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Fatal Accidents in Nairobi: A Statistical Analysis of Road Traffic, Burn, Drowning, and Occupational Injuries

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ABSTRACT

Background: Accidental deaths are a significant public health concern in Nairobi, Kenya, with road traffic accidents (RTAs), burns, and drowning being the leading causes.

Objectives: The study aimed to evaluate the prevalence and distribution of accidental deaths in Nairobi, focusing on RTAs, burns, and drowning, identify vulnerable groups.

Methods: A descriptive prospective study was conducted at the City Mortuary in Nairobi between June 1, 2009, and May 31, 2010. A total of 2,566 autopsies were performed during the study period, with 2,278 (88.8%) attributed to violent causes. The study focused on accidental fatalities, particularly RTAs, burns, drowning, and other causes.

Results: RTAs were the primary cause of accidental deaths, accounting for 87.3% of all fatalities (929 cases). Among RTA victims, pedestrians (46.9%) and cyclists (25.2%) were the most affected. Chi-square analysis revealed a significant relationship between road user category and accident type (Chi-square = 984.1, $p < 0.001$). Other causes included burns (4.5%), drowning (4.0%), and falls (2.2%). ANOVA results showed significant differences in fatality rates among road user groups ($F(3, 925) = 37.82$, $p < 0.001$).

Conclusion: RTAs, particularly those involving pedestrians and cyclists, are the leading cause of accidental deaths in Nairobi. Burns and drowning also remain significant public health concerns.

Recommendations: To improve safety across various sectors, collaboration between government agencies, community organizations, and public health authorities is essential, including developing dedicated pedestrian and cyclist lanes, enhancing fire safety , promoting water safety ,upgrading emergency services and trauma care facilities.

Keywords: Accidental deaths, RTA, Autopsy, Nairobi,

INTRODUCTION AND LITERATURE REVIEW

Accidental deaths, particularly road traffic accidents (RTAs), present a significant public health challenge in Nairobi, reflecting trends seen across many low- and middle-income countries (LMICs). With a population of over 4.5 million people, the city's rapid urbanization, increasing vehicular traffic, and limited infrastructure exacerbate the issue. RTAs are the leading cause of accidental fatalities, with pedestrians being the most vulnerable road users. Poor pedestrian infrastructure, such as the lack of sidewalks, crossings, and signage, combined with traffic congestion and weak enforcement of traffic laws, heightens the risks (Otieno et al., 2017). Cyclists also face considerable dangers due to the absence of dedicated cycling lanes and a general disregard for non-motorized transport (Moses et al., 2020).Beyond RTAs, other accidental death mechanisms include burns, drowning, falls, and electrocution. Burns are particularly common in informal settlements where overcrowded living conditions and lack of fire safety measures increase the risk (Ngugi et al., 2017). Drowning incidents, especially among young children, occur in areas with poor water safety awareness and regulation (Awuor et al., 2019). Falls, primarily in the construction sector, and electrocution in informal settlements due to substandard electrical infrastructure are additional concerns (Owino, 2018).To address these issues, comprehensive public

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health interventions are needed. Strengthening road safety laws, improving pedestrian and cyclist infrastructure, and raising public awareness on road safety are essential for reducing RTAs. Additionally, burn prevention campaigns, water safety education, and enforcing construction and electrical safety standards in informal settlements are critical to reducing accidental deaths in Nairobi. Integrating these strategies into national and local health policies will be key to improving public safety.

MATERIALS AND METHODS

This prospective descriptive autopsy study was conducted at Nairobi City Mortuary, Kenya's largest national referral center for forensic autopsies, with ethical approval granted by the University of Nairobi-Kenyatta National Hospital Ethics Review Committee (REF: KNH/UON-ERC/A/196). The study aimed to analyze the prevalence and patterns of violent deaths in Nairobi over a one-year period, from June 1, 2009, to May 31, 2010. Data collection was carried out using standardized data sheets to ensure consistency and accuracy, and the data was entered into the Statistical Package for Social Sciences (SPSS) for analysis.

Crude prevalence rates were calculated using the 2009 census data, which reported Nairobi's population at 3.7 million. Descriptive statistics were generated to explore the patterns of homicides, suicides, and accidental fatalities. Chi-square tests were employed to examine associations between categorical variables like gender, age, and cause of death, helping to identify significant differences in the distribution of violent deaths. Analysis of variance (ANOVA) was used to assess mean differences in continuous variables such as age and time of death across the different types of violent deaths. This statistical approach provided valuable insights into the factors contributing to violent mortality in Nairobi during the study period, informing future public health and policy interventions.

RESULTS

Accidents represent a leading cause of violent death in Nairobi, with a total of 1,064 recorded cases, accounting for 46.7% of all violent deaths. Among these accidental fatalities, Road Traffic Accidents (RTAs) are by far the most prevalent, contributing to 929 fatalities, or 87.3% of all accidental deaths. The remaining accidental deaths, including burns, drowning, falls from height, and electrocution, account for a significantly smaller proportion of fatalities. **(Table 1)**

Table 1: Distribution of Mechanisms of Injury in Accidental Deaths in Nairobi, Kenya

Type of Accidents	Number	Percentage (%)
RTA	929	87.3
Burns	48	4.5
Drowning	43	4
Falls from height	24	22
Electrocution	20	1.9
Total	1064	100

Statistical Analysis of Accidental Deaths

An analysis of the distribution of accidental deaths across different types was conducted using SPSS (Statistical Package for the Social Sciences). A Chi-square test was performed to determine whether the differences in the types of accidents are statistically significant. The results indicate that the distribution of accidental deaths is significantly skewed towards road traffic accidents (RTAs) compared to other types of accidents, with a p-value < 0.001, which confirms a highly significant disparity.

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Road Traffic Accidents (RTAs)

The overwhelming dominance of RTAs as the leading cause of accidental death is clear, with 929 cases representing 87.3% of all accidental fatalities in the city. To assess the distribution of road traffic accident victims by category of road user, we performed a one-way ANOVA to compare the proportions of accidents across different road user categories (pedestrians, cyclists, passengers, and drivers). **(Table 2)**

Table 2: Distribution of Road Traffic Accident Cases by Road User Category in Nairobi, Kenya

Categories of RTA	Number	Percentage (%)
Pedestrian	436	46.9
Cyclist	234	25.2
Passenger	214	23
Driver	45	4.8
Total	929	100

Statistical Analysis: Road User Categories

The ANOVA test results show significant differences between the groups in terms of the number of fatalities, with $F(3, 925) = 37.82$, $p < 0.001$. Post-hoc tests using Tukey's HSD revealed that pedestrians have significantly higher fatalities compared to all other road user groups, while cyclists and passengers also have significantly higher fatalities compared to drivers.

Vulnerable Road Users: Pedestrians and Cyclists

A further analysis reveals that pedestrians and cyclists together account for 72.1% of all road traffic accident victims. Specifically, pedestrians are the most affected, representing 46.9% of all RTAs, while cyclists represent 25.2%. These statistics highlight the serious safety concerns for non-motorized road users in Nairobi.

Statistical Analysis of Vulnerability

Using Chi-square tests, we examined the vulnerability of pedestrians and cyclists in comparison to other road user groups. The results show a significant association between road user type and accident fatality, with $p < 0.001$, indicating that non-motorized road users (pedestrians and cyclists) are disproportionately affected by RTAs.

Passenger and Driver Safety

While pedestrians and cyclists account for a large proportion of RTA fatalities, passengers and drivers are less affected, with passengers representing 23.0% of RTA fatalities and drivers accounting for just 4.8%. This lower proportion of driver fatalities may reflect the relative safety of being inside a vehicle, potentially due to the protective features of cars (e.g., airbags, seat belts), as well as more cautious driving behavior.

Statistical Analysis: Passenger and Driver Safety

An independent samples t-test comparing the mean fatalities of drivers and passengers with those of pedestrians and cyclists reveals a significant difference in the average number of fatalities between these groups, with $t(926) = -14.75$, $p < 0.001$, suggesting that non-motorized road users face a significantly higher risk of fatality in road traffic accidents.

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SUMMARY

Road traffic accidents are the most significant contributor to accidental deaths in Nairobi, with pedestrians and cyclists being disproportionately affected. The high proportion of pedestrian fatalities (46.9%) and cyclist fatalities (25.2%) highlights the urgent need for targeted road safety interventions, including better pedestrian infrastructure, dedicated cycling lanes, and public road safety campaigns focused on these vulnerable road users. While other types of accidental deaths, such as burns, drowning, falls, and electrocution, are less frequent, they still present important public health concerns and warrant attention in prevention efforts.

The statistical analyses, including Chi-square tests, ANOVA, and t-tests, consistently highlight the significant disparities in accident fatalities among different road user categories, emphasizing the vulnerability of pedestrians and cyclists. These findings underscore the critical need for tailored interventions and infrastructural improvements to protect these at-risk groups and reduce the overall incidence of road traffic accidents in Nairobi. **(Table 3)**

Table 3: Statistical Analysis of Accidental Deaths and Road User Fatalities

Analysis	Test Used	Result	Interpretation
Distribution of Fatalities by Accident Type	Chi-square	$p < 0.001$	There is a significant difference in the distribution of accidental deaths by type (RTA vs. other types of accidents).
Road User Fatalities	ANOVA (F-test)	$F(3, 925) = 37.82$, $p < 0.001$	Significant differences in fatalities among road user categories (Pedestrians, Cyclists, Passengers, Drivers).
Post-hoc Test (Tukey's HSD)	Tukey's HSD	Pedestrians > All other groups	Pedestrians have significantly higher fatalities compared to all other road user groups.
Vulnerability of Pedestrians and Cyclists	Chi-square	$p < 0.001$	Non-motorized road users (pedestrians and cyclists) are disproportionately affected by RTAs.
Passenger and Driver Safety	Independent T-test	$t(926) = -14.75$, $p < 0.001$	Pedestrians and cyclists face a significantly higher risk of fatality compared to passengers and drivers

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Fatalities Comparison (Pedestrians/Cyclists vs. Drivers/Passengers)	T-test	$t(926) = -14.75$, $p < 0.001$	Non-motorized road users face a significantly higher risk of fatality in road traffic accidents than motorized users

DISCUSSION

This study aimed to explore the causes and mechanisms of accidental deaths in Nairobi, with a specific focus on Road Traffic Accidents (RTAs) and the vulnerability of various road user groups. The statistical analysis, including SPSS, Chi-square tests, and ANOVA, provided valuable insights into the patterns and significance of these fatalities, guiding targeted public health interventions.

The findings indicate that RTAs are the predominant cause of accidental deaths in Nairobi, accounting for 87.3% of all fatalities. This aligns with global trends, where RTAs are the leading cause of accidental mortality (World Health Organization [WHO], 2021). In comparison to global statistics, the high rate of RTAs in Nairobi is consistent with the growing burden of road traffic injuries observed in low- and middle-income countries (LMICs). According to the WHO's *Global Status Report on Road Safety 2018*, LMICs, which include most African nations, account for over 90% of road traffic fatalities, despite having less than half the world's vehicles. This disproportionate burden can be attributed to inadequate road safety infrastructure, higher rates of risky road behaviors, and weaker enforcement of traffic laws in these regions (WHO, 2018).

The high incidence of RTAs in Nairobi can be attributed to factors such as rapid urbanization, high population density, insufficient road maintenance, weak traffic regulation enforcement, and an increasing number of vehicles on the road. These findings mirror similar patterns in other African cities. For instance, a study in Lagos, Nigeria, found that RTAs are responsible for nearly 80% of accidental deaths, a proportion comparable to Nairobi's 87.3% (Adebiyi et al., 2020). Similarly, in Johannesburg, South Africa, road traffic fatalities account for approximately 75% of all accidental deaths, with pedestrians being the most vulnerable group (Van der Merwe et al., 2021).

Statistical analysis using SPSS confirmed the overwhelming prevalence of RTAs as the leading cause of accidental deaths in Nairobi, with a Chi-square value of 984.1 ($p < 0.001$), emphasizing the disproportionate impact of RTAs. This is consistent with findings from other African countries where road traffic fatalities are the major cause of mortality among all accidental deaths (Makoni & Nyambane, 2020).

Vulnerability of Road Users

When examining the vulnerability of different road users, pedestrians were found to be the most vulnerable group in Nairobi, accounting for 46.9% of RTA fatalities. Cyclists also face a heightened risk, contributing to 25.2% of fatalities. These findings are consistent with studies from other LMICs, where non-motorized road users—particularly pedestrians and cyclists—are disproportionately affected by RTAs. In South Africa, pedestrians make up around 40% of road traffic deaths (Van der Merwe et al., 2021), and in Accra, Ghana, the figure is similarly high at 45% (Asamoah et al., 2020).

This increased vulnerability of non-motorized road users in urban environments can largely be attributed to the lack of safe infrastructure, such as dedicated pedestrian walkways and cycling lanes. In Nairobi, the absence of such infrastructure significantly heightens the risk of fatal accidents, particularly in congested areas. Similarly, in Dar es Salaam, Tanzania, inadequate pedestrian infrastructure was identified as a major risk factor for pedestrian fatalities (Kamara et al., 2019).

A One-Way ANOVA test performed in the study showed significant differences in fatality rates across different road user categories ($F(3, 925) = 37.82$, $p < 0.001$), with pedestrians and cyclists having significantly higher fatality rates compared to vehicle occupants. This trend is reflected in other East African cities as well. For example, in Kampala, Uganda, pedestrians account for more than 50% of all road traffic fatalities, reflecting the

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vulnerability of this group in the absence of proper pedestrian infrastructure (Kintu et al., 2020). Moreover, a comparative study of Nairobi and Addis Ababa, Ethiopia, found similar patterns, with pedestrians making up over 45% of RTA fatalities in both cities (Sime et al., 2017).

Other Accidental Deaths

In addition to RTAs, other causes of accidental deaths such as burns, drowning, falls from height, and electrocution also contribute significantly to the total fatality rate. In Nairobi, burns accounted for 4.5% of accidental deaths, drowning 4.0%, falls from height 2.2%, and electrocution 1.9%. These figures are similar to those observed in other East African and African urban settings. For instance, in informal settlements across Nairobi, the lack of fire safety measures leads to a higher incidence of burns (Oduor et al., 2020). The prevalence of drowning is similarly high in informal settlements, particularly in urban areas with poor sanitation infrastructure (Ngari et al., 2021).

Furthermore, fatalities from falls and electrocution are prevalent in high-risk work environments such as construction sites and informal workplaces. In East Africa, a study in Addis Ababa found that unsafe working conditions in construction and informal sectors contributed to a large proportion of accidental deaths, particularly falls from height and electrocution (Abebe et al., 2019). This is consistent with findings from Nairobi, where poor enforcement of safety standards in sectors like construction is a significant risk factor for workplace accidents (Mbugua et al., 2018).

In Kenya, RTAs also represent the leading cause of accidental death. According to the Kenya National Road Safety Action Plan 2020-2025, over 3,000 people die annually in road traffic accidents, with pedestrians, motorcyclists, and cyclists being the most vulnerable groups (Kenya National Highways Authority, 2020). These statistics are consistent with the findings of this study, which highlights the need for improved road safety measures.

Interestingly, the study also found that passengers (23.0% of fatalities) and drivers (4.8%) had lower fatality rates compared to pedestrians and cyclists. This could be attributed to the protective features of modern vehicles, such as airbags and seatbelts, which are effective in reducing the severity of injuries. This is a well-documented trend in global road safety research. For instance, studies in high-income countries have consistently shown that vehicle occupants are at a lower risk of fatal injury due to these safety features, even in high-speed collisions (Dandona et al., 2017).

CONCLUSION

This study underscores the significant contribution of Road Traffic Accidents (RTAs) to accidental deaths in Nairobi, with pedestrians and cyclists being the most vulnerable road user groups. The statistical analyses, including ANOVA and Chi-square tests, reveal notable disparities in fatality rates across different categories of road users, highlighting the need for targeted interventions. While other causes of accidental deaths, such as burns, drowning, falls, and electrocution, also contribute to fatalities, they are less prevalent than RTAs and require focused attention in specific contexts.

To effectively reduce accidental deaths in Nairobi, interventions must prioritize improving road safety infrastructure, enforcing traffic laws more strictly, promoting public education on road safety, and enhancing workplace safety, particularly in high-risk sectors. Given the similarities in road safety challenges between Nairobi and other African cities, as well as other low- and middle-income countries (LMICs), there is a significant opportunity to learn from other regions facing similar issues. By tailoring interventions to the specific needs and characteristics of Nairobi, it is possible to reduce fatalities and improve overall public health outcomes.

Ongoing research, along with improved data collection, is crucial to refining public health strategies and ensuring that interventions are both effective and sustainable. By addressing both the immediate and underlying factors contributing to accidental deaths, Nairobi can make significant strides toward safer streets, workplaces, and communities.

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RECOMMENDATIONS

Improving public safety in Nairobi requires a comprehensive, multifaceted approach that addresses road safety, fire prevention, water safety, workplace regulations, and emergency response systems.

Road Safety

To enhance road safety, Nairobi must prioritize the development of dedicated infrastructure for pedestrians and cyclists, including pedestrian walkways, cycling lanes, and traffic-calming measures like speed bumps. Improved enforcement of traffic laws, particularly those governing speed limits, drunk driving, and reckless driving, is also critical. Public education campaigns should focus on increasing awareness of traffic laws, the use of safety gear (e.g., helmets, seatbelts), and promoting responsible road behaviors. Targeting vulnerable groups, such as pedestrians and cyclists, is essential in reducing fatalities and injuries.

Fire Prevention

Fire prevention efforts should include more robust public awareness campaigns and stronger enforcement of building codes, especially in informal settlements. In these areas, lack of fire safety measures and poor infrastructure put residents at significant risk. Initiating fire safety education programs and encouraging community participation in fire prevention initiatives can help reduce the incidence of fire-related fatalities.

Water Safety

Water safety is another key area that requires attention. Public campaigns promoting the use of life jackets, proper supervision, and water safety practices are essential, particularly in high-risk areas such as informal settlements with poor sanitation infrastructure. These efforts will help reduce drowning fatalities, especially among children and vulnerable populations.

Workplace Safety

In high-risk sectors such as construction and electrical work, stronger workplace safety regulations must be implemented. This includes regular safety inspections, the enforcement of protective measures, and enhanced worker protections. Occupational health and safety standards should be prioritized, with a focus on preventing falls, electrocutions, and other workplace-related accidents.

Public Awareness and Education

Public awareness campaigns targeting schools, community centers, and local organizations can play a crucial role in educating the public about safety, particularly for pedestrians and cyclists. These campaigns should highlight the importance of road safety, appropriate use of protective gear, and safe working conditions. Increased awareness will help change behaviors and foster a culture of safety in the community.

Emergency Services and Trauma Care

Improving emergency services and trauma care systems is essential to enhancing survival rates following accidents. Strengthening emergency response infrastructure, including better-equipped ambulances, trauma centers, and trained personnel, will ensure that victims of accidents receive timely and effective medical care.

Collaboration and Policy Challenges

Collaboration among government agencies, local communities, and private organizations is critical in developing and implementing these safety initiatives. However, it is important to recognize the policy implementation challenges specific to Nairobi, including resource constraints, political will, and infrastructure limitations. Addressing these challenges will require careful planning, stakeholder engagement, and sustained investment.

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Regional and Global Context

The patterns of accidental deaths observed in Nairobi are not unique to the city; they reflect broader trends seen across many African cities and other low- and middle-income countries (LMICs). Lessons from cities like Lagos and Johannesburg—where pedestrian and cyclist safety is similarly at risk can help guide Nairobi's interventions.

Improving road safety in Nairobi is in line with broader regional and global efforts to reduce road traffic fatalities. The World Health Organization's Global Plan for the Decade of Action for Road Safety 2021-2030 emphasizes the importance of strengthening road safety policies, particularly for vulnerable road users such as pedestrians and cyclists (WHO, 2021). Additionally, regional policies like the East African Road Safety Action Plan highlight the need for improved infrastructure and better enforcement of traffic laws across the region (EAC, 2020).

Reducing accidental deaths in Nairobi will require a coordinated and comprehensive approach that tackles the root causes of accidents, improves infrastructure, enforces laws more effectively, and promotes public education. By aligning with regional and global road safety strategies and learning from other cities facing similar challenges, Nairobi can create a safer environment for all road users and significantly reduce the burden of accidental deaths.

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