Original Article

Epidemiological profile and mapping geographical distribution of road traffic accidents reported to a tertiary care hospital, Mangaluru using quantum geographic information system (QGIS)

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Abstract

Background: The worldwide annual average of road traffic accident (RTA) is approximately 7,00,000 and out of that 10% occur in India. It is estimated that in India, by 2020 RTA would have its fatal effect on about 5,50,000 people annually. This study was conducted to describe the epidemiological profile and spatial distribution of RTAs using quantum geographic information system (QGIS) software reported to a tertiary care hospital in Mangaluru. **Methods:** It was a record based descriptive study conducted in a tertiary care hospital of Mangaluru. The complete enumeration of all RTAs reported to Yenepoya Medical College Hospital (YMCH) during January 2018 to June 2018 was followed. QGIS software was used to depict spatial distribution of the road traffic accident on open street map. **Results:** A total of 180 cases of RTA was reported to the hospital during the study period, of which 86.1% were males. The mean age of the study participants was 33.99 years. The lower limb was the most common site of injury (48.3%) and fractures were the most common type of injury (55.6%). As per the type of RTA majority (55.6%) was motorbike accidents and drivers (47.8%) were the most common RTA victims. Predominantly RTAs occurred during evening hours of the day (40%). QGIS plotting revealed clustering of RTAs in Dakshina Kannada district, North Karnataka and neighboring districts of Kerala. **Conclusion:** QGIS can be used at the health care system level as an important tool to plan preventive measures and early intervention measures at the site of RTA.

Keywords: Epidemiological profile, QGIS, RTA, spatial distribution

Introduction

Worldwide one of the leading causes of morbidity and mortality is Road Traffic Accidents (RTAs) accounting for more than one million deaths per year.[1]Accident is an "occurrence in a sequence of events which usually produces unintended injury, death, and property damage".[2]

RTAs are defined as a collision involving at least one vehicle in motion on a public or private road that results in at least one person being injured or killed.[3]

It has been predicted that by 2020 global death rates from RTAs will rise by 67% due to the effect of rapid population growth, industrialization, and an increase in road vehicles.[4]

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With increasing population, increasing vehicular density, and with poor infrastructure, the 21st century is loaded by RTAs.[3]

The worldwide annual average of RTA is approximately 7,00,000 and out of that 10% occur in India. It is estimated that in India, by 2020 RTA would have its fatal effect on about 5,50,000 people annually.[5]

The global status report on road safety 2015 reflects the information from 180 countries and it indicates that worldwide the total number of road traffic deaths has raised ground at 1.25 million per years, with the highest road traffic fatality rates in low income countries.

In 2018, seventeen countries have aligned at least one of their laws with best practice on seat belts, no drinking and driving, speed, motorcycle helmets, or child restraints.[6]

The World Health Organization predicts that road traffic injuries would become the sixth commonest cause of death by the year 2020 and the fifth by 2030.[4]

Understanding the epidemiology of RTAs and profile of injury is essential in the planning of preventive strategies and establishment of health care facilities offering appropriate services.

Geographic Information System (GIS) is a software that lets users to visualize, question, analyze, and interpret geographical data to help them understand and solve the issues regarding the relationships and patterns. It enables identify high risk areas that seek attention and call for action. The use of GIS will facilitate understand the spatiotemporal clustering of road traffic accidents. The compendious information extracted from QGIS elucidates the geographic accessibility to closest healthcare facilities in the terms of distance. The increased frequency of RTAs in a particular area calls for necessary preparedness to deal with trauma cases.[7]A study was conducted by Lakshmi *et al.*, to describe the epidemiological profile of RTAs reported to a tertiary care hospital. The study also describes the spatial distribution of RTAs using QGIS software.[8]

Materials and Methods

This was a record based descriptive study conducted in a tertiary care hospital of Mangaluru. The hospital is located in the southern part of Mangaluru city, Dakshina Kannada District, Karnataka state. The complete enumeration of all RTAs reported to Yenepoya Medical College Hospital (YMCH) during January 2018 to June 2018 was followed. The Institutional Ethics Committee approval was obtained for conducting the study (Protocol number: 2018/130, approved on 26-07-2018).

The case sheets of RTAs reported to the hospital during January 2018 to June 2018 were obtained from the medical record department of YMCH. The data was abstracted using a pre designed, pre tested, and semi-structured data abstraction tool. The information was collected on socio demographic profile of the patient (age, gender), profile of injuries (time of accident, site, and type of injury), and place of accident. The data was entered in Microsoft (MS) excel sheet. The data was analyzed using statistical package for social sciences (SPSS) (23.0 IBM, New York, USA). The descriptive statistics was reported as mean (SD) for continuous variables and frequency (proportions) for categorical variables. This study used an Open Source QGIS (QGIS, 2.18 QGIS Development Team) to depict spatial distribution of the road traffic accident on an open street map. The district-wise distribution of the road traffic accidents is depicted using QGIS software.

The permission to carry out the study was obtained from hospital authorities.

Results

A total of 180 cases of RTAs were reported to the hospital during the study period.

Majority (45%) of the RTA victims belonged to the age group of 19–39 years. The mean age of the study participants was 33.99 years (±17.37). Among the RTA victims, majority (86.1%) were males, and 13.9% were females.[Table 1].

Table 1: Socio demographic details of the road traffic accident victims (*n*=180)

Socio-demographic variables		Number (Percent)
Age groups (years)	≤18	34 (18.9)
	19-39	81(45.0)
	40-59	47 (26.1)
	≥60	18 (10.0)
Gender	Male	155 (86.1)
	Female	25 (13.9)

Table 2: Profile of road traffic injuries (*n*=180)

Profile of injuries		Number (Percent)
Site of injury	Head, Neck and Face	77(42.8)
	Upper limb	44(24.4)
	Thorax	4(2.2)
	Lower limb	87(48.3)
	Abdomen	1(0.6)
	Pelvic region	5(2.8)
	Back	4(2.2)
Type of injury	Laceration	33(18.3)
	Bruise	42(23.3)
	Contusion	8(4.4)
	Sprain	7(3.9)
	Concussion	5(2.8)
	Fracture	100(55.6)

* MULTIPLE RESPONSES

Among the study participants, majority (48.3%) had lower limb injury followed by head, neck, and face (42.8%). Among the participants, majority (55.6%) had fractures followed by bruise (23.3%) [Table 2].

As per type the of RTA, majority (55.6%) was motorbike accidents and another 17.2% were pedestrian accidents.[Table 3].

The RTA victims included drivers (47.8%), pedestrians (28.9%), and pillion riders (16.1%), information was missing in 13 case sheets and (3.9%) of the victims were under the influence of alcohol at the time of RTA. The study reported fatal outcome in (3.3%) of the RTAs. The complications reported among the road victims were monoplegia (3), paraplegia (2), hemiplegia (1), facial palsy (3), and neurological deficit (2).

Figure 1 depicts the number of RTA by time period of the day. Among the RTAs, majority (40%) occurred during the evening hours of the day.

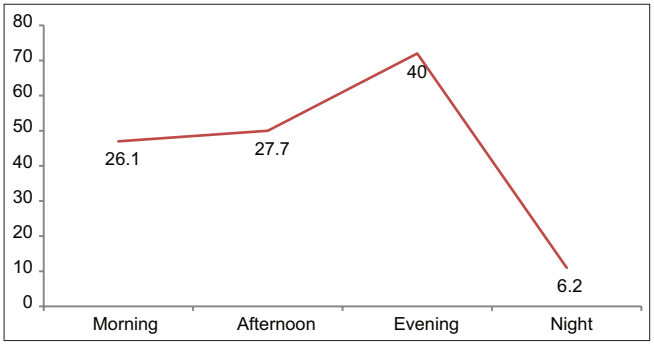

Figure 1: Percent of road traffic accidents by time period of the day (N = 180)

The distribution of RTA is displayed using QGIS [Figure 2]. Among 180 RTAs reported to YMCH, the clustering of RTAs was seen in and around YMCH hospital, belonging to Dakshina Kannada district, North Karnataka and neighboring districts of Kerala.

The map depicts the area wise distribution of RTAs in Mangaluru and clustering of cases is seen in localities such as Madaninagar, Thokkottu, and Derlakatte, which are in the vicinity of YMCH[Figure 3].

Discussion

Among the 180 road traffic victims, majority (45%) of them were belonging to the age group of 19–39 years. Similar findings were found in the study done by Ganveer GB *et al.*,[9] Kotresh M *et al.*[10] and Thalappillil Mathew Celine *et al.*[2] It was found that middle aged road users are the most common victims of RTAs. This can be attributed to the fact that they are more mobile, go for work, and keep themselves outdoor most of the hours.

Out of all the cases reviewed, majority (86.1%) belonged to male gender. The increased number of males being involved

Table 3: Description of road traffic accidents (*n*=180)

Description of road traffic accidents		Number (Percent)
Type of RTA	Pedestrian	31 (17.2)
	Bicycle	6 (3.3)
	Motorbike	100 (55.6)
	3-Wheeler	16 (8.9)
	4 -Wheeler Light Motor	15 (8.3)
	4 -Wheeler Heavy Motor	11 (6.1)
	Others	1 (0.6)

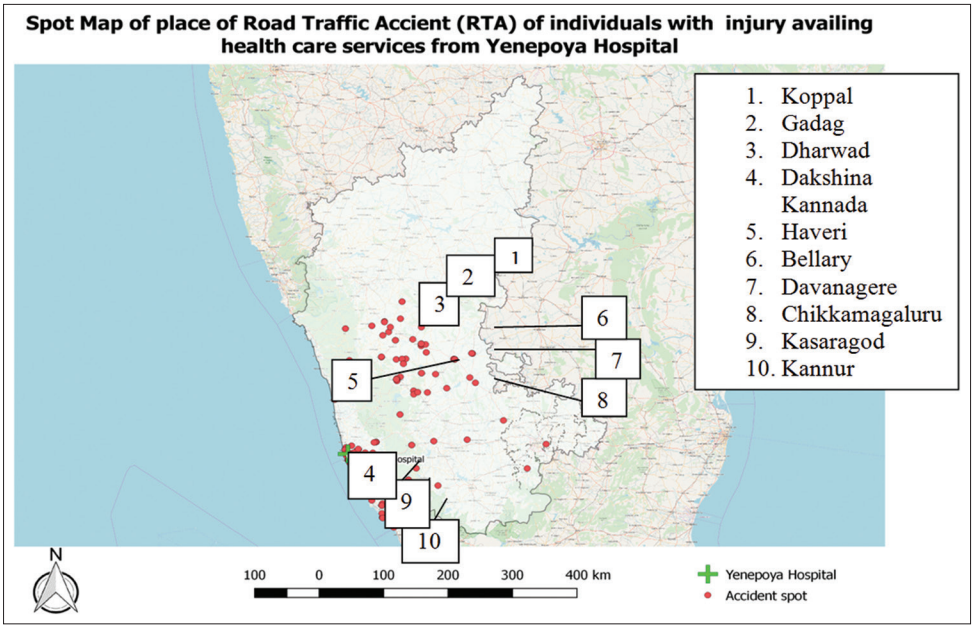

Figure 2: Spot map of place of RTA of individuals with injury availing health care services from YMCH

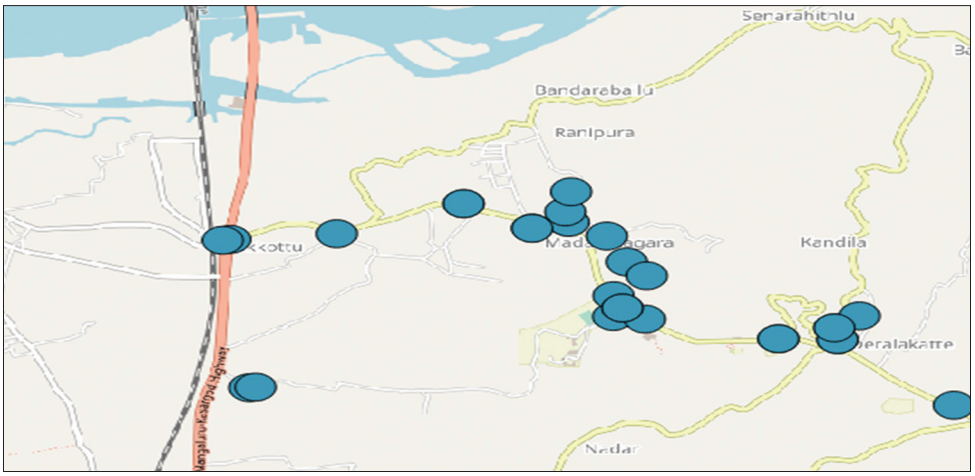

Figure 3: Spot map of road traffic accident (RTA) in Mangaluru

may be attributed to their occupation. Being involved in RTA leads to loss of productive days of work and incurring out of pocket expenditure on health care management thus pushing the family into financial stress. Similar observations are reported from studies conducted in Chithradurga,[10] Tirupati,[11] and Delhi.[12]

In our study, the majority of the RTA victims were drivers (47.8%) followed by pedestrians (28.9%) and pillion riders (16.1%). Similar results were found in the study done by Kotresh M *et al.*,[10] where the majority of the RTA victims were drivers. Hadaye RS *et al.* conducted a study which also showed similar results. They found that 47.9% of the victims were pedestrians and 12.1% were pillion riders.[13]Among the RTA victims 3.9% were under the influence of alcohol at the time of RTA. In a study done by Sigh A *et al.*[14] and Kotresh M *et al.*,[10]18.01% and 14.8% were under the influence of alcohol at the time of RTA. Whereas, in a study done by Hadaye R S, the proportion of victims under the influence of alcohol was higher than in the current study i.e. 21.5%.[13] The study reported fatal outcome in (3.3%) of the RTAs. This finding is similar to a study done in Kerala (3.25%)[2] and Chithradurga (3.25%).[10]

Among the participants, majority (40%) of the RTA occurred during the evening hours of the day. This finding is similar to the study done by Biswas *et al.*[15] and Kotresh *et al.*,[10] where majority of the RTAs occurred during evening hours. Le K G *et al.* in their study were able to establish a relationship between the frequency of accidents and their time of occurrence and as per their study, the frequency was higher between 2:00 pm and 3:00 pm and also between 7:00 pm and 11:00 pm.[16] This might be attributed to increase in the activities on the road during evening hours. Moreover, it is speculated that people have reduced efficiency and focus towards the end of the day. Factors such as insufficient road lighting leading to poor visibility of roads and absence of traffic signals also contribute to RTAs during the evening hours.

The spatial distribution of RTAs was depicted using QGIS. Among 180 RTAs reported to YMCH, the clustering of RTAs was seen in and around YMCH hospital, belonging to Dakshina Kannada district and neighboring districts of Kerala. The clustering of cases is observed among those reported from north Karnataka and some parts of Kerala. This may be attributed to the proximity of these areas to the study site. They may have also approached this tertiary care hospital to avail specialty services. The RTAs reported to YMCH from Davanagere, Haveri, Bellary, and Chikamagaluru might be due to the health camps conducted in these districts by YMCH and the provision of healthcare facilities at subsidized rates. GIS was used by Le KG *et al.* at Hanoi, the area of study in Vietnam, and here hotspots were noted in the center of Hanoi, which has many cross roads and also along the National Highway (NH)-1A.[16] Achu AL *et al.* conducted a similar study in Thrissur, Kerala using a tool that identifies spatial clusters or hot spots and found clustering of accidents in Thrissur town.[17]

The key message of this study suggests the use of QGIS to depict the spatial distribution of RTA cases. We may not be able to generalize the study findings as it is a record based study from a single site, yet this could play out as strength of this study. Increased cases clustering about a specific region could be the cue to venture into the regional factors that might have led to the RTAs. Quite often, necessary accident preventive measures are implemented regionally by traffic officials for example, speed breakers constructed at places where deemed necessary. Therefore, in view of safeguarding lives, this could be advantageous if used by the regional traffic police departments to make necessary changes or increase vigilance.

What better way to handle RTA cases than to provide speedy and necessary primary care integrated with emergency care? With the exact location of hotspots for RTAs, nearest primary health centers or health facilities can be better equipped to manage trauma cases to provide quick and efficient care for the injured.

Considering the results obtained from this study, many young adult males succumbed to injuries following RTAs and this could be attributed to the fact that most men drive to and from

work. This further probe us to find out if these accidents can be linked to reasons such as poor adoption of personal protective measures, inappropriate driving, geographical factors, and lighting. The use of QGIS to identify hotspots is quite unique and constructive in a manner such that it could help manage or alleviate the frequency of accidents by help making amends. Most importantly, providing primary health care at the appropriate place and at the appropriate time can save many lives especially in emergencies which could be the next step after having identified the places of clustering.

Conclusion

We were able to describe the epidemiological profile of the RTAs and depict the spatial distribution and clustering of the cases using QGIS. The epidemiological determinants will help to plan tailored interventions and QGIS can be used at the health care system level as an important tool to plan preventive measures and early intervention measures at the site of RTA.

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Conflicts of interest

There are no conflicts of interest.

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