (%)
Urban	37	46.8
Rural	42	53.2
Total	79	100.0



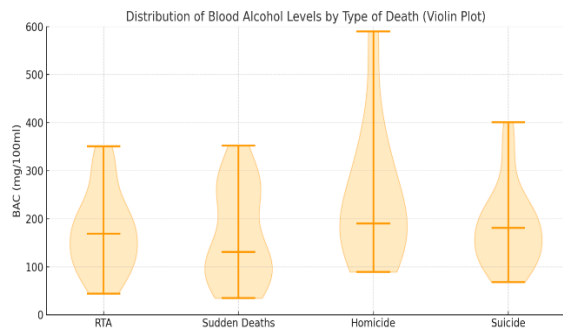
The bar chart illustrates the distribution of alcohol-positive cases according to place of residence. Of the 79 alcohol-positive cases, 42 cases (53.2%) were from rural areas, while 37 cases (46.8%) were from urban areas.

The findings show a slightly higher prevalence of alcohol-related fatalities among rural residents compared to urban residents. Although the difference is small, rural cases constituted the majority of alcohol-positive deaths in the study population.

Table 6: Distribution of blood alcohol range with manner of death

BAC Distribution Table (mg/100ml)				
BAC Range (mg/100ml)	RTA (27 cases)	Sudden Deaths (18 cases)	Homicide (11 cases)	Suicide (23 cases)
0–50	1	2	0	0
50–100	4	4	1	3
100–150	7	4	2	6
150–200	5	0	4	5
200–250	4	2	1	3

250–300	2	3	1	1
300–350	2	1	1	1
350–400	1	1	1	1
>400	0	0	1	1



The distribution of Blood Alcohol Concentration (BAC) among different categories of intoxication-related fatalities showed varying patterns. Among Road Traffic Accident (RTA) cases (n=27), the majority of victims had BAC levels between 100–150 mg/100 ml (7 cases, 25.9%), followed by 150–200 mg/100 ml (5 cases, 18.5%). Only one case had a BAC level below 50 mg/100 ml.

In Sudden Death cases (n=18), the most common BAC ranges were 50–100 mg/100 ml and 100–150 mg/100 ml, each accounting for 4 cases (22.2%). Higher BAC levels above 250 mg/100 ml were observed in a smaller proportion of cases.

Among Homicide cases (n=11), the highest frequency was observed in the 150–200 mg/100 ml range (4 cases, 36.4%), while isolated cases were distributed across other BAC categories. One homicide victim had a BAC level exceeding 400 mg/100 ml.

In Suicide cases (n=23), the most common BAC range was 100–150 mg/100 ml (6 cases, 26.1%), followed by 150–200 mg/100 ml (5 cases, 21.7%). BAC levels above 400 mg/100 ml were observed in one suicide case.

Overall, the 100–150 mg/100 ml BAC range constituted the largest proportion of intoxication-related fatalities, followed by the 150–200 mg/100 ml range, indicating that moderate to high levels of alcohol intoxication were commonly associated with fatal outcomes. Extremely high BAC levels (>400 mg/100 ml) were relatively uncommon and were observed only in homicide and suicide cases.

DISCUSSION

Alcohol consumption remains a major public health and forensic concern worldwide owing to its association with a wide spectrum of accidental, suicidal, homicidal, and natural deaths. In the present study, a total of 856 medicolegal autopsies were conducted during the year 2024. Of these, 437 cases were subjected to forensic toxicological analysis for suspected alcohol involvement, and 79 cases were found to be positive for alcohol. This finding demonstrates the substantial contribution of alcohol

intoxication to medicolegal fatalities encountered in routine forensic practice.

The prevalence of alcohol-positive cases observed in the present study is comparable to findings reported in several Indian forensic studies, where alcohol has been identified as an important contributory factor in unnatural deaths. The detection of alcohol in one-third of the analyzed cases emphasizes the need for routine toxicological screening in medicolegal autopsies, particularly in cases involving trauma, poisoning, drowning, burns, and sudden unexplained deaths.

In the present study, Road Traffic Accidents (RTA) accounted for the largest proportion of alcohol-positive fatalities (33.1%), followed by suicides (25.7%), sudden deaths (20.1%), and homicides (21.1%). The predominance of RTA cases among alcohol-positive deaths is consistent with the established role of alcohol in impairing judgment, reaction time, coordination, visual perception, and decision-making ability. Alcohol intoxication significantly increases the risk of vehicular accidents and remains one of the leading preventable causes of road traffic fatalities worldwide. The findings support existing evidence that alcohol consumption continues to be a major risk factor for fatal road traffic injuries. All alcohol-positive cases in the present study were males, accounting for 100% of cases. The absence of female alcohol-positive fatalities may reflect regional sociocultural patterns in alcohol consumption, where alcohol use remains predominantly concentrated among males. Similar male predominance has been reported in numerous Indian studies and may be attributed to greater alcohol consumption, increased outdoor activity, occupational exposure, risk-taking behavior, and involvement in interpersonal violence and road traffic incidents among men. The findings reinforce the observation that alcohol-related mortality disproportionately affects the male population.

Age-wise analysis revealed that the majority of alcohol-positive cases occurred in the 21–30 years age group (31.6%), followed by the 31–40 years age group (27.8%). Together, these age groups accounted for nearly 60% of all alcohol-positive fatalities. This observation is particularly significant because these individuals represent the most economically productive segment of society. Increased social interaction, occupational stress, greater mobility, risk-taking tendencies, and higher rates of alcohol consumption among young adults may contribute to their increased vulnerability to alcohol-related mortality. The comparatively low incidence observed in individuals below 20 years of age likely reflects lower alcohol exposure and reduced participation in high-risk activities.

Residence-wise analysis demonstrated a slight predominance of alcohol-positive cases among rural residents (53.2%) compared with urban residents (46.8%). Although the difference was modest, the findings may indicate increasing alcohol consumption within rural communities. Factors such as easy availability of locally produced alcoholic beverages, lower awareness regarding alcohol-related harm, delayed access to emergency healthcare facilities, and greater occupational exposure to hazardous environments may contribute to the higher rural representation. Similar rural predominance has been documented in several Indian studies examining alcohol-related morbidity and mortality.

Analysis of Blood Alcohol Concentration (BAC) revealed values ranging from 40 mg/100 ml to 590 mg/100 ml. The majority of fatalities were observed within the BAC range of 100–150 mg/100 ml, followed by 150–200 mg/100 ml. These concentrations are known to produce significant impairment of psychomotor performance, judgment, coordination, and reaction time. Individuals within these BAC ranges commonly exhibit slurred speech, impaired balance, reduced inhibition, and poor decision-making, thereby increasing susceptibility to fatal accidents, violence, and self-harm.

Among Road Traffic Accident cases, the highest frequency was observed in the BAC range of 100–150 mg/100 ml. This finding supports the well-established relationship between moderate to high levels of alcohol intoxication and increased risk of fatal vehicular crashes. Even BAC levels below 150 mg/100 ml can significantly impair driving ability and increase accident risk.

In homicide cases, the highest proportion of victims demonstrated BAC levels between 150–200 mg/100 ml, and the highest recorded BAC level in the study (590 mg/100 ml) was observed among homicide-related fatalities. Alcohol intoxication has long been recognized as a contributing factor in violent behavior, aggression, interpersonal conflicts, and impaired judgment, which may explain its association with homicidal deaths. The presence of extremely high BAC levels among homicide victims also suggests that severe intoxication may increase vulnerability to victimization.

Suicide cases similarly demonstrated a concentration of cases within the 100–200 mg/100 ml BAC range. Alcohol intoxication may lower inhibitions, increase impulsivity, impair judgment, and exacerbate underlying psychiatric conditions, thereby facilitating suicidal behavior. The detection of alcohol in a substantial proportion of suicide victims underscores the importance of addressing alcohol use as a preventable risk factor for self-harm and suicide. Sudden deaths exhibited a broader distribution of BAC levels, with most cases occurring between 50–150 mg/100 ml. Alcohol may contribute to sudden death through various mechanisms, including cardiac arrhythmias, aspiration of gastric contents, respiratory depression, metabolic disturbances, and exacerbation of pre-existing cardiovascular disease.

Therefore, alcohol should always be considered a potentially contributory factor in sudden and unexpected deaths.

The forensic significance of the present study lies in demonstrating the multifaceted role of alcohol in medicolegal mortality. Alcohol was not only associated with accidental deaths but was also frequently encountered in suicides, homicides, and sudden deaths. The wide range of BAC levels observed indicates that fatal outcomes may occur across varying degrees of intoxication depending on the circumstances of death, associated injuries, and individual susceptibility.

The findings of this study emphasize the need for stricter enforcement of drunk-driving regulations, public awareness programs regarding the harmful effects of alcohol, early identification of high-risk alcohol users, and routine toxicological analysis in medicolegal autopsies. Such measures may contribute to reducing preventable alcohol-related mortality and improving public health outcomes.

Although the present study provides valuable insights into intoxication-related fatalities, it is limited by its retrospective design and reliance on cases referred for toxicological analysis. Larger multicentric studies involving longer study periods may further clarify the epidemiological patterns of alcohol-related deaths and strengthen preventive strategies.

The present study demonstrated that 33.3% of cases subjected to toxicological analysis were positive for alcohol. Similar observations have been reported in forensic literature, highlighting alcohol as a significant contributory factor in medicolegal deaths. In the present study, Road Traffic Accidents (33.1%) constituted the largest proportion of alcohol-positive fatalities. A study by Chhetri et al. conducted in Manipur on fatal road traffic accident victims reported that 25% of cases were alcohol positive, with the highest prevalence observed among young adults aged 21–30 years. The authors concluded that alcohol consumption was an important risk factor in fatal road traffic accidents.^[11]

The present study found that the majority of alcohol-positive cases occurred in the 21–30 years age group (31.6%), followed by the 31–40 years age group (27.8%). Similar findings were reported by Sharma et al, who observed that the 21–30 years age group constituted the largest proportion of fatal road traffic accident victims, accounting for 34.37% of cases. The study also demonstrated a marked male predominance, which is consistent with the findings of the present study.^[12]

A striking finding of the present study was that all alcohol-positive cases were males. Similar male predominance has been reported in most Indian forensic studies and is generally attributed to higher rates of alcohol consumption, increased mobility, occupational exposure, and risk-taking behaviour among men.

The present study also identified alcohol positivity among suicide victims. Behera et al., in a study of suicide victims from South Delhi, reported alcohol

positivity in approximately 20% of suicide cases, suggesting that alcohol may lower inhibitions and increase impulsive behaviour, thereby contributing to self-harm and suicide.^[13]

The Blood Alcohol Concentration (BAC) findings in the present study ranged from 40 mg/100 ml to 590 mg/100 ml, with the majority of cases falling within the 100–200 mg/100 ml range. A postmortem toxicological study from New Delhi involving 150 cases demonstrated a high prevalence of ethanol positivity, particularly among road traffic accidents and hanging cases, emphasizing the significant role of alcohol in fatal incidents.^[14]

Overall, the findings of the present study are in agreement with previous forensic and toxicological studies, which consistently demonstrate that alcohol intoxication is an important risk factor for road traffic accidents, suicides, violent deaths, and other medicolegal fatalities. The predominance of young adult males and the frequent occurrence of moderate to high BAC levels further reinforce the need for targeted preventive interventions and strict enforcement of alcohol-control measures.

CONCLUSION

The present study highlights the significant role of alcohol intoxication in medicolegal fatalities encountered at a tertiary care center. Out of 856 autopsies conducted during the study period, 437 cases were referred for toxicological analysis due to suspected alcohol involvement, of which 79 cases were found to be alcohol positive. The findings demonstrate that alcohol continues to be an important contributory factor in both accidental and non-accidental deaths.

Road Traffic Accidents constituted the largest proportion of alcohol-positive fatalities, emphasizing the strong association between alcohol consumption and fatal injuries. Alcohol was also frequently detected in cases of suicide, homicide, and sudden death, indicating its broad impact across different manners of death. The study further revealed a marked male predominance, with all alcohol-positive cases occurring among males, and the highest incidence observed in the economically productive age groups of 21–40 years.

Most fatalities were associated with moderate to high Blood Alcohol Concentration (BAC) levels, particularly within the range of 100–200 mg/100 ml, where impairment of judgment, coordination, and reaction time is substantial. Rural residents constituted a slightly higher proportion of alcohol-positive cases than urban residents, suggesting the need for increased awareness and preventive measures in rural communities.

The results of the present study underscore the medicolegal and public health importance of alcohol intoxication as a preventable risk factor for mortality. Strengthening enforcement of drunk-driving laws,

promoting responsible alcohol consumption, enhancing public awareness programs, and ensuring routine toxicological evaluation in medicolegal autopsies are essential measures for reducing alcohol-related deaths. Further large-scale multicentric studies are recommended to better understand regional patterns of alcohol-related mortality and to support the development of effective prevention strategies.

Key conclusions from this study include

- **High BAC levels are significantly correlated with violent or high-risk deaths**, such as RTAs and homicides.
- **Alcohol is a major contributory factor** in both intentional (e.g., suicide) and unintentional (e.g., accidents) fatalities.
- **Men and individuals in the productive age group** are disproportionately affected, indicating a need for targeted interventions.
- **Post-mortem toxicology plays an essential role** in understanding and categorizing alcohol-related deaths accurately.

The findings underscore the urgent need for preventive strategies such as stricter enforcement of DUI laws, improved mental health support, community-based awareness programs, and increased access to rehabilitation services. Through multidisciplinary efforts in healthcare, law enforcement, and social policy, the burden of alcohol-related deaths can be significantly mitigated.

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