

# INTERACTIONS BETWEEN PEDESTRIANS, INFORMAL TRANSPORT, AND ROAD INFRASTRUCTURE

*A SAFE SYSTEM PERSPECTIVE ON URBAN ROAD SAFETY IN LUSAKA, ZAMBIA.*



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Committed to reduce Road Traffic Accidents

## Organization Background



Passengers, Pedestrians, and Cyclists Association (PAPECA) is a registered non-governmental organization in Zambia.

Our organization is dedicated to promoting road safety awareness, education, and advocacy for vulnerable road users including passengers, pedestrians, cyclists, and persons with disabilities.

PAPECA was established in response to the alarming number of road traffic accidents affecting vulnerable groups.

### Vision:

To build a Zambia where every road user—whether pedestrian, cyclist, driver, or passenger—can move safely and confidently. We envision roads that are designed and managed to protect the most vulnerable, fostering a culture of respect, responsibility, and shared accountability among all users

# Mission statement

Our mission is to empower communities across Zambia with the knowledge, resources, and support systems needed to promote safer road behaviors. Through targeted education, advocacy, and collaboration with government and stakeholders, aiming to significantly reduce road traffic injuries and fatalities, ensuring that vulnerable groups enjoy their right to safe and accessible transportation

# Background

## Why This Study Matters:



### Fact

Global road traffic deaths annually

LMICs share of fatalities

Sub-Saharan Africa

Pedestrians

### Data

1.19 million (WHO, 2023)

>90%

Highest fatality rate globally

Most vulnerable road users

**The Gap:** Limited system-level evidence for African cities with informal transport

# Problem Statement



## The Core Problem:

### Issue

High-speed arterials through residential areas

Absent/discontinuous sidewalks & crossings

Minibus dominance

Behavioural framing

### Evidence from Lusaka

Road function misaligned with land use

52.6% of crashes at locations with no crossing

46.3% of pedestrian crashes

Ignores structural/environmental factors

**Question:** How do interactions between pedestrians, vehicles, and infrastructure produce crash risk?



## Research Aim & Objectives

### **Aim:**

To examine how interactions between pedestrians, vehicles (especially minibuses), and road infrastructure influence pedestrian safety in Lusaka using a Safe System perspective.

### **Objectives:**

- Identify spatial/temporal patterns of pedestrian crashes
- Examine relationships between injury severity and road environment
- Assess role of vehicle type (informal transport)
- Analyse pedestrian behaviour & infrastructure conditions

# Theoretical Framework

## Complementary Theories:



### Theory

Safe System Approach

Systems Theory

Risk Compensation Theory

### Contribution

Human error is inevitable, design systems to prevent fatal injuries

Safety emerges from interactions, not isolated failures

People adapt behaviour to perceived risk

**Key implication:** Focus on design, not just behaviour change

# Methodology



## Mixed-Methods Design

### Component

Quantitative

Qualitative

Analysis

Framework

### Details

Police-recorded pedestrian crashes

Field observations + key informant interviews

Descriptive states, cross-tabs, ordinal logistic regression, thematic analysis

Safe System + Systems Theory + Risk Compensation Theory

**Sample Size:** Yamane formula (n=272 from estimated 850 crashes over 3 years)

# Key Findings

## Spatial Patterns:

## Where Do Crashes Happen?

Location	% of Crashes
Lumumba Road	19.9%
Industrial areas	22.8%
Local roads	34.9%

**Temporal pattern:** Daytime crashes (58.8%) > Nighttime (41.2%)

**Key insight:** Non-random clustering (predictable hotspots)





## Key Findings Cont'd

### Injury Severity:

### Injury Severity Distribution

Severity	%	n
Minor	24.6%	67
Serious	48.2%	131
Fatal	27.2%	74

**Speed matters:** 79% of crashes in zones  $\geq 50$  km/h

**Crossing matters:** 52.6% of crashes where NO crossing available

# Key Findings Cont'd

## Vehicle Type

### Minibus Dominance



Vehicle Type	% of Crashes	Serious Injuries
Minibus	46.3%	63
Private car	32.7%	43
Truck	9.9%	18
Bus	7.4%	4
Motorcycle	3.7%	3

**Minibus odds ratio:** 2.44 (95% CI: 1.61–3.69,  $p < .001$ )

# Key Findings Cont'd

## Multivariate Results: Independent Effects



Variable	Odds Ratio	95% CI	p-value
Minibus (vs. private car)	2.44	1.61–3.69	<.001
Speed 50 km/h (vs. 40)	1.84	1.14–2.97	.012
Speed 60 km/h	2.44	1.53–3.90	<.001
Speed 80 km/h	3.08	1.88–5.04	<.001
Crossing available (vs. no)	0.58	0.40–0.84	.004
Industrial area (vs. residential)	1.97	1.24–3.13	.004

**Model fit:**  $\chi^2(14)=87.62$ ,  $p<.001$ , Nagelkerke  $R^2=0.287$

# Qualitative Themes



## Dominant Themes from Interviews & Observations

### Theme

1. Inadequate infrastructure
2. Unsafe minibus operations
3. Excessive speed
4. Weak enforcement

### Key Finding

- Missing sidewalks, poor crossing visibility
- Sudden stopping, non-compliance
- Speeding in pedestrian-dense areas
- Absent/occasional traffic law enforcement

**Quote:** *"No safe places to cross near markets"*

# Safe System Analysis



## Lusaka's Misalignment with Safe System Principles

### Safe System Principle

Safe speeds ( $\leq 30$  km/h)

Forgiving infrastructure

Shared responsibility

Human error tolerance

### Current Status in Lusaka

79% of crashes at  $\geq 50$  km/h

52.6% lack crossings

Weak enforcement, blame on pedestrians

48.2% serious injuries — system unforgiving

**Conclusion:** Systemic redesign needed, not just behavioural campaigns

# Conclusion



## Key Takeaways:

- Pedestrian crashes in Lusaka are **predictably clustered** — not random
- Minibuses are disproportionately involved (46.3%, OR=2.44)
- Speed is the critical determinant of severity (OR up to 3.08 at 80 km/h)
- Infrastructure deficits (52.6% no crossings) force risky pedestrian behaviour
- Safe System principles are applicable but require contextual adaptation
- Low-cost engineering (speed humps, crossings, lay-bys) can deliver 20-40% risk reduction

Lusaka can be a vanguard for SDG 3.6-aligned road safety reform in Africa





## Limitations

- Secondary crash data may have under-reporting issues
- Data fragmentation limited some analyses
- Qualitative findings based on limited number of informants
- Budget

# Recommendations

## Immediate Low-Cost Interventions



Intervention	Target	Expected Impact
Speed humps, raised platforms	Lumumba Road + 5 industrial corridors	20-40% crash reduction
Zebra crossings with bollards	Locations lacking crossings (52.6%)	Reduced crossing conflicts
Contiguous sidewalks (min 1.5m)	Local roads (34.9% of crashes)	Fatal injury reduction

**Lead agencies:** RDA, LCC | **Timeline:** 6-12 months

# Recommendations Cont'd

## Minibus & System-Level Interventions



### Intervention

Designated lay-bys

Operator guidelines

30 km/h safe speed zones

Cross-agency taskforce

### Details

5-10 locations with pedestrian refuges

Voluntary stopping protocols + signage

Hotspot pilots with feedback signs

RDA-LCC-Police quarterly audits

**Lead agencies:** LCC, Ministry, RDA | **Timeline:** 3-24 months



***Thank You For Your Attention.***

***Any Question or Contributions?***