

Piloting a multidisciplinary and integrated road traffic injury surveillance system in Kaduna Metropolis, Kaduna Nigeria.

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Research Methods

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Abstract

Background

African has the highest road fatality rate per 100,000 population, but Nigeria accounts for a quarter of the World Health Organization Afro region road traffic injury (RTI) related deaths. The Nigeria Federal Road Safety Corps (FRSC) is the sole agency for RTI surveillance. RTI data generated from a single source is inadequate, under-reported, and defective for effective planning to achieve SDG 3.6 target. This pilot study aimed to describe under-reporting of single RTI surveillance data source by FRSC, and feasibility of multidisciplinary and integrated RTI surveillance systems in Kaduna metropolis, Nigeria.

Methods

The WHO Injury Surveillance Guideline, and Centres for Disease Control and Prevention Surveillance Training Manual were adapted for this study. Selected RTI reporting sites for this study were FRSC, police, and three major health facilities. Trained data collectors used a pretested RTI data tool adapted from the existing tools to collect information on road traffic crashes and the injured from February – July 2016. Data linked by the deterministic method were merged, duplicates removed, and analysed for frequencies, proportions, and Chi-square odds ratio for associations between exposure variables and moderate to fatal injury. Statistical significance for all calculations was set at p-Value < 0.05.

Results

Of the 667 road traffic crashes (RTC), FRSC reported 103 (15.4%). Of the 1,062 people injured, FRSC and Police reported 183 (17.2%), and 381 (35.9%) respectively, pedestrians were 180 (17%), and 374 (35.2%) were in 25–34 years age group. Overall, 110 (10.4%) were fatally injured and died including 62.7% (69/110) who were initially rescued alive from the crash site. Among the 252 motorcycle riders, protective helmet was used by 26 (10.3%). Also, 136 (26.4%) vehicle users from 516, used a seat belt during the crash. Moderate to fatal injury was associated with being a vehicle operator during the crash (OR 1.7, C.I. 1.3–2.2, $p = 0.000$).

Conclusion

Road traffic crashes and injuries were under-reported with single source RTI surveillance systems common to low and middle – income countries like Nigeria. However, a multidisciplinary and integrated RTI surveillance system is feasible and recommended to generate quality data for action.

Background

Road traffic injury (RTI) is the unplanned occurrence of auto crashes that may result in injuries, loss of lives and property [1]. It is the most common cause of unintentional injury [2] and was the eighth leading cause of death globally for all age groups and the leading cause of death for children and young people 5–29 years of age [3]. RTI causes severe socio-economic burden to individuals, households, and the whole nation [4]. It caused 1.35 million deaths [3] and injured 50 million people annually, with aged 15–44 accounting for half of the injured [5–7]. Low and middle-income countries account for 90% of global mortality due to RTI with a disproportionate number of vehicles [3, 6]. The WHO African region has the highest rate of road fatality rate per 100,000 population among WHO regions and reported 20% of global road traffic deaths with 272,000 deaths in 2018 [8]. Nigeria accounts for more than twenty-five per cent of RTI related deaths in WHO Afro region [9, 10] and estimated rate of road traffic death per 100,000 was 20.5 compared to 26.6 in Afro region [8, 11]. In Nigeria, Kaduna State ranked 5th on RTI-related deaths per 1000 in 2011–2012 and reported 454 deaths from 426 road crashes [10].

To improve global road safety, the United Nation 64th session declared “Decade of global action for road safety with the aim to reduce the increasing trend in road traffic death [12]. This was further strengthened in the Brasilia declaration [13] and to ensure healthy lives and promote well-being for all at all ages, the sustainable development goal (SDG) target 3.6 seeks to halve the global number of road traffic deaths by 2020 [4]. Therefore, to monitor and evaluate the progress toward achieving this goal, the WHO Afro region recommended strengthening data collection among countries to identify gaps in the system and deliver well-tailored interventions for improvement [8, 9].

Succinctly, in most African countries, RTI surveillance data is poor. They depend on single RTI data source, i.e., police report, but 16% of these countries use multiple data sources like the police and health records [9]. Like most of the counties in Africa, RTI data surveillance in Nigeria was saddled with a sole agency, the Federal Road Service Corps (FRSC) who was responsible for RTI surveillance and reporting. In addition, police motor traffic departments also involved in RTI data collection, especially if litigation is likely, and most minor RTI cases will present to health facilities while some that occurred in the community are not reported. These RTI data from the police and health facilities are rarely integrated with the FRSC as indicated in 2015 Global Safety Report on Road Safety, where Nigeria reported 6,450 road traffic-related deaths which were lower than 35,641 deaths estimated by WHO using vital registration data [4].

Currently, efforts are being made by FRSC to establish a comprehensive and integrated RTI surveillance in Nigeria. This pilot study was developed to describe the feasibility of integrating RTI surveillance data from FRSC, Police and health facilities. This will generate a robust and reliable RTI data needed for information to plan and formulate policy, to advocate for funding to support RTI surveillance to achieve sustainable development goal 3.6 target (SDG-3.6) of halving road traffic deaths and injuries by 2020 in Nigeria. The SDG 3.6 may not be achieved if no drastic action is instituted [3]. There is no known similar study in Nigeria. The study aimed to describe a pilot study on the feasibility of integrating RTI data from the Police, health facility and FRSC for improving RTI surveillance in Nigeria.

Methods

The method as outlined in Injury surveillance guidelines [14] and surveillance training manual [15] of the World Health Organization and Centres for Disease Control and Prevention was adapted for this study.

The Study Setting

Kaduna State, North-Western Nigeria, has 23 local governments with Kaduna metropolis as its capital. Kaduna is an industrial centre and a former administrative seat of Northern Nigeria. It is the third-largest city in Nigeria with 1.9 million people as the estimated population in 2015. This cosmopolitan city, covering an area of 3,080 Km/m² is about 200 km from Abuja the federation capital city. Being a transit town from Abuja the nation's capital to the 18 Northern states, it has a high volume of vehicular movement with 3 major highways traversing the metropolis. Although the city is rapidly growing in motor vehicle ownership, in 2006 it witnessed a considerable increase in the average of 4,000 vehicular registration per annum [16], mostly using two-, three- and four-wheel vehicles for transportation. In 2013, the use of a protective helmet by motorcyclist was legalized but was not enforced in the state.

RTI Stakeholders' Identification And Collaboration

The identified stakeholders of RTI surveillance in Kaduna Metropolis are FRSC, health workers at Accident and Emergency (A & E), Pathology/mortuary, Police Motor Traffic Division, Road transport workers, Ministry of Roads and Transport, Ministry of Health, Journalists, Civil Society Organisations and the public. Following the advocacy visits, the stakeholders brainstorm and developed an RTI surveillance mechanism, design data tools, defined monitoring indicators and met every 3 months to review the progress of the study. A case was defined as any person in Kaduna metropolis killed or died within 30 days because of injuries incurred from a collision on a public road involving at least one moving vehicle. The cases were identified, investigated and reported by the designated RTI reporting site [17, 18].

The following indicators were developed for monitoring:

1. Total number of road traffic crashes that occurred within a reporting month
2. Total number of people injured following road traffic crashes (minor, severe and fatal)
3. The proportion of the people injured that resulted from a crash without no primary object of a collision that occurred within a reporting month. The denominator is the total number of the injured.
4. The proportion of the injured following a crash that was transferred by the Police to the health facility within a reporting month. The denominator is the total number of the injured.
5. The proportion of the injured following a crash that was transferred by the FRSC to the health facility within a reporting month. The denominator is the total number of the injured.

6. The proportion of the injured that used safety element during the crash. The denominator is the total number of the injured.
7. The proportion of those that died (fatally injured) following road traffic injury within a reporting month. The denominator is the total number of the injured.
8. The proportion of death that occurred at the health facility among the fatally injured within a reporting month. The denominator is the total number of fatally injured.
9. Timeliness: Proportion of reporting sites that sends the monthly data before the end of five working days of the succeeding month.
10. Completeness: Proportion of reporting sites that send a completed monthly RTI data, including zero reporting.

RTI Data Collection Sources

Three major health facilities with high volumes of road traffic injury cases in the Kaduna metropolis, Kaduna State Nigeria e.g., Barau Dikko Teaching Hospital (BDTH), St. Gerald Catholic Hospital (SGCH) and 44 Army Reference Hospital were purposefully selected health facilities for this study. Other sectors or disciplines selected were The Police Motor Traffic Division (MTD) and lastly, the Federal Road Safety Corps (FRSC).

Data Tool

Using the existing FRSC and police motor traffic division's RTI surveillance data collection tools, three data collection tools were developed. Two of the data tools were paper-based and the last was electronic. The paper-based individual case-based form was used at the health facility and consisted of three sections; a section for demographic information like name, age, sex, address, occupation, crash number, case number, reporting date and name of reporting health facility; section on injury include variables such as date of the crash, time, location, mode of travelling, what the vehicle collided with, type of location (highway, road, street), and disposal from the crash site and injury description were reported; the last and third section includes post-crash care which includes information on the date of presentation at the health facility, time of presentation, time is seen by the healthcare worker, prior presentation at the health facility and where, who transported the victim to the health facility, vital signs on presentation (pulse rate, blood pressure, temperature, respiration rate), preliminary diagnosis, emergency treatment and disposal or outcome at Accident & Emergency were reported.

The second paper-based data tool was a monthly summary form. It includes such variables as the name of reporting health facility, date and time of the crash, number of the crash, age and sex of the injured and outcome of the crash (fatal, serious or minor), the crash site, the probable cause of accident and type of vehicle involved and the outcome. The electronic form is an excel Microsoft spreadsheet used to line-list RTI cases as seen by each reporting facility. Data were sent monthly to the data manager before the end

of the first five working days of the subsequent month and principal investigator provided feedback monthly.

Injury severity was classified into mild, moderate, and severe or fatal. The mild injury was an injury sustained following road crashes without hospitalization of the injured e.g., bruises or abrasion, contusion, minor lacerations, and other soft tissue injuries. Moderate injury included any fracture, spinal cord injury, loss of consciousness or vital-organ involvement that warranted a stay in the hospital, while severe or fatal injury was life-threatening conditions that resulted in death. The primary object of the collision was an object i.e., vehicles, road pavement, pedestrian, stationary objects like poles, parked vehicles etc., that a moving vehicle collided with during the crash and road was classified according to the number of lanes i.e., four- and two-lane roads.

Data collection

Data were collected between February to July 2016 by trained data collectors and their supervisors. Data were collected at the crash sites by the police and FRSC and move the victims to the health facility. At the health facilities, data collectors interviewed anyone presenting with RTI after they had been seen and clinically stabilised by the clinicians. In cases where the injured had been admitted into the wards within the hospital, data were collected at the ward if stable. Otherwise if unstable, dead, referred to other health facilities not included in the piloting surveillance or had been discharged before the interview, the data were extracted from the victim's health records. Also, data collectors actively search registers at A&E, General Outpatient Department (GOPD), autopsy or pathology department and mortuary to retrieve information on RTI cases. For RTI cases brought to the health facilities by the Police and FRSC data were collaborated between the two reporting sectors and duplicates marked in the line-listing of each sector.

At the end of each day, data collected were line listed on the Microsoft excel sheet and sent to data manager at the end of each month and together with individual case-based form, summary form and the excel line-list (e-copy form) latest within the five working days of succeeding month and duplicated copies were removed from the database. Zero reporting was allowed, and missing variables in the health records were coded "99". The supervisors in each reporting site validated the RTI data by checking for data completeness of the individual case-based form compared with the excel line list before submitting to the data manager.

Data analysis

The data were cleaned and uniformly standardized by removing any abbreviations, hyphens, incorrectly written alphabets, formatting date of birth and code "99" for missing variables. The data manager linked datasets from the health facilities with RTI data from the police and FRSC using a deterministic or rule-based method. The linkage was based on an agreement between four to six of these variables; hospital number, name, age, sex, address, date of the crash, location of the crash, who transferred to health facility, any prior health facility visit, and name of the previous hospital visited. If the RTI case from two reporting sites matched and assumed to be duplicated, one of such matched data is retained for

analysis. Finally, the data were consolidated on a single Excel Microsoft spreadsheet and exported into Epi-info statistical software version 7 for analysis.

Descriptive analysis such as frequencies and proportions were calculated and presented in tables, charts and trends analysis of some indicators. Odds ratios were used to calculate association with moderate to fatal injury. Variables with a greater proportion of non-completeness such as the use of alcohol, documentation of injury site, type and Abbreviated Injury Scale (AIS) score, preliminary diagnosis using International Classification of Diseases (ICD) codes were exempted from analysis as most are not documented by the attending health workers.

Pre-test

A two-day hands-on-training on data tools was conducted for supervisors and data collectors on the use of data tools, RTI surveillance system, data collection, storage, transfer, processing and dissemination. After the training and one month before the commencement of the study, the tools were pretested on RTI patients at the health facilities selected for the pilot study, for both interviewer and interviewee comprehension of the variables, acceptability, simplicity of use and time of administration. The identified corrections were made to the final draft of the questionnaire.

Ethical considerations

Ethical approval was granted by the Kaduna State Ministry of Health and Human Services Institution Review Board with reference number MOH/ADM/744/Vol.1/366. Participants or relatives were duly informed and verbal or written consent or assent was obtained before the interview. Participant privacy and confidentiality was maintained, and data were anonymised before analysis.

Results

There are 31 variables on the individual case-based forms. Variables like the use of alcohol, site of injury, type of injury, Abbreviated Injury Scale (AIS) score, and International Classification of Diseases (ICD) codes for diagnosis were not collected for more than 20% of the participants and were exempted from final analysis. The overall timeliness and completeness of RTI reporting was 100% and 83.2%, respectively. Furthermore, 110 records were duplicated and were deleted from the final analysis. Table 1 shows the RTI surveillance indicators monitored during the study. In overall, 667 road traffic crashes and 1,062 individuals had RTI during the study period. Of the 1,062 injured, 498 (46.9%) were seen at the health facility, 381 (35.9%) reported by the Police MTD, and 183 (17.2%) were reported by FRSC

Table 1

Road traffic injury surveillance indicators at Kaduna Metropolis, Kaduna Nigeria. February – July 2016

Indicators	Feb.	Mar	Apr	May	Jun	Jul	Total
Total number of crashes	113.0	127.0	96.0	133.0	100.0	98.0	667.0
Total number of the injured	168.0	228.0	172.0	190.0	148.0	156.0	1062.0
Prop. of injured from non-collision crash* (%)	26.8	5.5	12.2	6.1	8.0	5.2	10.8
Prop. of injured evacuated by police (%)	27.4	25.0	43.6	55.3	50.0	15.4	35.9
Prop. of injured evacuated by FRSC (%)	26.8	13.6	19.8	17.9	14.2	11.5	17.2
Prop. of injured with safety element (%)	19.6	18.9	23.3	10.5	9.5	7.7	15.3
Prop. of injured with fatal injury (%)	16.1	10.1	10.5	9.5	9.5	6.4	10.4
Prop. of fatally injured that died at Health facility (%)	51.9	21.7	77.8	83.3	100.0	70.0	62.7
Timeliness of reporting	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Completeness of reporting	61.0	68.0	70.0	100.0	100.0	100.0	83.2
*Crash involving vehicles without object of collision but occurred on public roads							

In Table 2, the median age (range) of the injured was 32 (1–95) years, males' gender was 844 (79.5%) and 373 (35.2%) were in age group 25 to 34 years and most affected.

Characteristics Of The Injured In Road Traffic Crash

Table 2
**Characteristics of the injured from road traffic crash, Kaduna metropolis,
 Kaduna Nigeria, February – July 2016.**

Characteristics	Fatal/severe	Total
Age (Years)		
< 15	57	5.4
15–24	182	17.1
25–34	374	35.2
35–44	256	24.1
45–54	112	10.5
> 54	81	7.6
Sex		
Male	844	79.5
Female	218	20.5
Occupation		
Trader	209	19.7
Student	204	19.2
Driver of motor vehicle	112	10.6
Artisans	76	7.2
Driver of motorcycle	86	8.1
Civil servant	51	4.8
Professionals-Doctors, Engr, etc.,	51	4.8
Military/Paramilitary	49	4.6
Unemployed	47	4.4
Housewife	40	3.8
Farmer	41	3.9
Driver of three-wheel vehicle	34	3.2
Pupils	26	2.5
Technicians	20	1.9
Others	15	1.4

Characteristics	Fatal/severe	Total
Mode of travelling		
Passenger in commercial vehicle	217	20.3
Passenger in private vehicle	199	18.7
Motorcycle driver	185	17.4
Pedestrians	181	17.0
Passengers in three-wheel vehicle (Commercial)	80	7.5
Passengers on Motorcycle	69	6.5
Driver in commercial vehicle	50	4.7
Driver in private vehicle	50	4.7
Driver in three-wheel vehicle (Commercial)	24	2.3
Passenger at the back of truck	6	0.6
Passenger hanging on moving vehicle	1	0.1
Pedal cyclist	1	0.1

Passengers in a commercial and private vehicle were most affected accounting for 217 (20.3%) and 199 (18.7%) of the injured respectively.

Characteristics of the road traffic crashes, post-crash management and outcome

In Table 3, of the injured, good Samaritans or road users evacuated 469 (44.2%), police MTD 381 (35.9%), and FRSC, 183 (17.2%). The fatally injured were 110 (10.4%), 380 (35.8%) had moderate injury, and 41 (3.9%) died at crash site. Among the 110 with fatal injury, 69 (62.7%) were rescued alive and transferred to the reporting health facilities but later died. Among the 252 motorcycle riders, 26 (10.3%) used helmet and 136 (26.4%) of the 516 vehicle users used seat belt.

Table 3

Characteristics of the crash, site evacuation and injury severity of road traffic injury cases at Kaduna Metropolis, Kaduna Nigeria. February – July 2016.

Road crash Injury severity				
Characteristics	Mild n (%)	Moderate n (%)	Severe/Fatal n (%)	Total n (%)
Crash time				
00:00–5:59 AM	23 (74.2)	5 (16.1)	3 (9.7)	31 (2.9)
6:00–11:59 AM	117 (42.9)	128 (46.9)	28 (10.3)	273 (25.7)
12:00–17:59 PM	278 (61.6)	135 (29.9)	38 (8.4)	451 (42.5)
18:00–23:59 PM	154 (50.2)	112 (36.5)	41 (13.4)	307 (28.9)
Crash at Metropolis centre				
Yes	330 (60.0)	171 (31.1)	49 (8.9)	550 (51.8)
No	242 (47.3)	209 (40.8)	61 (11.9)	512 (48.2)
Type of road				
Four lanes	323 (51.7)	226 (36.2)	76 (12.2)	625 (58.9)
Two lanes	249 (57.0)	154 (35.2)	34 (7.8)	437 (41.1)
Evacuated by				
Police	181 (47.5)	154 (40.4)	46 (12.1)	381 (35.9)
F.R.S.C	83 (45.4)	64 (35.0)	36 (19.7)	183 (17.2)
Other road users	300 (64.0)	143 (30.5)	26 (5.5)	469 (44.2)
Relatives	8 (27.6)	19 (65.5)	2 (6.9)	29 (2.7)
Received first aid in nearby health facility				
Yes	7 (20.0)	22 (62.9)	7 (17.1)	36 (3.4)
No	565 (57.3)	398 (36.3)	63 (6.4)	1026 (96.6)
Total	572 (53.9)	380 (35.8)	110 (10.4)	1062 (100)

Following the road traffic crash, 572 (54.0%) were treated and discharged from the Accident & Emergency ward, 333 (31.3%) were admitted for longer hospital stay, 26 (2.4%) were referred to tertiary or specialized health facility for further treatment, and 21 (2.0%) left the hospital prior to discharge.

Factors Associated With Moderate To Fatal Injury

Table 4 shows factors associated with moderate to fatal injury. Being a driver or operator of a vehicle during the crash was associated with having a moderate to fatal RTI (OR 1.7, C.I. 1.3–2.2, $p = 0.000$) when compared to being a passengers or pedestrians. Moderate to fatal injury was associated with victims that were evacuated by police or FRSC (OR 1.8, C.I. 1.4–2.4, $p = 0.000$) than those evacuated by good Samaritans. And receiving first aid care in a nearby health facility before transferring to the reporting health facilities were 5 times more likely to associate with moderate to fatal injury (OR 5.1, C.I. 2.2–11.7, $p = 0.000$). The injured, aged < 35 years were 50% (OR 0.5, C.I. 0.4–0.7, $p = 0.000$) less likely to associate with moderate to fatal injury and being injured in a crash within the metropolis were 40% less likely to be moderate to fatal injury (OR 0.6, C.I. 0.5–0.8, $p = 0.000$).

Table 6
Associated factors with moderate to fatal injury in Kaduna Metropolis, Kaduna Nigeria. February – July 2016.

Moderate to fatal injury					
Risk Factors	Yes	No	Total	OR (95% C.I)	p value
Age < 35 years					
No	248 (50.6)	201 (35.1)	449 (42.3)	ref	
Yes	242 (49.4)	371 (64.9)	613 (57.7)	0.5 (0.4, 0.7)	0.000
Sex					
Female	91 (18.6)	127 (22.2)	218 (20.5)	ref	
Male	399 (81.4)	445 (77.8)	844 (79.5)	1.3 (0.9, 1.7)	0.166
Crash at metropolis centre					
No	270 (55.1)	242 (42.3)	512 (48.2)	ref	
Yes	220 (44.9)	330 (57.7)	550 (51.8)	0.6 (0.5, 0.8)	0.000
Travelling in a commercial or private vehicle					
Pedestrian	89 (18.2)	92 (16.1)	181 (17.0)	ref	
Commercial	157 (32.0)	220 (38.5)	377 (35.5)	0.7 (0.5, 1.1)	0.113
Private	244 (49.8)	260 (45.4)	504 (47.5)	1 (0.7, 1.4)	0.929
Status during the crash					
Passengers	234 (47.8)	337 (58.9)	571 (53.8)	ref	
Drivers/operators	167 (34.1)	143 (25.0)	310 (29.2)	1.7 (1.3, 2.2)	0.000
Pedestrians	89 (18.2)	92 (16.1)	181 (17.0)	1.4 (1.0, 1.9)	0.060
Type of road					
Less four lane road	188 (38.4)	249 (43.5)	437 (41.1)	ref	
Four lane road	302 (61.6)	323 (56.5)	625 (58.9)	1.2 (1.0, 1.6)	0.100
Use safety element					
Yes	82 (16.7)	80 (14.0)	162 (15.3)	ref	
No	408 (83.3)	492 (86.0)	900 (84.7)	0.8 (0.6, 1.1)	0.247
Received first aid at health facility					
No	461 (94.1)	565 (98.8)	1026 (96.6)	ref	

Moderate to fatal injury					
Yes	29 (5.9)	7 (1.2)	36 (3.4)	5.1 (2.2, 11.7)	0.000
Evacuated by Police or FRSC					
No	190 (38.8)	308 (53.9)	498 (46.9)	ref	
Yes	300 (61.2)	264 (46.2)	564 (53.1)	1.8 (1.4, 2.4)	0.000

Discussion

This study demonstrates the feasibility of a multidisciplinary and integrated RTI surveillance system in Kaduna Nigeria. Similar studies have reported the integration of two or more RTI surveillance data [19–21]. The integration of RTI surveillance data from multidisciplinary sources will strengthen the surveillance system [20, 21]. For example, RTI data collected from single sources like the police, FRSC, emergency services, and morbid anatomy or pathology department are good for providing the number of fatalities, pre-hospital care, on-the-spot deaths, intoxication and use of safety element which may not be available in hospital records [22]. This study shows that multidisciplinary RTI data sources can be integrated and used for action on RTI prevention in a low resource setting like Kaduna Nigeria. This will obliterate the disadvantages associated with a single source RTI data.

Succinctly, in this study, FRSC and the police only reported 17% and 36% of the people injured, respectively. This discrepancy has been shown to exist between organizations [23], due to their different focus of data collection. Therefore, relying on data from these agencies for planning on holistic RTI prevention may be defective [23, 24]. Though a study in Saudi Arabi attributed the differences to the use of different data tools, data collection methods [24], the organizational context for which data are collected and used. But this was not the case in this study as a single data collection tool was used and for a single purpose of surveillance and not for litigations or insurance. Other defects of a sole RTI data source was under-detection by as shown in Iran [23]. The under-reporting of RTI was shown in a study the police that under-reported less severe RTI cases [19, 21]. Sometimes, the reporting agency undermines the severity of the RTI for example, less severe cases reported by the police and insurance [25] were fatal injury at the hospital [21]. The implication of the under-reporting greatly impacts on the current estimates of RTI burden and misguided prioritization of preventative initiatives [21].

A comprehensive data collection system for road traffic accidents should cover all the data collection sources [23] like the police, FRSC and Ambulance services that clearly records RTC description, and health facilities that provided care for the injured [25]. In this study, all the three sectors used similar tools that comprise the variables of interest to all sectors adapted from their original data tool. But variables like the use of alcohol, site of injury, type of injury, Abbreviated Injury Scale (AIS) score, and International Classification of Diseases (ICD) codes for diagnosis were not adequately recorded. This may be due to the lack of training on how to report these variables. One key factor hindering multidisciplinary RTI surveillance was database linkage [21] and merging of multi-source RTI data to avoid duplication and

wrong coding. This was demonstrated in the study from the Dominican Republic where 20% of data recorded were duplicated [25] compared to more than 9% duplicated records experienced in this study. In this study, a deterministic approach of data linkage was used but a semiautomated approach has been recommended to reduce data duplication [25].

Majority of the road traffic crash victims in this study were between the ages of 15–44 years with male preponderance. Similar to previous studies in Nigeria, this age group were in years of productivity resulting in high economic loss [26]. Most of the young population in this study were engaged in the driving of either the three-wheel vehicles or motorcycles for commercial purposes and found to have a mild injury. This was different from a study that found that most fatal RTI cases were in this age group [11] that can be prevented if safety elements were used. The use of helmet by motorcycle riders reported in this study was lower than 24.7% reported for the motorcyclist in another Nigeria study but far better than some previous studies [7, 27]. It further strengthens the fact that the use of safety elements is poor in Nigeria. However, the use of safety belt in this study was better than previous studies, 26.4% of vehicle users compared to 11% – 13% use seat belts during the crash [11, 26, 28]. This calls for enforcement of the consistent use of these safety elements and other preventive measures of road traffic injury in Nigeria.

Some limitations to this study were the inability of reporting sites to adequately report variables like the use of alcohol, injury sites, Abbreviated Injury Scale (AIS) score, diagnosis of injury type using International Classification of Diseases (ICD) codes by the reporting sites. This was due to a lack of training on these variables. Though deterministic linkage approach was used to link data and identify data duplication for deletion. This may not be perfect and could have been avoided if a citizen's unique national identification number is used but was not operating in Nigeria. Also, this study may not have reported all road traffic crashes in Kaduna metropolis during the study as some mild RTI might have not been caught by this integrated surveillance system but the system is more reliable to generate a robust RTI data for action than RTI data from a sole agency.

Conclusion

This study confirmed the feasibility of an integrated and multidisciplinary RTI data sources for injury surveillance in low resource setting like Kaduna metropolis in Nigeria. This pilot test can be scale up and will generate robust data to monitor and evaluate the progress of well-tailored interventions to improve RTI surveillance and prevention. This will improve the identification, collection, and reporting of RTI surveillance data needed for action to meet the SDG 3.6 target.

List Of Abbreviations

AIS - Abbreviated Injury Scale;

A & E – Accident and Emergency

BDTH – Barau Dikko Teaching Hospital

FRSC - Federal Road Safety Corps

ICD - International Classification of Diseases

LMIC - Low-and Middle-Income Countries

MTD – Motor Traffic Division

NARH – Nigerian Army Reference Hospital

RTA – Road Traffic Accident

RTC – Road Traffic Crash

RTI - Road Traffic Injury

SDG – Sustainable Development Goal

SGCH – St. Gerald Catholic Hospital

WHO - World Health Organizations

Declarations

Ethics approval and consent to participate

Ethical approval referenced MOH/ADM/744/Vol.1/366 was obtained from the Ethical Review Committee of Ministry of Health, Kaduna State, Nigeria. The approval was granted by the FRSC, Kaduna State Police motor traffic division and the administrators of the three major health facilities in Kaduna metropolis.

Consent for publication: Not applicable

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declared that they have no competing interests.

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Authors' contributions:

OJB conceived the study and was responsible for its design, data collection, analysis, and interpretation; and writing the manuscript.

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