Epidemiology and Factors Associated with Road Traffic Crashes in Zambia

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Received Date: June 06, 2015, Accepted Date: July 30, 2015, Published Date: August 10, 2015

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Abstract

Introduction: Road traffic crashes are a public health concern in Zambia. Literature review reveals a dearth of research data on the epidemiology and factors associated with road traffic crashes (RTCs) in Zambia. This paper documents the epidemiology of RTCs and factors associated with these RTCs in order to inform road safety measures and policies in Zambia.

Methods: The main study was a cross-sectional survey using mixed methods, including focus group discussions, key informant interviews, observations, and surveys. This paper is based on analysis of secondary data from police and hospital records, key informant interviews and focus group discussions.

Results: The rates of RTCs and deaths increased by 31% and 30% respectively between 2008 and 2013, rising at annual rates of 9% and 10% respectively. Out of 128,459 RTCs, 58% were from Lusaka, 23% from Copperbelt and 7% from Central province. Most crashes occurred between 1600 hours and 2000 hours. The increases in RTCs over the period were: 227% in North-Western, 65% in Southern and 53% in Copperbelt provinces. Data from the University Teaching Hospital (UTH), Lusaka shows that most fatalities of RTCs were males older than five years with the majority being males above 21 years of age. Poor road infrastructure, pedestrians road crossing and driver behavior were the primary factors associated with RTCs in Zambia. Driver behaviors included misjudging clearance distance, failing to keep to nearside, cutting in, reversing negligently, and excessive speed.

Conclusion: The rate of increase in RTCs and associated deaths over the past six years in Zambia is unacceptable and negates the country’s target of reducing death rates by 20% between 2011 and 2015. Apart from the human error, poor road signage and markings appear to contribute greatly to the increasing number of RTCs in Zambia.

Keywords: Accident rates; Road traffic crashes (RTCs); Epidemiology; Causes; Factors; Driver behavior; Zambia

Introduction

Current data shows that road traffic injuries are the eighth leading cause of death globally. About 1.24 million people die every year on the world’s roads, and another 20 to 50 million sustain non-fatal injuries as a result of road traffic crashes [1]. Ninety percent of the world’s road traffic deaths occur in low and middle income countries (LMICs), which are home to more than 80% of the world’s population and a sizeable population at risk for injuries and deaths related to road traffic crashes (RTCs). LMICs account for 53% of registered vehicles worldwide. Many of those most affected by RTCs belong to the most vulnerable populations in society. Young children account for nearly 20% of road traffic deaths while many are left with permanent disabilities. In most LMIC, road traffic injuries (RTIs) are among the top two causes of death from unintentional injury, with the highest rates being among 15-19 year olds, and 73% of all road traffic fatalities are males [2,3]. Risk factors associated with road traffic crashes were categorized by William Haddon in 1980 into three: Human, Vehicles & Equipment, and Environment. According to what became to be known as the Haddon matrix, each of these factors may be at play at each of three phases: pre-crash, crash, post-crash [4]. In general, the human factor has been associated with most RTCs [5,6].

To deal with this challenge, the World Health Organization (WHO) declared the period 2011 to 2020, a decade of global action for road safety and member countries agreed to develop Plans of Action [7]. This is in recognition of road safety and injury prevention as a key area of public health concern, especially within low- and middle-income level countries (LMIC). The goal of the plan of action was to stabilize and then reduce road fatalities by increasing activities conducted at national, regional and global levels.

Zambia continues to experience an increase in the number of RTCs, with the resulting number of fatalities steadily increasing between 2001 and 2007 [1,8]. Of the reported road traffic deaths, 45% were pedestrians and 13% were cyclists. In Zambia RTCs are ranked as the third leading cause of death after HIV/AIDS and Malaria within Lusaka Province [9]. Zambia has taken a number of measures to reverse this growing trend and has set an aggressive target to reduce traffic crashes and injuries by 20% [1] between 2011 and 2015. Although there is data on numbers of road traffic crashes in Zambia, there is no evidence of a thorough analysis of this data to describe the epidemiological profile of these crashes; neither is there comprehensive data that describes the factors most likely to contribute to these road traffic crashes. A few studies have been carried out, providing some aspects of the epidemiology and some factors associated with road traffic crashes in Zambia. In 1997 a master of public health student published a dissertation on a descriptive epidemiology of road traffic crashes in Zambia; but focusing only on data from the University Teaching Hospital (UTH) in Lusaka [10]. And recently in 2013 Abraham Silwenga and colleagues conducted a pedestrian survey, “monitoring the random pedestrian crossings at traffic lights in Lusaka, Zambia” [11]. One of the objectives of this study was to investigate the individual and situational factors which influence the increased road traffic crash risk among drivers of passenger-carrying commercial minibuses.

Study Purpose

The purpose of our main study was to carry out a situation analysis of the current state of road safety in Zambia; critically analyze the current road safety measures in terms of the
policies, statutes, interventions, and strategies; evaluate road user compliance to road safety rules and regulations; identify gaps in the measures currently in place to improve road safety, and recommend further action to improve road safety and mitigate the impact of road traffic crashes in Zambia. This paper focuses on the epidemiology and factors associated with road traffic crashes in Zambia. It highlights the trends in both the numbers and rates of RTCs over a six year period. The paper also highlights the areas of the country most affected, times when most crashes occur, and who is most affected in terms of gender and age. Based on the findings, suggestions are made on what needs to be done to reverse the trends in both RTCs and associated deaths.

**Materials And Methods**

**Design**

The main study from which the data reported here is derived was a cross-sectional survey of the status of road safety and road safety interventions in Zambia, using quantitative and qualitative methods, inspections, and observation methods.

**Study sites, study population, sampling and sample sizes**

The main study covered the following districts (Figure 1): Livingstone (Southern Province), Lusaka (Lusaka Province), Chibombo (Central Province), Kabwe (Central Province), Ndola (Copperbelt Province), Kitwe (Copperbelt Province), and Solwezi (North-Western Province). The districts were selected because they are located along the major road networks in Zambia, spanning over a region deemed as a national economic hub, encompassing five of the ten provinces of Zambia. The selected districts were also the regions reported to have the highest incidence of RTCs. The study population included automobile drivers (both public and private), various other types of road users, road safety stakeholders, and policy makers.

The sample size estimation for each of the population groups and methods was as follows:

**a) Police, RTSA, and Hospital records.** We collected data on road traffic crashes from all records available to us in all the seven districts covered by the five police divisions. We also collected data on the number of registered motor vehicles within these seven districts. From each police division we selected one main referral hospital, except in Lusaka where we selected the country’s largest hospital, UTH, in addition to the main secondary hospital, Levy Mwanawasa.

**b) Focus Group Discussions (FGDs) and Key Informant Interviews (KII):** The sample size for both FGDs and KII was chosen such that it was large enough to ensure that we were likely to reliably assess the perceptions of stakeholders that might be important regarding the subject matter. This was achieved by conducting interviews until a saturation point to responses was attained in participants (and responses were no longer providing any new insight or information). We had a total of 432 FGD participants in 70 FGDs; representing each of the following groups of drivers: private SUV motorists, drivers of private cars, minibus drivers, and big bus drivers. There was a total of 42 FGDs (288 participants) representing each of the following groups: Cyclists, motorcyclists, pedestrians. And we had a total of 69 KII participants broken down as follows: 2 representatives from the Ministry of Communication and Transport; 1 road safety engineer at headquarters in Lusaka; 7 police traffic officers; 7 road engineers from the district level; 7 RTSA road safety officers from the district level; 30 mini-bus drivers from the target districts; one representative of the pedestrians and cyclists association; 7 road traffic wardens and 7 doctors from the target districts.

**Methods**

The following data collection methods were used for the overall study (although this paper presents only data on epidemiology and

![Figure 1: Study site locations for RTCs study.](image-url)
factors associated with road traffic crashes: Systematic review of global, regional and Zambia-specific scientific literature, desk review of policy, strategy and legal documents related to road safety in Zambia; review and epidemiological analysis of road traffic data from hospitals and road traffic police records; in-depth interviews (IDIs) with key road safety stakeholders, FGDs with road users, policy makers and other road safety stakeholders; observations of drivers compliance to traffic rules and regulations; driver behavior surveys, and inspections of road safety infrastructure. This paper reports on results from review and epidemiological analysis of road traffic data from hospitals, road traffic police records, in-depth interviews (IDIs) with key road safety stakeholders, FGDs with road users, policy makers and other road safety stakeholders.

We reviewed all police records on road traffic crashes between 2008 and 2013; covering all the provinces and districts selected for the main study. We extracted and recorded data on numbers of RTCs by year, age and sex of crash victims, as well as time of the day when the accident happened. We also extracted data on deaths arising from road traffic crashes by age and sex. We recorded the ‘cause’ of each accident as reported by the police records. We use the word ‘cause’ here to reflect the language used in police records, but in essence these are factors associated with RTCs. In addition to police records we reviewed the data base of the Road Traffic and Safety Agency (RTSA) to document the number of registered cars by year, covering the period 2008 to 2013.

The records review was supplemented by IDIs and FGDs with all road users, which included motorists of various motor vehicles, motorcyclists, cyclists, and pedestrians. These qualitative methods asked questions that sought to understand the perceptions of road users on factors associated with RTCs in Zambia and what the road users proposed to be done to reduce road carnage.

We reviewed records of accident victims brought in dead (BID) to six hospitals; one from each of the following provinces or police Divisions: North-Western, Copperbelt, Central, Southern; and two from Lusaka Division. The study team however faced a challenge of poor record keeping and absence of records in these institutions. As a result very limited data was collected from Livingstone General Hospital in Southern Division, Liteta Hospital in Central division, and Solwezi General Hospital in North-Western Division. We were able to analyze data from University Teaching Hospital and Levy Mwanawasa Hospital in Lusaka Division as well as data from Kabwe General Hospital in Central Division.

Data management and Analysis

Quantitative data was collected using paper-based structured survey instruments. Survey forms were printed and provided to the field teams for data collection operations. Once a form was filled out, it was checked for completeness and entered into Microsoft Access database and cleaned. De-identified electronic secondary data was obtained from RTSA and Zambia Police Service (ZPS) for further analysis of socio-demographic factors. From the Access data base, the data was exported to Stata version 12 for analysis. Frequency tables and cross tabulations of key variables to look at associations were produced. Comparison of categorical variables was done through the chi-square tests. Aside from frequency tables, graphs were also used to present data.

Qualitative data was collected on paper-based instruments and digitally recorded FGDs. Both IDIs and FGDs were transcribed verbatim onto a word document and then imported into NVIVO software, summarized and shared the results of the qualitative data with the rest of the team who also read the transcripts to help validate the NVIVO results. The team also noted some factors that were mentioned by just few respondents (outliers) as possibly important. One such factor was the issue of unmarked speed humps being associated with RTCs, which was mentioned by few people but was noted.

Ethical Consideration

This study was approved by the local (Zambia) Research Ethics Committee, ERES Converge and was exempted by the Boston University Institutional Review Board. The study was also approved by the Zambia Ministry of Health.

Results

Epidemiology of Road Traffic Crashes in Zambia: 2008 to 2013

Number of Registered Vehicles: The number of registered vehicles increased from 277,865 in 2008 to 534,523 in 2013, a 92% increase (Figure 2). The increase has been exponential, with an average increase of 14% per annum in the number of registered vehicles over the six year observation period. The highest rate of increase (18%) in the number of registered vehicles was observed between 2011 and 2012 and between 2012 and 2013 respectively.

Number of road traffic crashes: The absolute number of RTCs has been increasing over the past six years; from 19,727 in 2008 to 29,118 in 2013 (Figure 3). This translates into a 48% increase over this period; with an average of a 9% increase in the number of
crashes per year.

Out of all the crashes data analyzed from five police geographic Divisions over the period 2008 to 2013, 58% (n = 74,215) of the crashes were reported from Lusaka, 23% (n = 30,166) were from Copperbelt and 7% (n = 9081) were reported from Central province. In terms of increases in absolute numbers of RTCs over the six year period, North-Western Division recorded a 227% increase, from 469 crashes in 2008 to 1533 in 2013, followed by Southern province with a 65% increase and Copperbelt with 53% increase (Table 1).

An analysis of the rate of increase in absolute numbers of RTCs by geographic region shows that North-Western province has had an annual increase of 34% on average; followed by Copperbelt and Southern provinces with 15% and 11% respectively. Lusaka province had the least annual rate of increase in RTCs at 7%. The annual rate of increase in the number RTCs in Central province was 8% (Table 2).

Rate of road traffic crashes: The accident rate per 100,000 vehicles decreased from 7,099 in 2008 to 5,447 (Figure 4); decreasing at an average rate of 5% per annum. The largest reduction in the rate of crashes per 100,000 vehicles was between 2009 and 2010 (17% reduction) and between 2012 and 2013 (13% reduction).

However, accident rates per 100,000 populations have been increasing: from 156/100,000 in 2008 to 205/100,000 in 2013; translating into an overall increase of 31% increase (Figure 5) over this period. Further analysis of this data shows that the number of crashes per 100,000 people has been increasing at annual rate of 6%; with the highest increase of 22% between 2011 and 2012 and no change between 2012 and 2013.

Number of fatal road traffic crashes: Figure 6 shows that the number of fatal RTCs increased from 1,238 in 2008 to 1,851 in 2013, with the highest number of fatalities recorded in 2012 (2,360 fatalities). On average there has been a 10% annual increase in the absolute numbers of fatal RTCs over the period under review.

### Table 1: Number of crashes reported by police geographic division from 2008 to 2013.

<table>
<thead>
<tr>
<th>Division</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
<th>% increase between 2008 and 2013</th>
<th>% contribution of each geographic division</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lusaka</td>
<td>11,180</td>
<td>11,430</td>
<td>11,055</td>
<td>11,428</td>
<td>13,687</td>
<td>15,435</td>
<td>74,215</td>
<td>38%</td>
<td>58%</td>
</tr>
<tr>
<td>Copperbelt</td>
<td>3,442</td>
<td>6,137</td>
<td>4,371</td>
<td>4,743</td>
<td>6,196</td>
<td>5,277</td>
<td>30,166</td>
<td>53%</td>
<td>23%</td>
</tr>
<tr>
<td>Central</td>
<td>1,311</td>
<td>1,339</td>
<td>1,402</td>
<td>1,384</td>
<td>1,763</td>
<td>1,882</td>
<td>9,081</td>
<td>44%</td>
<td>7%</td>
</tr>
<tr>
<td>Southern</td>
<td>1,234</td>
<td>1,074</td>
<td>1,128</td>
<td>1,335</td>
<td>1,674</td>
<td>2,034</td>
<td>8,479</td>
<td>65%</td>
<td>7%</td>
</tr>
<tr>
<td>N/Western</td>
<td>469</td>
<td>1,017</td>
<td>863</td>
<td>1,109</td>
<td>1,527</td>
<td>1,533</td>
<td>6,518</td>
<td>227%</td>
<td>5%</td>
</tr>
<tr>
<td>Total</td>
<td>17,636</td>
<td>20,997</td>
<td>18,819</td>
<td>19,999</td>
<td>24,847</td>
<td>26,161</td>
<td>128,459</td>
<td>48%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Table 2: Percentage increase or decrease in the number of road crashes reported between the years.

<table>
<thead>
<tr>
<th>Division</th>
<th>2008-2009</th>
<th>2009-2010</th>
<th>2010-2011</th>
<th>2011-2012</th>
<th>2012-2013</th>
<th>Average Increase</th>
<th>Median Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lusaka</td>
<td>2.2</td>
<td>-3.3</td>
<td>3.4</td>
<td>19.8</td>
<td>12.8</td>
<td>7.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Copperbelt</td>
<td>78.3</td>
<td>-28.8</td>
<td>8.5</td>
<td>30.6</td>
<td>-14.8</td>
<td>15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Central</td>
<td>2.1</td>
<td>4.7</td>
<td>-1.3</td>
<td>27.4</td>
<td>6.7</td>
<td>8.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Southern</td>
<td>-13</td>
<td>5.0</td>
<td>18.4</td>
<td>25.4</td>
<td>21.5</td>
<td>11.0</td>
<td>15.0</td>
</tr>
<tr>
<td>N/Western</td>
<td>116.8</td>
<td>-15.1</td>
<td>28.5</td>
<td>37.7</td>
<td>0.4</td>
<td>34.0</td>
<td>31.0</td>
</tr>
</tbody>
</table>
Rate of fatal road traffic crashes: The number of road traffic fatalities per 100,000 population increased from 10/100,000 in 2008 to 13/100,000 in 2013 (Figure 7); but there was no change in the number of fatalities per 100,000 vehicles (Figure 8). On average, there has been an 8% increase in the rate of fatal road traffic crashes per 100,000 populations per annum over the observed period.

Road traffic case fatality rates: Data on case fatality rate, calculated as number of people who died as a percentage of the number of crashes, show that Police Central geographic Division had the highest case fatality rate of 17.1%, followed by Southern with 8.3% and North-western Division with 7.0% in 2013 (Table 3).

Time of crashes: An analysis of data available from four police geographic Divisions of Lusaka, Central, Southern, and North-western shows that during the period 2008 through 2012, most crashes occurred between 1600 hours and 2000 hours (Figure 9). The highest total number of crashes (10,782) occurred between 1800 and 2000 hours, followed by the period between 1600 hours and 1800 hours (10,474), and lastly the period between 0900 hours and 1200 hours (10,330).

Road traffic fatalities by gender: Data from the UTH, Kabwe General Hospital, and Levy Mwanawasa Hospital, on accident victims brought in dead (BID) shows that between 2008 and 2013 most BIDs were males (Tables 4, 5, 6).

Factors associated with Road Traffic Crashes in Zambia

Below we summarize the factors most associated with RTCs in Zambia based on the Haddon matrix.

Pre-crash phase

Human factors

We analyzed the data on human factors based on four themes: Information, attitudes, impairment, and police enforcement. Analysis of data from police records reveals the following human factors as the six commonest factors associated with RTCs in Zambia: Misjudgment of clearance distance, failing to keep to nearside, cutting in, reversing negligently, excessive speed, pedestrian crossing the road. Records show that in 2012, 2,565 crashes were attributable to misjudgement of clearance distance, 2,085 cases were due to failing to keep to near side, and 1,820 cases were due to cutting in. The pattern was similar over the previous...
years (Figure 10). Most of the above stated factors appear to be related to attitudes. Based on above factors, police categorization factors list failing to keep traffic rules as the 9th cause of RTCs.

Respondents from both KIIs and FGDs mentioned drunk driving and not following traffic rules and signs as the most prominent factors contributing to RTCs in Zambia. Other human factors most cited by respondents were: Over speeding, unlicensed and inexperienced drivers, driver fatigue especially among long distance drivers, and poor road user attitudes. When asked about what needed to be done to improve road safety in Zambia, one of the actions most cited by respondents was community sensitization and behavior change communication on road safety; despite the fact that ignorance on road safety was not ranked high among the factors. Top of the list on measures suggested by respondents to reduce RTCs was that government should stiffen the current road traffic regulations and the law enforcement agents should come up with effective strategies to enforce the laws. However, the respondents cited corruption among law enforcement agents as the greatest challenge to enforcement of road traffic regulations. On community sensitization and road safety education, respondents cited the language in which materials are produced, including the Highway Code, as the greatest barrier. "...you have to consider the 7 languages which are normally used through our radios, if those also can have prints of the Highway Code in 7 languages I think that can help us very much..." said one of the respondents. Related to the issue of language in relation to road safety education and enforcement of road traffic regulations was illiteracy; as the following quotes from two different respondents illustrate: "Illiteracy - most drivers cannot read only a few can read (especially when it comes to bus drivers and taxi drivers); ...language - this hinders most road users from getting information. Booklets, leaflets on road safety should be translated in different languages, sensitization should be spread to rural areas" ..."Illiteracy - some people are able to drive but they can't read so even if they get these leaflets they just go home and pack them or even throw them away; ...translate leaflets and flyers into different languages to cater for those who can't read English." One other issue brought up by respondents was the fact that law enforcement agents concentrated on motorists and not so much on the vulnerable road users like pedestrians and cyclists. There was a suggestion to enforce traffic rules to cyclists, pedestrians and owners of animals that cross roads un-aided. As one focus group participants stated: "All bicycles should have brakes; bicycles be fit and have all parts; no cycling while drunk."

### Vehicles and Equipment factors

Respondents from both FGDs and KIIs cited inadequate transport, inadequate breathalyzer machines, speed guns, and inadequate manpower as the biggest challenges to enforcement of road traffic regulations in Zambia in addition to the road user human factors referred to above. The study team was told that there were very few breathalyzers in the country and even their calibration was a challenge as there was few traffic officers trained to do so.

### Road safety environment factors

Poor road infrastructure was cited as the greatest challenge to road safety in Zambia. Various issues were raised with regard to road infrastructure and included; narrow roads, lack of pedestrian and cyclists paths, no shoulders on many roads, few or lack of dual carriage ways, poorly maintained roads, inadequate number of roads against a growing number of vehicles. This is compounded by the fact that many of these roads lacked road signs and markings or clear lanes. Lack of road signs, especially on curves and before speed humps was mentioned as a big factor in the causation of road traffic crashes on Zambian roads. "No proper signs in dictating speed

### Table 5: Number of accident victims brought in dead at Kabwe General Hospital from 2008-2013 by age group and gender.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>0-5 years</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6-10 years</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11-15 years</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>16-21 years</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>&gt;21 years</td>
<td>12</td>
<td>7</td>
<td>22</td>
<td>7</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
<td>15</td>
<td>49</td>
<td>11</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

### Table 6: Number of accident victims brought in dead at Levy Mwanawasa Hospital from 2008-2013 by age group and gender.

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>0-5 years</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6-10 years</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>11-15 years</td>
<td>3</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>16-21 years</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>&gt;21 years</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>4</td>
<td>14</td>
<td>7</td>
<td>30</td>
<td>5</td>
</tr>
</tbody>
</table>
humps so drivers lose control,” said a FGD participant. Participants were concerned with the absence of road markings, making it difficult for motorists to keep to their lanes, especially at night.

**Crash phase**

**Human factors**

In terms of injury prevention during crash we examined two human factors: restraint and impairment. Results from driver behavior (full results to be reported in a separate paper), 64% of drivers interviewed said they wore a seat belt while driving and did so nearly all the time, while 58% said they insisted on their passengers wearing seat belts and did so nearly all the time. Police records did not specify if crash victims wore seat belts or not. The driver behavior survey also revealed that the rate of using mobile phone while driving was 37% and texting was about 10% among the drivers interviewed in Zambia. We did not come across data on the prevalence of drunk driving among crash victims from the police reports; however the reports do list drunk driving as one of the factors associated with the recorded number of crashes.

**Vehicles and Equipment factors**

We did not specifically collect data on vehicle crash protective designs and status occupants.

**Road safety environment factors**

We did not specifically collect data on crash protective roadside objects.

**Post-crash phase**

**Human factors, vehicle and equipment, and road environment factors**

For the sake of coherency and flow, we have decided to report the various factors in the post-crash phase together. Results of some of the key informant interviews revealed that the Government of Zambia through the RTSA and the Ministry of Health is implementing a post-crash injury reduction strategy that include: a) Emergency rescue services that involves include a 24 hours call centre with a toll free number 983 and communication facilities such as walk talkie and a rescue ambulance service; b) First Aid Education, which has been introduced as mandatory in all driving schools; c) Trauma centers and emergency wards. At time of data collection in 2014, national trauma centers and emergency wards for crash victims were being created through identifying strategically located hospitals and health centers with the possibility of upgrading them. In spite of these efforts by government, some respondents from both KIs and FGDs reported that the post-crash response was one of the weakest in road safety in Zambia.

Most participants (79 references) when asked on whether there were measures to deal with victims of RTCs in terms of both first aid at the scene of the accident or emergency transfer of the victim to the health facility, said there were no such measures in Zambia. Some (45 references) said there were measures for helping accident victims. “They are not there because when an accident happens we rely on other motorists to help as well as the police but there is no immediate help; first aid should be emphasized in driving schools, all drivers should be equipped with knowledge on how to use all tools in the first aid box as well as how to handle accident victims especially those who are seriously injured without finishing them off,” said one of the respondents. The challenge of the timely removal of accident victims trapped in vehicles is illustrated by the comment by one of the respondents, “Yeah! After crash, I think that’s where, I think as a government and these other institutions are behind………a lot of people have died due to inadequate attention. …..People have been trapped, you find that someone has been trapped maybe let’s say for the last 3hrs someone is just in pain, people have no means on how to like help those people that are trapped in the vehicles, …we need special machines;….we need equipment…we need the training to mitigate the issues to do with road crash victims on the actual scene.” The respondents said there was no well-coordinated emergency response system to deal with victims of RTCs although some acknowledged the good response that has been accorded to some of the large fatal accidents in the past. “Yes, measures are there like ambulances and other vehicles are also used but these are inadequate; we need more quick response equipment such as helicopters, ……..paramedics are needed to sort out the injured from the dead as they are a priority, rush them to hospitals and come back for the dead by doing so we can save lives,” said one of the respondents. And another respondent said, “Measures are there but are not sufficient; we do not have enough ambulances; no paramedics to provide medical help right at the scene of accident, these are people trained to do medical work but they are not medical doctors, they are competent with handling of RTA victims.”

**Discussion**

Our results show that between 2008 and 2013 the number of road traffic crashes increased by 48% in absolute terms and the crashes rates per 100,000 populations increased by 31%. There was no change in the rate of RTCs between 2011 and 2012 and between 2012 and 2013, an indication that the country may be moving towards a stable state. During the period of observation, the number of registered vehicles increased by 92%. This means the increase in RTCs cannot solely be explained by the increase in the number of vehicles; in fact the rate of crashes per 100,000 vehicles shows a decline over the period of review. There is literature to show that increase in the number of vehicles does not necessarily lead to an increase in the rate of road traffic crashes. Sweden is a good example. Sweden is among the five countries with the world’s lowest rate of traffic crashes, at 3 per 100,000 populations. Available information shows that although the number of cars in circulation and the number of miles driven both doubled since 1970 in Sweden, the number of deaths due to traffic crashes fell by four-fifths during the same period [12]. It should also be noted that our study recorded the number of registered vehicles rather than the number of vehicles actually on the roads.

The number of fatalities due to RTCs almost doubled between 2008 and 2012; increasing from 1,238 to 2360 fatalities. There was a drop to 1,851 fatalities in 2013, which is difficult to interpret because the general trend is that of almost exponential increase even with this drop. The rate of fatal crashes per 100,000 populations has also been on the increase; from 10/100,000 in 2008 to 17/100,000 in 2012; again with a slight drop in 2013 to 13/100,000 population. As it was for RTCs rate, the fatality rate shows a steady upward trend even when the slight drop in 2013 is considered. A year to year analysis of increases in both traffic crashes and fatalities shows 9% and 10% increases per annum. This is a challenge, considering Zambia’s target of reducing deaths by 20% between 2011 and 2015 [1].

According to available global figures from 182 countries in 2010 Zambia was the 24th highest in terms of road traffic fatalities at 23.8 fatalities per 100,000 population; highest being Niue with 68.3/100,000 and the lowest being San Marino with zero deaths/100,000 population [13]. Our figures show that the fatality rate in 2010 was 11 per 100,000 populations. This would place Zambia at number 130th highest in terms of road traffic fatalities. The current rate of fatalities in Zambia is just below the average for middle income countries, estimated at 20/100,000 in 2010 and the
There is a possibility that part of the increase in RTCs in Zambia could be due to rapid urbanization. Our results show that most RTCs over the past six years were recorded from Lusaka province, followed by Copperbelt and Central provinces respectively. We also observed that in terms of annual increase in road traffic crashes, North-western province recorded the highest rate of increase, followed by Copperbelt and Southern provinces respectively. This may be a reflection of urbanization in these regions, with increase not just in the number of cars but also the number of people using the roads. Urbanization also may not have been matched with increase and improvements in road infrastructure or persons recruited and deployed to enforce traffic regulations.

Our data shows that most crashes occur between 1600 hours and 2000 hours. This may be explained by the fact that this is the time when most vehicles are on the road and most people, including pedestrians and cyclists (vulnerable road users) are on the road back from work. This time period constitutes the peak hours for all road users and should ideally be the time when law enforcement agents and road safety agents institute road safety measures.

Respondents in this study ranked the human factor highest among the causes of road traffic crashes in Zambia. The question is what human factors contribute most to RTCs in Zambia? All the six factors highlighted under the results section are human factors. Our study was not designed to establish actual “causes” of road traffic crashes, but the above factors are likely to be the most contributing factors to the increase in RTCs in Zambia. Our findings are similar to other findings within the African region. The WHO World Report on Injury Prevention [14] states that errors like loss of control of the vehicle, excessive speed, misjudgment and improper overtaking, contributed to 44% of all police-reported crashes in Kenya [15].

The challenge is what interventions should be put in place to deal with these human factors? Are there interventions that would help reduce errors of overtaking, cutting in, failure to keep on the near side? The latter may be related to lack of road markings, potholes in the road, obstructions on the road, and other factors, in addition to human error. Dual carriageways, one-way streets, overtaking lanes on curves and hills, should help. The world report on traffic injuries prevention [14] recommends the following measures:

- Provision for slow-moving traffic and for vulnerable road users
- Lanes for overtaking, as well as lanes for vehicles waiting to turn across the path of oncoming traffic
- Median barriers to prevent overtaking and to eliminate head-on crashes
- Improved vertical alignment

In our literature search, we found that some of the research evidence reviewed suggests that the most successful interventions are those that reduce or eliminate the hazard and do not depend on changes in road users’ behavior or on their knowledge of road safety issues [16].

It is surprising to note that drunk driving was listed as the least among the 15 factors associated with RTCs from police records. We believe this factor is being grossly under-reported, most likely due to inadequate breathalyzers to confirm drunk driving. Respondents from qualitative interviews observed, (perhaps correctly), that drunk driving is one of the factors most frequently associated with RTCs.

**Limitations**

The results of this study must be interpreted with caution as the study was not conducted country-wide and may not represent the situation in the rural parts of the country. The study was cross-sectional and factors associated with the rates of RTCs may not necessarily mean they ‘caused’ the crashes. Hospital data was very sparse and made it difficult to fully describe the epidemiology of RTCs in Zambia.

**Conclusions**

In absolute terms, the number of RTCs has almost doubled in the last 6 years in Zambia and the crashes rate has continued to rise at approximately 9% per annum; with fatality rates increasing at approximately 10% per annum. Poor road infrastructure, especially poor road signage and markings, as well as human factors like misjudgment of clearance distance, failing to keep to nearside, cutting in, reversing negligently, excessive speed, pedestrian crossing the road, drunk driving, appear to be the most contributing factors to RTCs in Zambia.

**Acknowledgements**

The authors wish to acknowledge the financial support from the Government of the Republic of Zambia through the Ministry of Health (MOH) and RTSA. Thanks go to Boston University, Centre for Global Health and Development (CGHD) for providing technical support through the Principal Investigator of this study. A lot of appreciation goes to the invaluable cooperation received from stakeholders across the study sites that supported the study teams from proposal development, during data collection and report writing. Many thanks to the field team members for their commitment and enthusiasm in this undertaking. These include: Aroan Tembo, Harrison Banda, Belinda B. Mukemu, Nicholas Mushimba, and Oliver Chitalu.

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