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Trends and spatial distribution of road traffic injuries, Uganda, 2012–2023

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Summary

Background: Road traffic injuries (RTIs) rank sixth among causes of death and fourth for disability in Uganda. In 2019, Uganda's RTI mortality was 29 per 100,000, higher than the global average of 18 per 100,000. Although the Uganda Ministry of Health (MoH) collects RTI data in the District Health Information System (DHIS 2), recent trends have not been analyzed to inform programming. We analyzed DHIS2 data to examine RTI trends and distribution in Uganda, 2012–2023.
Methods: We extracted data on RTIs for 2012–2023 from DHIS2 and determined the annual trends of RTIs per 100,000 population. We used data from 2015–2023 to determine the annual trends of motorcycle RTIs and data from 2020–2023 to determine the semi-annual trends of RTIs among males and females and deaths due to RTIs using the mid and end-year populations. We determined the significance of the trends using Mann-Kendall test.
Results: There was a decline in all RTIs from 411 to 357/100,000 population (p=0.034) between 2012–2023. However, admissions due to RTIs increased from 77 to 116/100,000 (p=0.034). The incidence of RTIs involving motorcycles did not change (211-232/100,000, p=0.47) while RTIs from other causes decreased (429 to 176/100,000, p=0.0049). Mortality due to RTIs dropped from 14 to 7/100,000 (p=0.0094) between 2020–2023. Males were more affected by all RTIs (224/100,000) compared to females (144/100,000) (p=0.0000304). Motorcycle RTIs affected more males (126/100,000) compared to females (72/100,000) (p=0.00012). RTI-related deaths among males (14/100,000) were not different from deaths among females (7.1/100,000) (p=0.13). RTI-related deaths among persons ≥20 years (27 deaths/100,000) were not different from deaths among persons <20 years (18 deaths/100,000) (p=0.18). The incidence of RTIs declined in most districts but persisted between 1,000-4,000/100,000 in Obongi and Kampala City.
Conclusion: While there was a decline in the overall incidence of RTIs due to RTIs, the rise in severe injuries requiring hospitalization highlights ongoing challenges. Motorcycle-related RTIs predominantly affecting males and adults (≥20 years) necessitates targeted interventions. Despite progress in reducing mortality rates, particularly at emergency departments, continued investment in comprehensive road safety strategies, emergency medical services, and public health interventions is imperative further to mitigate the burden of RTIs.

Background

Road traffic injuries (RTIs) are among the primary public health problems in Uganda, causing significant morbidity and mortality (1). According to the Global Burden of Disease Study 2019, RTIs were the sixth leading cause of death and the fourth leading cause of disability-adjusted life years (DALYs) in Uganda (2). The mortality rate from RTIs was about 29 per 100,000 population in 2019, which is much higher than the global average of 18 per 100,000 (2).
According to the Uganda Ministry of Works and Transport (MoWT), road traffic crashes are responsible for an average of 10 deaths per day and the main cause has been careless driving (2,4). According to the 2022 Uganda Police Force (UPF) annual crime report, 21,473 people were involved in RTAs and 1,712 (8%) of them were slightly injured, 15,227 (71%) were severely injured, and 4,534 (21%) died on spot (4). The number of RTI victims in 2022 increased by 19% compared with those registered in 2021. About 34% of the victims were pedestrians, 33% were motorcyclists, 13% were passengers on motorcycles, 11% were passengers in motor vehicles, 5% were motor vehicle drivers, and 4% were cyclists (4).

Data on RTIs are captured by UPF at the accident scene mostly in urban areas and on the major highways. The RTIs that are not detected and recorded by the UPF go unreported especially those that occur away from police presence, those that occur in the rural areas and those involving motorcycles and bicycles (5). It is not a common practice for individuals to self-report RTIs to police in Uganda and Africa and this makes the number reported by police much lower (6,7). According to a study by Muni et al, the official police records of road traffic fatalities in Uganda are significantly underreported (8). Additionally, the fatalities reported by UPF are always recorded immediately after the crashes. However, more deaths continue to occur hours and days later while the victims are in health facilities (9).

In 2010, the Uganda Ministry of Health (MoH) started capturing data on RTI victims that seek care from health facilities using the District Health Information System (DHIS2), an online database used for health information management in Uganda (1).
Most of the RTI victims in Uganda seek health care from public and private health facilities and their data are captured and reported in the DHIS2. Although the MoH collects RTI data, recent trends have not been analyzed to determine whether there has been progress in reducing RTIs in Uganda. We analyzed DHIS2 data to examine RTI trends and distribution in Uganda, 2012–2023, to inform programming.

Methods

Study design and data source

In 2010, the MoH started reporting aggregated data on RTI victims seeking care at out-patient departments (OPD) and those admitted in in-patient departments (IPD) in health facilities through the DHIS2 and by 2012, the quality of the RTI data in DHIS2 had improved. Since 2015, the MoH started capturing data on RTIs due to motorcycles and

from 2020, the RTI data were further disaggregated by sex, age, and other causes like bicycles and pedestrians (10).

Study variables, data abstraction, and analysis

We extracted OPD and IPD data on RTIs from 2012–2023 from the DHIS2 database. The OPD data included information on the RTI victims managed at the health facility and the deaths due to RTIs at emergency units. The IPD data included information on admitted RTI victims and deaths due to RTIs among in-patients.

We extracted data on overall RTIS, admissions due to RTIs, RTIs due to motorcycles, RTIs due to other causes, and mortality due to RTIs. Overall RTIs were determined as a total number of individuals who sustained injuries as a result of road traffic crashes, including pedestrians, cyclists, motorcyclists, and vehicle occupants reported in DHIS2. Admissions due to RTIs were cases of RTI victims that required admission to IPD in health facilities reported in DHIS2. Road traffic injuries due to motorcycles were individuals who sustained injuries specifically involving motorcycles, including motorcyclists, their passengers, or individuals hit by motorcycles reported in DHIS2. Road traffic injuries due to other causes were individuals who sustained injuries resulting from other vehicles (for example cars and trucks), bicycles, and pedestrian incidents not involving motorcycles.

Mortality due to RTIs was deaths occurring as a result of road traffic injuries reported in DHIS2. We also extracted data on the annual OPD and IPD reporting rates from DHIS2, which were already calculated by dividing the number of reporting facilities by the total number of facilities expected to report. These reporting rates helped to ensure the consistency and completeness of the reporting data to validate trends and identify any anomalies or gaps in reporting.

We determined the incidence of RTIs, admissions due to RTIs and deaths due to RTIs per 100,000 population using population estimates from Uganda Bureau of Statistics (11). We used data from 2012–2023 to determine the annual overall RTIs incidence and data from 2015–2023 to determine the annual incidence of RTIs due to motor-cycle. We used data from 2020–2023 to determine the semi-annual incidence of RTIs among males and females and deaths due to RTIs using the mid and end-year population estimates. We determined the significance of the trends using Mann-Kendall test. We demonstrated the spatial-temporal distribution and trends of RTIs using Quantum Geographic Information System (QGIS) maps.

Ethical considerations

This study used routine surveillance data reported by health facilities in the DHIS2 which were also aggregated with no individual patient identifiers. However, we obtained administrative clearance to use the data from the Uganda Ministry of Health. The US Centers for Disease Control and Prevention (CDC) also determined that this activity was not human subject research and its primary intent was for public health practice or disease control. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. §§See e.g., 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

Results

Annual proportion of road traffic injuries by cause and associated hospital admissions, Uganda, 2020-2023

From 2020 to 2023, motorcycles consistently caused most of the RTIs 82,089 – 87,881 (53-55%), followed by pedestrians 30,126 – 34,462 (19-21%), motor vehicles 25,914 – 33,378 (16-21%), and bicycles 10,395 – 13,820) (7-9%). The total admissions increased from 46,679 (29%) to 58,780 (37%) (Table 1).

Table 1: Annual distribution of road traffic injuries by cause and associated hospital admissions, Uganda, 2020 – 2023

Time (years)	2020	(%)	2021	(%)	2022	(%)	2023	(%)
RTI cause								
Motor vehicles	25,914	(16)	30,425	(19)	33,378	(21)	27,772	(17)
Motorcycles	85,106	(54)	86,820	(53)	82,089	(53)	87,881	(55)
Bicycles	13,820	(9)	12,611	(8)	10,395	(7)	10,854	(7)
Pedestrians	33,550	(21)	33,959	(21)	30,126	(19)	34,462	(21)
Total RTIs	158,390	(100)	163,815	(100)	155,988	(100)	160,969	(100)
Admissions	46,679	(29)	53,560	(33)	51,071	(33)	58,780	(37)

Trend of all road traffic injuries and associated admissions, Uganda, 2012-2023

From 2012–2014, there was an increase in the incidence of RTIs from 411/100,000 to 552/100,000, corresponding with an increase in the OPD reporting rate. Since 2015–2023, there was a significant decline in the incidence of RTIs from 552/100,000 to 357/100,000 (p-value = 0.034), despite the increase in the OPD reporting rate. The incidence of admissions due to RTIs increased significantly from 77/100,000 in 2012 to 116/100,000 in 2023 (p-value = 0.034), corresponding with an increase in the IPD reporting rate (Figure 1).

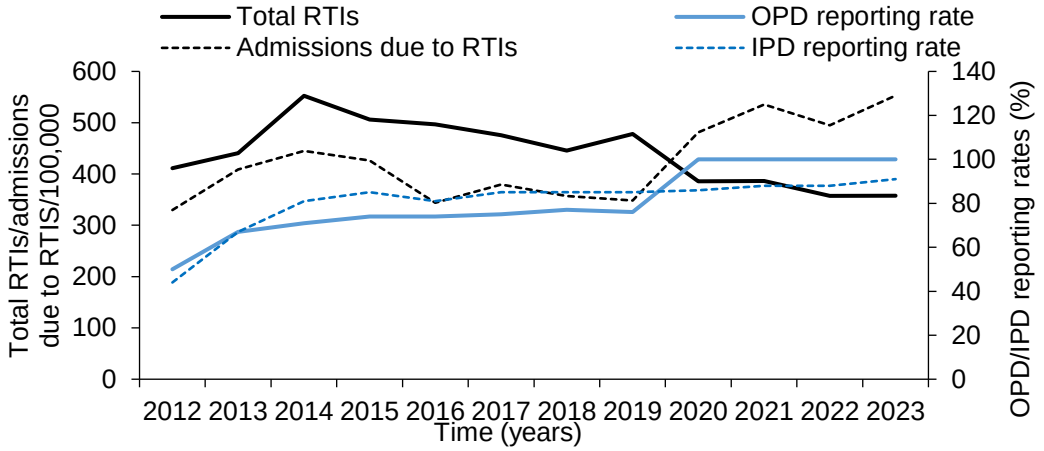

Figure 1: Annual trends of incidence of all road traffic injuries and associated admissions, Uganda, 2012–2023

Trend of road traffic injuries due to motorcycles and other vehicles, Uganda, 2015-2023

The incidence of road traffic injuries due to motorcycles increased from 123/100,000 in 2015 to 232/100,000 in 2016 where it stagnated until 2023 (p-value =0.47). The incidence of road traffic injuries due to other causes (motor vehicles, bicycles and pedestrians) declined significantly from 429/100,000 in 2015 to 176/100,000 in 2023 (p-value = 0.0049). Since 2015, the incidence of road traffic injuries due to other causes was higher than that due to motorcycles until 2020 when the incidence of road traffic injuries due to other causes declined below that due to motor cycles (Figure 2).

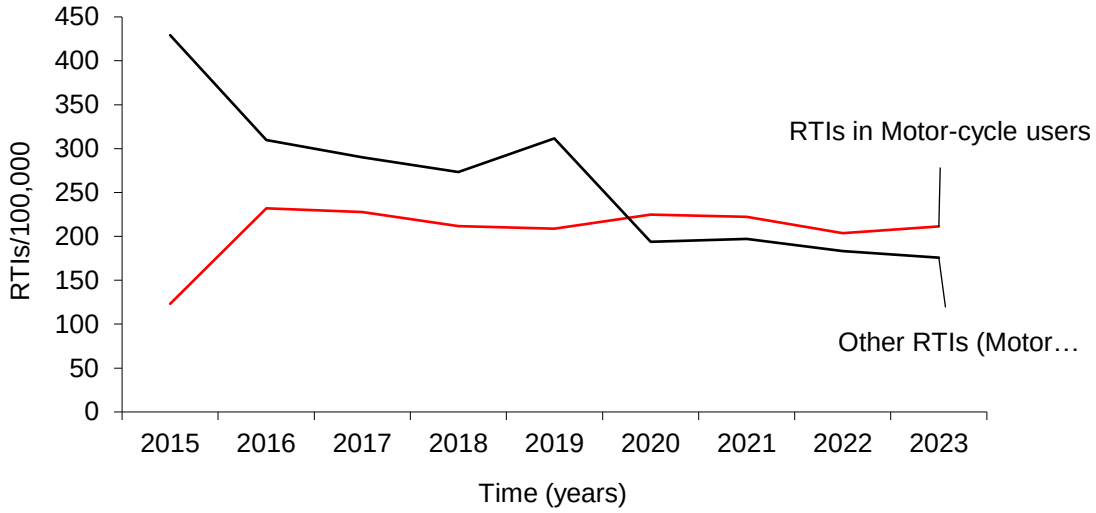

Figure 2: Annual trends of incidence of road traffic injuries due to motorcycles and other causes, Uganda, 2015–2023

Trend of mortality due to road traffic injuries, Uganda, 2020-2023

The mortality due to RTIs at emergency department declined significantly from 14 deaths/100,000 in January 2020 to 7.1/100,000 in December 2023 (p-value =0.0094) while that at the IPD stagnated at around two deaths/100,000 in the same period (p-value = 0.11) (Figure 3).

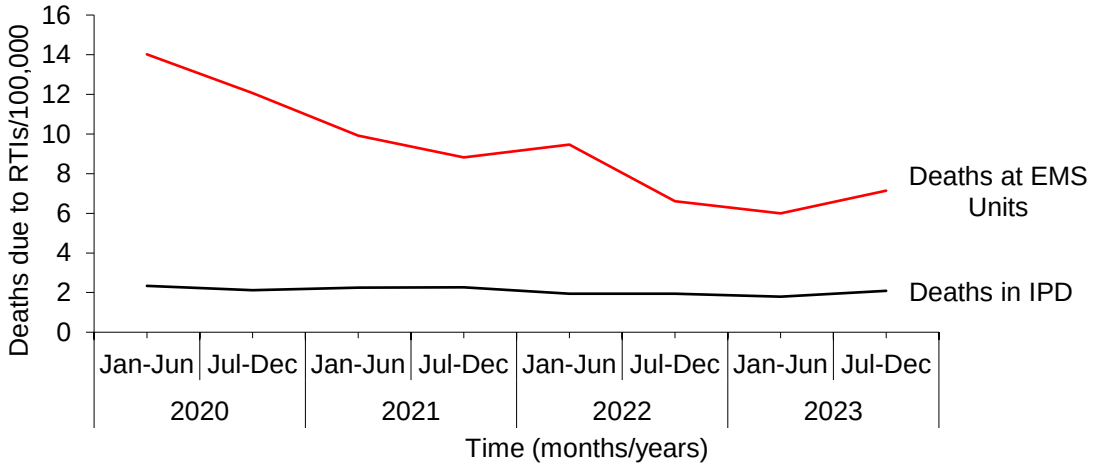

Figure 3: Trends of deaths due to road traffic injuries at emergency units and in the in-patient departments, Uganda, 2020–2023

Incidence of road traffic injuries and associated deaths among males and females and different age categories, Uganda, 2020-2023

From 2020–2023 when the MoH started disaggregating RTI data by sex, males were more affected by all RTI causes with an average RTI incidence of 224/100,000 compared to females with an average RTI incidence of 144/100,000 (p=0.0000304). The incidence of RTI due to motor cycles were higher in males with an average incidence of 126/100,000 compared to females with an average incidence of 72/100,000 (p=0.00012). The deaths rates due to RTIs among males compared to females and that among persons aged ≥20 years compared to persons aged <20 years were not significantly different (Table 2).

Table 2: Annual incidence of road traffic injuries and associated deaths among males and females and different age categories, Uganda, 2020–2023

	2020	2021	2022	2023	Average	p-value
All RTIs /100,000						
Male	250	221	205	221	224	0.0000304
Female	149	139	148	140	144	ref
RTIs due to motor-cycle/100,000						
Male	141	123	117	124	126	0.00012
Female	77	71	69	71	72	Ref
Total deaths due to RTIs/100,000						
Male	17	14	12	11	14	0.13
Female	9.4	7.2	6.2	5.8	7.1	Ref
Deaths at emergency unit due to RTIs/100,000						
<20 years	25	19	15	14	18	0.18
≥20 years	37	27	25	20	27	ref
Deaths in the IPD due to RTIs/100,000						
<5 years	7.8	3.9	3.6	2.1	4.4	0.81
5+ years	3.1	4.1	3.6	4.0	3.7	ref

Trend of incidence of road traffic injuries by districts, Uganda, 2012-2023

From 2012 to 2016, there was an increase in the incidence of RTIs in most of the districts. Thereafter, there was decline in most of the districts except Obongi and Kampala City where the incidence of RTIs persisted between 1,000-4,000/100,000 (Figure 4).

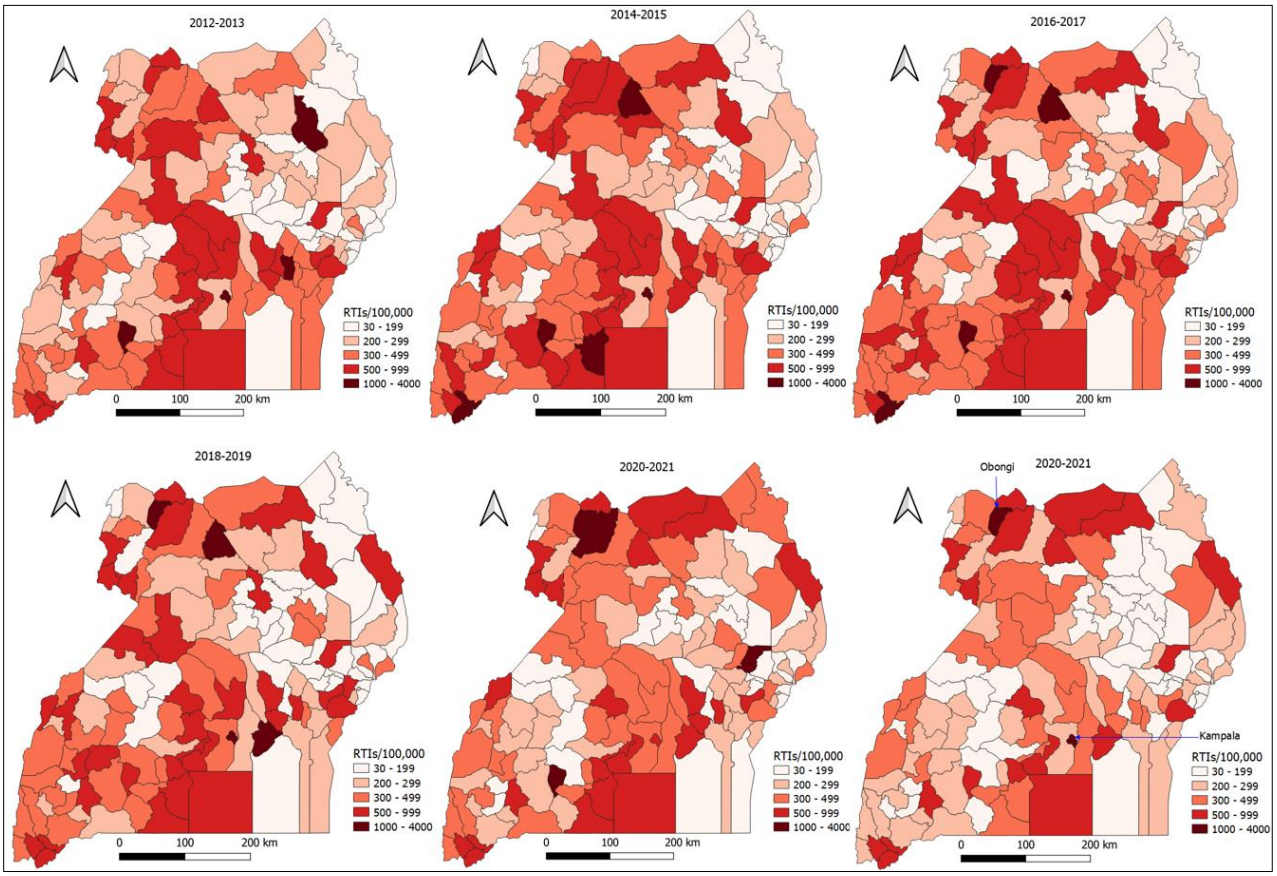

Figure 4. Trend of two-year average incidence of road traffic injuries by districts, Uganda, 2012-2023

Discussion

We reveal a notable overall decline in the incidence of RTIs in Uganda from 2012 to 2023, with significant reductions observed from 2015 onwards. We also found a significant decrease in mortality due to RTIs at emergency departments. Despite these positive trends, RTI-related hospital admissions have increased. The analysis showed disproportionately higher RTI incidence and mortality among males and adults aged ≥20 years. Motorcycles were the leading cause of RTIs, with persistently high RTI incidence and disproportionately affected males more than females. Our spatial analysis highlighted that the incidence of RTIs persisted over 1,000/100,000 population over time in Kampala city and Obongi District.

The observed decline in the incidence of overall RTIs in Uganda especially notable from 2015 coincides with the implementation of enhanced road safety measures and public health interventions. Uganda adopted the 2011–2020 United Nations' resolution on decade of action for road safety with a target of reducing RTIs by 50% by 2020, which was renewed in 2021 for the next 10 years (12,13). During this period, there were efforts to improve road safety management and increase safer roads, vehicles, and users (14). This could explain this decline in the incidence of RTIs.

The declining mortality due to RTIs is a positive indication and suggests potential effectiveness of interventions aimed at reducing fatalities due to RTIs. These interventions include improvements in pre-hospital care, such as timely access to emergency medical services and trauma centers, as well as advancements in hospital-based care, including surgical interventions and intensive care management. In 2021, the Uganda MoH operationalized the emergency medical services policy and strategic plan to improve emergency medical services (pre-hospital and hospital care) (15). Additionally, public awareness campaigns promoting safer road behaviors, enforcement of traffic regulations, and infrastructure enhancements might have contributed to this decline in mortality (16). However, it's essential to note that the mortality rate among the inpatients stagnated at around two deaths per 100,000 population during the same period, indicating the need for continued efforts to enhance care for admitted RTI victims.

The increase in admissions may reflect improved access to healthcare services or changes in reporting practices but underscores the ongoing burden of RTIs on the healthcare system. This implies that there is still a long way to achieve the target of reducing severe road traffic injuries by half by 2030 (17). A study by Biribawa et al also found a nonsignificant decline in severe RTIs between 2012–2016 in Kampala using data from UPF (18).

Despite this progress, challenges persist, particularly in addressing the underlying risk factors contributing to RTIs and fatalities. For instance, the disproportionate burden of RTI mortality among males compared to females underscores the need for targeted interventions addressing gender-specific risk behaviors and vulnerabilities on the road. These findings are consistent with other findings in Uganda and globally and could be explained by the fact that men are more involved in driving and riding vehicles than women(19–21). According to the Insurance Institute for Highway Safety (IIHS), the number of male crash fatalities has been more than twice as high as the number of female crash fatalities for almost every year between 1975–2021 (22). Additionally, men are also more likely to involve in risky driving and riding behaviors than women like drunk driving, over speeding, and not using seat belts (23).

Similarly, the higher mortality rates among adults aged ≥20 years highlight the importance of interventions tailored to this demographic group, such as driver education programs and workplace safety initiatives. These people are the working age and their injuries or deaths cause huge social and economic harm to their society. The high risk in this age group is consistent with other findings all over the world (19).

The number of motorcycles used for commercial transportation of passengers is rapidly increasing in Uganda mainly because of their affordable price to purchase, swiftness, and easy to beat traffic jams in urban roads, easy to connect many streets and roads among others (24). The motorcycle crashes are high mainly because most operators are not trained and licensed and most do not adhere to traffic safety

regulations like using crash helmets and reflector jackets (19,21). Efforts to reduce RTIs due to motorcycle are crucial for mitigating the burden of RTIs in Uganda. Efforts like enhanced rider education programs and stricter enforcement of traffic laws, could yield substantial benefits in reducing the incidence of RTIs due to motorcycles and associated fatalities.

The gender disparities also underscore the importance of gender-sensitive interventions aimed at promoting safer motorcycle riding practices and reducing risk-taking behaviors among male riders.

The high incidence of RTIs in Kampala city could be explained by the high traffic concentration of vehicles especially motorcycles and pedestrians. In addition, Kampala city hosts national referral hospitals and several other hospitals which receive, manage, and report patients referred from several districts. However, it is not clear why the incidence persisted high in Obongi Districts. This warrants further investigation to ascertain the circumstances associated with this high incidence.

Study limitations

While our study provides valuable insights into road traffic injuries (RTIs) in Uganda, some limitations should be acknowledged.

Firstly, our analysis relied on secondary data extracted from the DHIS2 database, which may be subject to reporting biases, underreporting, and data quality issues inherent in routine surveillance systems and hence we are likely to have underestimated the study outcomes.

Additionally, the focus on healthcare facility data may underestimate the true burden of RTIs, as it excludes cases that do not seek medical care or are treated outside of formal healthcare settings and deaths on accident scene.

Lastly the spatial analysis was based on the reporting district not the district where the RTI occurred. This has a risk of exaggerating the burden in districts hosting referral hospitals.

Conclusion

This study underscores the urgent need for sustained efforts to address the significant public health challenge posed by RTIs in Uganda. While there has been a promising decline in the overall incidence of RTIs, the rise in severe injuries requiring hospitalization highlights ongoing challenges. Motorcycle-related RTIs, predominantly affecting males, have emerged as a leading cause of injuries and fatalities, necessitating targeted interventions to promote safer road behaviors and improving motorcycle safety measures. Despite progress in reducing mortality rates, particularly at emergency departments, continued investment in comprehensive road safety strategies, emergency medical services, and public health interventions is imperative to further mitigate the burden of RTIs and save lives on Uganda's roads.

Recommendations

Based on the findings of our study RTIs in Uganda, we propose the following recommendations to address the identified challenges and improve road safety: Firstly, implementing comprehensive road safety education programs for road users, with a focus on promoting safe driving practices, importance of helmet use, and pedestrian safety awareness by the MoH and UPF could reduce severity of RTIs, admissions, and mortality due to RTIs.

Secondly, the increasing enforcement of existing traffic laws, including speed limits, seatbelt usage, and helmet laws by the UPF through stricter penalties and enhanced police patrols, particularly in high-risk areas would reduce on the incidence and severity of RTIs.

Thirdly, there is need for the MoH to expand access to emergency medical care to enhance access to timely and quality emergency medical care for RTI victims by investing in emergency response systems, equipping healthcare facilities with necessary resources, and training healthcare workers in trauma management to reduce mortality among the RTI in-patients.

In addition, the UPF, MoH, MoWT could develop targeted interventions tailored to address the specific needs of high-risk groups, such as young adult males and motorcycle riders, including targeted education campaigns, training programs, and community outreach initiatives. These could reduce RTIs among young adult males.

Furthermore, the MoH needs to strengthen the capacity for RTI data collection and surveillance systems, including enhancing the accuracy and completeness of data captured in health information systems. In addition, integrating data from MoH and UPF could provide a more comprehensive understanding of RTI trends and patterns.

Lastly, the spatial distribution of RTI particularly in areas with persistently high incidence like Obongi District and Kampala City, needs further evaluation, targeted interventions and resource allocation to address district specific disparities.

Conflict of interest

The authors declare that they have no conflict of interest.

Authors' contributions

AK participated in the conception, design, analysis, interpretation of the study and wrote the draft bulletin. BK, RM, DK, EJN, JK, IM reviewed the report and the drafts of the bulletin for intellectual content and made multiple edits to the draft bulletin; BK, LB, and ARA reviewed the final bulletin to ensure intellectual content and scientific integrity. All authors read and approved the final bulletin.

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