

Investigating Road Safety Deficiencies in School Zones (Case Study: Kigali City)

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ABSTRACT: This report examines road conditions within school zones in Kigali City, Rwanda, focusing on how defects in road design result in traffic accidents, especially injuring students. Rwanda, as a developing nation with increased motorization, is witnessing rising traffic accidents, to some extent caused by unsafe structures. The study used on-site measurements and observations according to safe system principles to determine hazardous design elements such as harsh roads, inadequate footpaths, absence of safe crossing facilities, badly designed intersections, exclusion of vulnerable road users (e.g., children and the disabled), inadequate signs, and inadequate speed control near schools. According to best international practice, the report determines short-term, medium-term, and long-term measures to ensure enhanced safety and student-friendly and inclusive road infrastructure.

KEYWORDS: Traffic accident, school zone, motorization, safe system, hazardous design.

1. INTRODUCTION

Globally, road traffic injuries (RTIs) are the 8th leading cause of death among all age groups (Patel et al., 2016). Road traffic accidents and injuries have now emerged as a severe man-made epidemic, with an estimated 1.35 million people killed and as many as 50 million injured worldwide each year (Hamim & Ukkusuri, 2022). Injuries that result from road traffic collisions rank high as the leading cause of injuries that result in deaths for individuals who are aged between 5 to 29 years (WHO, 2023). The countries that principally experience these fatalities are low and middle-income countries, and even though they account for around 60% of the entire global vehicle population, over half of all global traffic deaths are amongst vulnerable road users, such as pedestrians, bicycle users, and motorcycle users. Several nations lose around 3% of their gross domestic product to road accidents (WHO, 2023). In road traffic crashes in developing countries, more than 51% are vulnerable road users, and school children are particularly at risk, with fatality rates of 11.1 per 100,000 children aged 5-14. It is 58% higher in low- and middle-income countries than in higher-income countries (Grous A., 2019).

Data from the Rwanda National Police shows concerning trends in the years 2020, 2021, and 2022; there were 178, 167, and 153 deaths registered in Rwanda within the 0-20 years group, respectively, most of which were students. As vulnerable road users, the students do not know how to use the road safely, use the road inattentively, have less knowledge of traffic rules, and some drivers do not respect pedestrian rights on the road (Sabiiti, 2023). This data explains why there is a desperate call for the implementation of regular and appropriate school zone inspections that conform to the national road safety requirements and save the lives of young children. The study conducted by Nkurunziza & Tafahomi (2020) found that the majority of road networks in the City of Kigali did not provide walkway traffic signal designs, and availability was very poor, and some of them were not functioning, zebra crossing facilities were not provided adequately, pedestrians shelter on bus stop are almost absent and ignored, vehicles traveling speed is still high and does not allow pedestrians to move freely, and the mobility of physically challenged people has been forgotten and suggesting an introduction of the pedestrian overpass bridges in clouded zones of the city center. The study is for studying road safety in school zones to ensure the safety of students in Kigali city, especially for schools closer to the national roads. It is also involved in assessing road safety conditions in Kigali City school areas, detailing safety issues like poor signing and absence of pedestrian or cycling facilities. It also sought to propose realistic recommendations for improving safety, particularly among vulnerable road users like children. This study investigates issues Kigali City students face when traveling to

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and from school. Researchers visited school zones during rush hours (morning and afternoon) and observed safety issues like crosswalks, speed limit, road signs, and road condition. With the aid of a checklist, researchers indicated problems at locations near national roads, focusing on road structure and surrounding environment. They also depended on information from past studies and reports (secondary data) to further understand road safety around schools. Photos were taken along the tours to facilitate analysis of the problems later in the office. Based on what they witnessed and the existing safety standards, the team suggested possible improvement.

2. LITERATURE REVIEW

Child safety in the road to school is a priority concern in developing countries, where inadequate infrastructure, unsafe means of transport, and inadequate traffic safety awareness considerably compromise students' well-being. Children simply walk or cycle on roads shared with motorized vehicles, with no pavements, lighting, or pedestrian-only infrastructure. Overloaded and poor public transport also adds to children's risks in peripheral communities. Investigation, such as that done by Ipingbemi and Aiworo (2013) and du Plessis (2014), shows not only the infrastructural deficiency but also a lack of awareness among students and parents of basic safety practices like helmet and seatbelt use. The Safe Systems Approach is a globally accepted methodology that centres on integrated measures from safer road design, speed control, safer vehicles, and road user education. Evidence from South Korea, where child road deaths fell by 95% between 1988 and 2013, confirms the effectiveness of strategies such as designated school zones, 30 km/h speed limits, and rigorous parking controls. Encouraging safe roads to school requires both environmental and behavioral interventions. Evidence attests to speed reduction advantages, as in the instances of high success in South Africa where speed calming along schools has led to remarkable reductions in both private and public vehicle speeds (Lambert & Venter, 2015). Physical measures such as flashing beacons, cat-eye reflectors, raised crosswalks, chicanes, and chokers have been effective in reducing traffic speed and delineating pedestrian areas. Roundabouts also help reduce points of collision in densely populated urban areas (Ambros et al., 2023). Rwanda has a high rate of road traffic fatalities at 655 deaths in 2021, a sharp rise from 593 deaths in 2018, with the simultaneous increase in the ownership of motor vehicles. Nationally, the fatality rate is 29.7 deaths per 100,000 population, which is disproportionately distributed between the 16–30 age range. Vulnerable road users, including pedestrians and cyclists, are responsible for over half of these fatalities. The reaction has included government mobilizations such as the nationwide campaigns "Gerayo Amahoro," which have reduced accidents by 17%, and investment in infrastructure development such as pedestrian walkways and cyclist roads. Enforcement has also been stepped up through the utilization of automated speed cameras and car inspections (Sabiiti, 2023; GATESI et al., 2022). Global best practices for safety in school transport are informed by comprehensive approaches, including slow speed zones, well-defined and well-administered pedestrian crossings, and accessible infrastructure in the form of cycling paths and walkways. Denmark is an excellent case study where social participation, education, and infrastructure investment have made significant contributions to child pedestrian safety (Jensen, 2008; Yu & Zhu, 2016).

3. GENERAL DESCRIPTION OF THE INSPECTED SCHOOL ZONES

The study involved observation of 27 schools along five large national roads, NR1 to NR5, within Kigali City. The roads, which connect urban and peri-urban residents, have varying traffic levels and include residential and commercial areas. The assessment sought to identify infrastructural and behavioral risk factors that compromise the students' safety. Criteria included sidewalk availability and continuity, crosswalks, and bike lanes, as well as signage visibility and quality. Other dangers, such as potholes, open drainage ditches, and visual obstructions, were also noted to ensure thorough insight into school zone vulnerabilities. Traffic conditions for flow differed by location and time of day, with peak risk times during the opening and closing times of schools. Traffic during these times was congested with a mix of private vehicles, motorcycles, buses, and freight. Vulnerable road users, such as children, were frequently seen walking under unsafe conditions, like on too narrow paths or open roads that offered no pedestrian protection.

4. SUBSTANTIVE ROAD SAFETY PROBLEMS AND SUGGESTED SOLUTIONS

Field observations in school zones in Kigali City revealed some fundamental safety concerns in need of expedient interventions. Most school zones were found to have unmapped pedestrian crossings, broken sidewalks, and poor drainage protection. Such deficiencies expose school children to greater risks of injury and death, particularly when students walk between roads at unsignalized locations or travel along open side ditches. Inaccessible pedestrian facilities and the absence of inclusive measures place children with mobility impairments at high risk. Optimum pedestrian space planning with uninterrupted and accessible routes and crossings is essential. None of the school trips visited had separated cycle facilities either. Consequently, cyclists, including children, need to share road space with motor vehicles, making them more vulnerable to crashes. The adoption of

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segregated cycling infrastructure, learning from low-accident cities, can significantly improve safety. Properly designed on-road bike lanes reduce conflicts and promote safe cycling as a mode of school commute.

Lack of essential signage and markings like speed limits and school zone warning were seen in most locations. Drivers do not slow down near schools without visual warning, raising the likelihood of accidents. Installing standard road markings, reflective paint, and visible signage, including a 30 km/h school zone speed limit, can promote safer driving behavior and facilitate child pedestrian independence. Open drain and other roadside hazards were ubiquitous near schools and presented physical barriers to pedestrians. Facilitating cover of ditches and the construction of protective barriers, and clearly demarcating pedestrian zones, will significantly promote safety.

Measures for effective speed management were absent in many school zones. In areas with speeds greater than 60–80 km/h, vulnerable road users' chances of survival are largely reduced when incidents occur. Physical traffic calming devices such as humps, bumps at crossing points, and curb extensions can be implemented to achieve the internationally promoted 30 km/h school zone. Moreover, poorly designed or governed on-street parking expels pedestrians, including children, into the road. It undermines visibility as well as brings in pedestrian–motorist conflict. Paving over parking spaces with adequate signs, covered pedestrian paths, and loading zones can reduce this hazard.

Hazardous pedestrian behaviors, such as illegal crossing outside zebra crossings, were common. Such behavior is normally promoted by the lack of infrastructure and inadequate supervision. It is recommended to put in regular, strategically placed zebra crossings and adult supervision, along with traffic education for schools. Infrastructure in the majority of school grounds was not designed to accommodate disabled children. Raised kerbs, missing or narrow pavements, and inaccessible crossings were the norm. Upcoming projects must be based on universal design to ensure safe and dignified access for all users of roads.



Figure 1: Typical road deficiencies identified

5. CONCLUSION

The study explores various road deficiencies in school zones located in Kigali city and assesses the current road safety conditions. It develops recommendations for policy changes to enhance students' transportation and safety. It identifies and analyses significant transportation challenges school children face, including inadequate pedestrian infrastructure, lack of dedicated bike lanes, and high vehicle speeds in school zones. 27 schools have been visited in Kigali city, while 11 schools are directly closer to the national roads, and 16 schools are located at distances between 100m and 500 m from the national roads. After an intensive study based on observation and assessment of the safe lens design, the study found several design defects that might be contributors to routine crashes and possible future hazards in the school zones in Kigali city. Those include unfavorable road conditions, especially discontinuous sidewalks and pedestrian crossings, which are crucial for ensuring school children's safety. Additionally, the lack of traffic calming measures in school zones allows motorists to drive at high speeds higher than 30km/h, which is dangerous to vulnerable road users. The study highlights the necessity of a comprehensive approach to address these issues. It emphasizes the importance of infrastructural improvements and enforcing lower speed limits to increase safety in school zones. It is recommended

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that road safety audits be performed during the design and early operation of the road; regular road safety inspections must also be taken into consideration, especially in school zones, and the countermeasures identified during this study must be implemented.

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