Road traffic injuries and fatalities in Dominican Republic, 2017-2021: a neglected epidemic

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Abstract

Background. Road traffic injuries and fatalities are a major public health concern in the Dominican Republic (DR). Despite efforts to improve road safety, the number of deaths and injuries remains high. This study aimed to analyze and describe the epidemiology of road traffic fatalities and injuries in the country from 2017 to 2021.

Population and Methods. Data on road traffic injuries and fatalities were collected from the National Police Department, the Ministry of Health, and hospitals across the country. Descriptive statistics were used to analyze the data, including age, gender, and type of vehicle involved in crashes that resulted in injuries.

Results. During the study period, there were 513,629 road traffic injuries and 14,692 fatalities in the DR, a ratio of 34.9 injured per each deceased person. The majority of those involved in crashes were males aged between 20-39 years old. Motorcycles were the most common type of vehicle involved in crashes. There was a significant reduction in the number of injuries and deaths in 2020, likely due to mobility restrictions during the COVID-19 pandemic.

Discussion. Road traffic injuries and fatalities in the DR are a neglected epidemic that requires immediate attention. Improving road safety measures, targeting high-risk groups, and implementing safer pedestrian infrastructure are essential to reducing the number of injuries and deaths on the country's roads.

Keywords: road traffic injuries, road traffic fatalities, motorcycles, epidemiology, Dominican Republic

Introduction

Injuries and trauma from traffic injuries are a major cause of mortality and disability worldwide. It is estimated that annually between 20 and 50 million non-fatal injuries and 1.3 million related deaths occur worldwide [1]. These injuries represent the eighth leading cause of death in the world among people of all ages and the leading cause among children and young adults aged 5-29 years [2]. Road traffic injuries have become one of the main causes of hospitalization, socioeconomic losses, and years of life adjusted for disability worldwide [3]. According to the World Health Organization, in 2019 the mortality rate from road traffic in the world was 17 deaths/100,000 inhabitants and in the Americas region, it was 15.3 deaths/100,000 inhabitants [4]. To address the problem, the United Nations declared a Decade of Action for Road Safety 2021-2030, with the goal of halving the number of deaths and injuries from traffic injuries during this period [5].

Most deaths related to road traffic injuries worldwide occur in low- and middle-income countries, where the lack of accurate and reliable information hinders the determination of the magnitude of the problem [6], resulting in lower priority given to road safety compared to other public health challenges. The World Bank estimates that in these countries, the potential growth of Gross Domestic Product (GDP) per capita could decrease by 7%-22% over the coming years [7]. The Dominican Republic (DR), a country in the Latin America and Caribbean region, has the highest rate in the world with a rate of 64.6/100,000 population, surpassing the global rate by 3.8 times and the regional rate by 4.2 times. Road traffic injuries represent the fourth cause of death and disability in the DR for all ages. The road safety situation in the DR is a serious public health problem that implies a social cost of 2.2% of the annual GDP [9].

Previous studies have highlighted the need to address the issue of road traffic injuries due to the high burden of disease in the country [10], but very few have focused on describing the epidemiological situation, making it a "neglected epidemic" [11]. In order to develop appropriate public health policies

and interventions to reduce and prevent road traffic injuries, it is important to characterize their magnitude and describe high-risk populations. The main objective of this study is to explore the epidemiology of deaths and injuries from traffic injuries in the DR Dominican Republic between 2017 and 2021.

Population and methods

This was a descriptive study based on publicly available data from the Permanent Road Safety Observatory (OPSEVI) of the National Institute of Land Transport and Traffic (INTRANT) of the DR between 2017 and 2021 [12].

Study setting

The Dominican Republic is a high-middle income country [2021-GDP per capita: USD $8,476.8; 2019. Current health expenditure (% of GDP): 5.9%]. It has a population of 11.1 million inhabitants with a life expectancy of 73 years [13]. The country is divided into 31 provinces and a National District (capital city). The vehicle density is 106.7 vehicles per square kilometer, and the registered vehicle density is 489.1 vehicles per 1.000 population, with motorcycles being the main registered vehicle. In recent years, the most common traffic violation is riding a motorcycle without a required helmet. INTRANT is the main agency in charge of regulating mobility, land transport, traffic, and road safety in the Dominican Republic.

Data sources

The OPSEVI integrates and consolidates data from eight institutions related to road safety: Ministry of Public Health, General Directorate of Road Safety and Land Transport, National Institute of Forensic Sciences, Military and Police Commission of the Ministry of Public Works and Communications, Dominican Institute of Prevention and Protection of Occupational Risks, Superintendency of Health and Occupational Risks, Driver's House, and the Motorist Center. General road safety data (vehicle fleet and main traffic violations) and the number of road traffic injuries (RTIs) and road traffic fatalities (RTFs) were

collected according to operational definitions: any accident involving at least one moving road vehicle on a public or private road to which the public has access, resulting in at least one person injured or killed, including deaths within 30 days after the accident [14]. RTFs were stratified by gender, age, road user, type of accident, location, and time of the accident.

Data analysis

We conducted a descriptive analysis to summarize the RTIs and RTFs, calculating frequency measures for the variables of interest, including prevalence and mortality rate compared by year based on national population estimates [15]. Patterns of mortality due to traffic injuries were studied through a geo-temporal analysis by year and province where the accident occurred using the Datawrapper tool. The statistical analysis was performed using Microsoft Excel. We used the proportion hypothesis test to measure differences between groups. A two-sided *P*-value of <0.05 was considered statistically significant.

Protection of Human Subjects

This study was deemed exempt from ethical review by the Institutional Review Board of the Dr. Hugo Mendoza Pediatric Hospital, as it is based on publicly available and open access unidentified data repositories.

Results

Situation of road traffic injuries and deaths

A total of 513,629 injuries and 14,692 deaths related to traffic injuries were recorded in the Dominican Republic between 2017 and 2021. The prevalence of RTIs increased from 96.2 deaths per 10,000 inhabitants in 2017 to 105 in 2021. However, there was a 9.4% increase in the number of fatalities from 2020 to 2021, with a total of 2,967 fatalities in 2021. The highest number of RTIs in the entire series occurred in 2019 with 112,177 injuries and the lowest in 2020 with 83,520 (Table 1).

Table 1. Distribution of road crash fatalities and injuries, Dominican Republic, 2017-21

Variable	2017	2018	2019	2020	2021
Injuries					
Number of Road Traffic (RT) injuries	97,821	109,705	112,177	83,520	110,406
Relative change ((SDG Target 3.6= -50%)	-7.6%	12.1%	2.3%	-25.0%	32.1%
RTI rate/10,000 population	96.2	106.9	108.3	79.9	105
RTI/10,000 vehicles	239	252	242	172	214
Deaths					
Number of RT deaths	2,804	3,006	3,204	2,711	2,967
Relative change (SDG Target 3.6= -50%)	-10%	7.2%	6.5%	-15.3%	9.4%
Death rate/100,000 population	27.6	29.3	30.9	25.9	28.2
Death rate/10,000 vehicles	6.8	6.9	6.9	5.6	5.8

Source: INTRANT (2021)

Socio-demographic profile of road traffic fatalities

Among road traffic fatalities, the proportion of males was higher (87.6%) giving male to female ratio of 7:1. The highest numbers of victims occur in the 20-39 age group (50%) followed by 40-59 years (24.3%). Motorcycles were involved in the majority of crashes (58.0%), followed by pedestrians (12.4%). The most common type of road accident was a collision, accounting for 64.0% of all injuries, run over (16.6%), slide (14.6%), crashing (3.6%) and other (1.1%) (Table 2).

Temporal distribution of road traffic fatalities

A growing trend in fatal road traffic injuries was observed per month during the study period. The average monthly RTF was 244.8, with a standard deviation of 15 deaths. The highest number of RTF was observed in December 2017, 2018, and 2020 with 270, 294, and 290 deaths respectively. However, in 2019 and 2021, March had the highest number of deaths with 287 and 273 deaths respectively (Figure 1).

Table 2. Frequency distribution of road traffic fatalities by demographic characteristics, Dominican Republic, 2017-2021 (n= 14,692)

Variable	N	(%)	95% Confidence interval
Gender [a]			
Male	12,861	87.6	86.6-88.6
Female	1,813	12.4	11.3-13.3
Age (years) [b]			
0-19	1,834	13.2	11.2-15.1
20-39	6,959	50.0	48.4-51.6
40-59	33,84	24.3	22.8-25.8
60-69	951	6.8	6.0-7.6
≥70	778	5.6	4.8-6.3
Road user catogry [c]			
Motorcycles	7,854	58.0	56.9-59.0
Pedestrians	1,680	12.4	11.8-13.1
Four-wheeled vehicles	1,162	8.6	8.1-9.1
Trucks	456	3.4	3.1-3.8
Bus	112	0.8	0.6-1.1
Other vehicles	2,288	16.9	16.2-17.7
Types of road injuries [d]			
Collision	7,383	64.0	63.2-64.8
Run over	1,914	16.6	15.9-17.14
Slide	1,689	14.6	13.9-15.3
Crashing	421	3.6	3.2-4.0
Other	129	1.1	0.9-1.4

Source: INTRANT (2021)

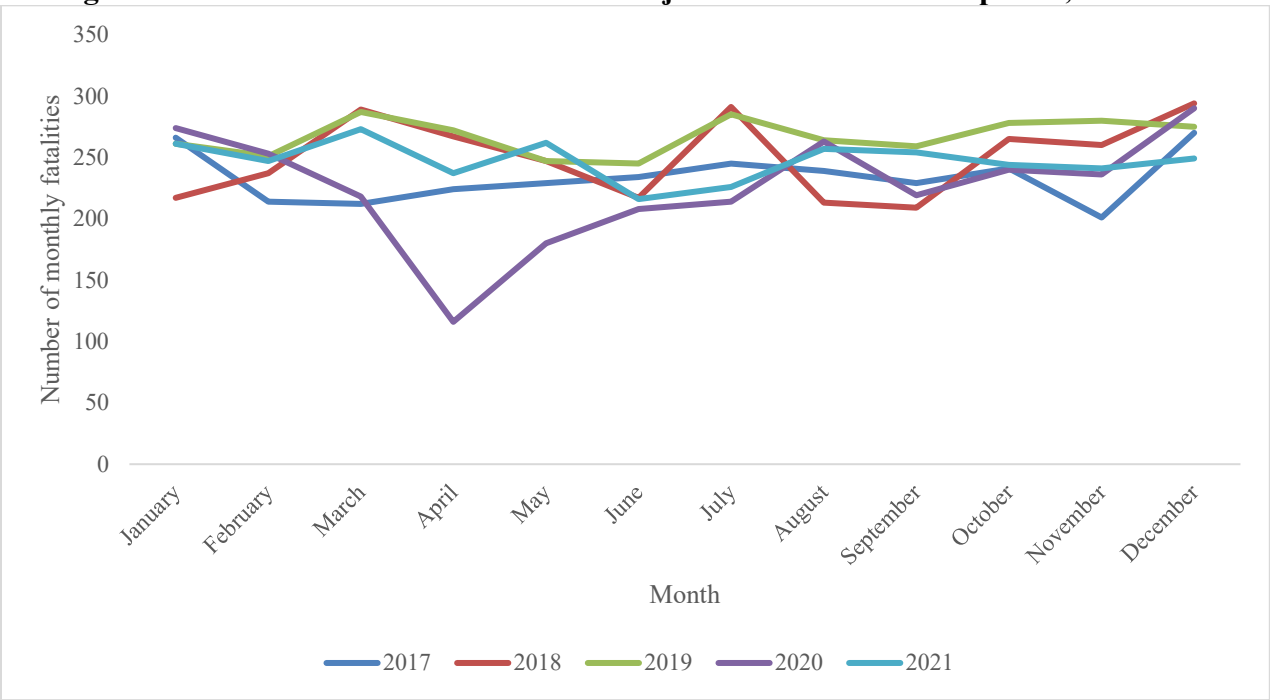
a. 18 records excluded due to missing data

b. 784 records excluded due to missing data

c. 1140 records excluded due to missing data

d. 3156 records excluded due to missing data

Figure 1. Trends of fatalities due to traffic injuries in Dominican Republic, 2017-2021



Source: INTRANT (2021)

Table 3 shows the distribution of RTFs by day of the week and time of occurrence. We observed that most RTFs were reported on Sunday (22.8%), Monday (16.8%), and Saturday (14.6%), with the rest of the days maintaining a uniform trend (11%-12%). In terms of the time and day of the week when road traffic fatalities occurred, most fatalities occurred during the evening rush hour from 18:00 to 23:59 (31.0%), followed by the morning rush hour from 06:00 to 11:59 (24.7%). The highest number of fatalities occurred on Sundays (22.8%), followed by Monday (16.8%).

Table 3. Road traffic fatalities by time and day of week, Dominican Republic, 2017-21

Variable	n	(%)	95% Confidence Interval
Time of day[a]			
00:00 - 05:59	2,606	19.8	18.9-20.6
06:00 - 11:59	3,251	24.7	23.8-25.6
12:00 - 17:59	3,225	24.5	23.6-25.4
18:00 - 23:59	4,073	32.1	30.0-32.0
Day of the week			
Monday	2,466	16.8	16.0-17.6
Tuesday	1,714	11.7	11.0-12.4
Wednesday	1,609	11.0	10.4-11.7
Thursday	1,646	11.2	10.6-11.9
Friday	1,765	12.0	11.4-12.7
Saturday	2,148	14.6	13.9-15.3
Sunday	3,344	22.8	21.9-23.7

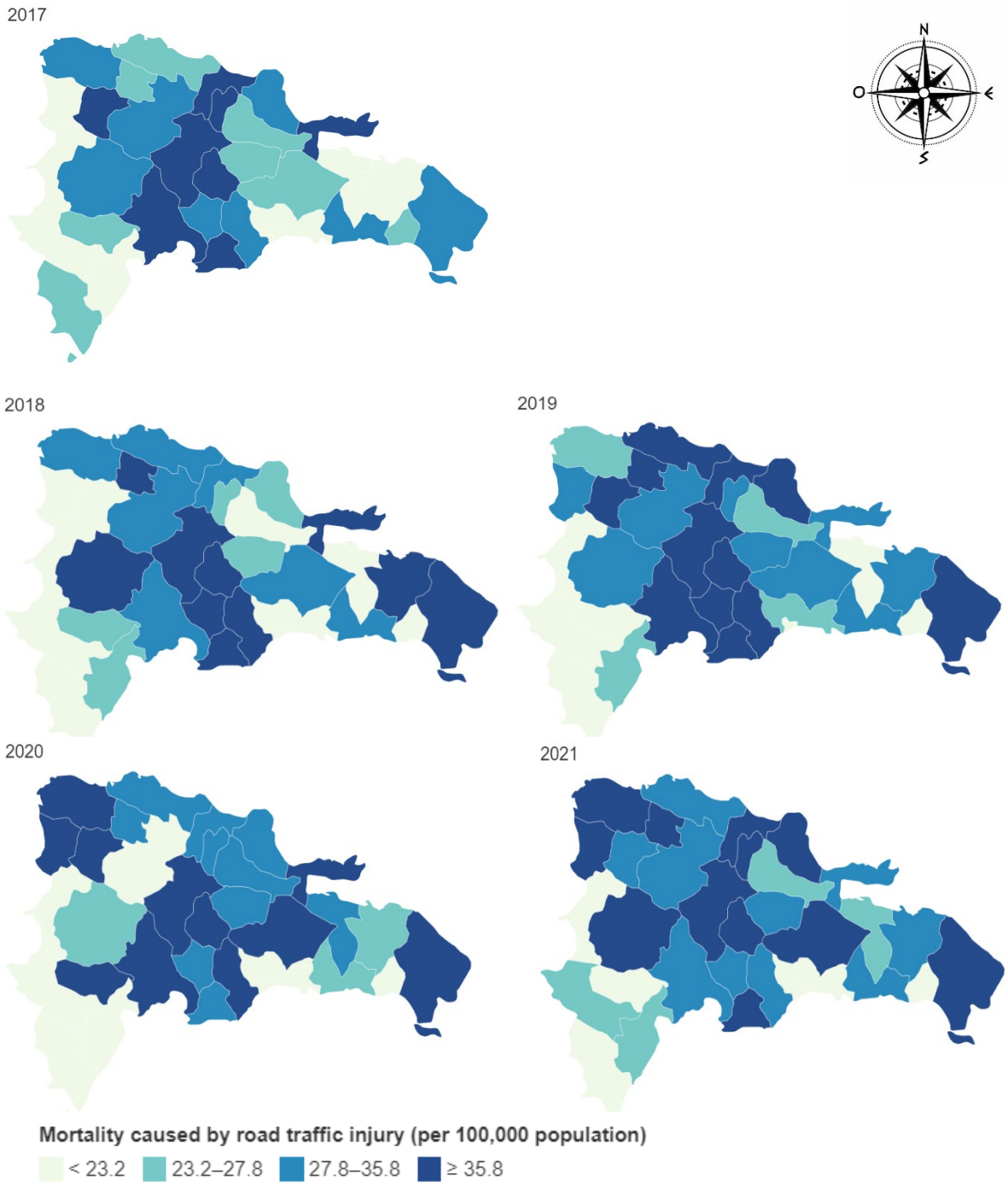
Source: INTRANT (2021)

a. 1538 records excluded due to missing data

Geo-temporal analysis of road traffic fatalities patterns

Figure 2 shows a series of maps that describe the geo-temporal evolution of RTF behavior in the past five years. It can be observed that provinces maintain a similar geographic distribution pattern in all years, were the three main provinces that reported the highest prevalence of traffics deaths per 100,000 inhabitants included Hermanas Mirabal (58.5), La Vega (52.3), and Monseñor Nouel (46.5) in 2017; in 2018, they were Monseñor Nouel (60.8), La Altagracia (51.5), and La Vega (51.2); in 2019, they were La Vega (70.7), La Altagracia (52.9), and Santiago Rodríguez (50.6); in 2020, they were Samaná (63.3), La Vega (55.7), and Dajabón (54.2); in 2021, they were Monseñor Nouel (58.3), La Vega (55.3), and Montecristi (51). In contrast, the lowest prevalence was observed in the Distrito Nacional (2017= 13.7, 2019= 13.4, 2020= 11.1, and 2021= 14.7) and the Dajabón province (2018= 9.1).

Figure 2. Distribution of road traffic deaths in Dominican Republic, 2017-2021



Source: INTRANT (2021)

Discussion

In this study, we analyzed the epidemiology of road traffic crash fatalities and injuries from 2017 to 2021 in the Dominican Republic. The results underscore the pressing need for enhanced road safety measures in the country. During the study period, traffic injuries accounted for 6.5% of all recorded deaths in the country [29]. The reduction in traffic-related injuries and fatalities was significantly less in 2020, following the emergence of the first COVID-19 case in March, likely due to mobility restrictions during the pandemic; this situation was similar in other studies [16-17]. To highlight the magnitude of the problem, traffic crash deaths surpassed those from COVID-19 in 2020 and 2021 [18-19].

The demographic characteristics of those involved in road traffic fatalities, with a high proportion of males and the age group of 20-39 years old, and the high number of traffic violations, particularly the failure to wear helmets while riding motorcycles, suggest the need for targeted road safety education campaigns and prevalence studies for this group [20-22]. As in other low- and middle-income countries, the economic impact in the DR Dominican Republic is devastating, primarily affecting the economically disadvantaged population [2].

Additionally, the high number of pedestrian fatalities highlights the need for safer pedestrian infrastructure, such as sidewalks, crosswalks, and pedestrian signals. These findings are consistent with previous studies [23-24].

The results of this study highlight the necessity of enhancing road safety enforcement measures during rush hour periods, especially in the evenings and on weekends. The high number of deaths occurring during non-working days and holiday periods each year suggests a seasonal pattern, which intensifies during the months of March and December, likely due to Easter and Christmas festivities, as demonstrated in previous studies [25-30]. Therefore, it is essential to reinforce preventive measures

during these periods to reduce risks and prevent unnecessary loss of human lives. Law enforcement agencies could prioritize these times for enforcement activities, such as speed checks and alcohol testing.

Most traffic fatalities occur during the afternoon and evening, which increases the risk of injuries due to the end-of-day rush and changes in lighting conditions [31-33]. Under these conditions, visibility can be limited, even with high-beam headlights, which reduces the driver's reaction time and increases the risk of fatal accidents [33-34]. One possible solution to reducing the number of fatalities is to increase lighting and traffic lights at urban intersections [35].

This study provides valuable information on the geographic distribution of deaths in the Dominican Republic and highlights the need for targeted interventions in provinces with higher incidence rates of road traffic injuries and fatalities. Additionally, the consistent low incidence and mortality rates in certain provinces may provide insights into potential factors contributing to lower mortality rates that could be replicated in other provinces. Various studies have revealed the influence of road conditions on the behavior of road users and the occurrence of traffic accidents [31, 36, 37]. These conditions are related to factors such as street lighting density, street design, and the presence of pedestrian crossings, among others [2, 37]. The findings of this study highlight provinces that are vulnerable to high mortality rates from traffic injuries, such as La Vega and Monseñor Nouel, due to their consistently high RTF rate year after year.

The government of the Dominican Republic has taken measures to address road safety, including the Law 63-17 of Mobility, Land Transport, Traffic and Road Safety and the PENSV 2021-2030. However, this study supports the consensus of the WHO that current policies and programs in the Dominican Republic are only marginally effective. It is recommended to implement effective long-term interventions and for the Dominican government and other stakeholders to continue enforcing legislation,

accompanied by public campaigns to increase awareness of the risks and reasons behind such legislation.

Given that many injuries are related to drivers and driving behaviors, individual interventions, such as sobriety check points, driver, education, or mass media campaigns have been found to be highly effective [38]. Individuals should be the key focus for any future intervention. Some authors refer to the necessary implementation of specific safety measures, considering gender and age group, given the importance of these two factors in traffic injuries [39]. Education and safety compliance should be targeted to specific groups and at appropriate times and places. Stricter enforcement of traffic regulations, RTI preventive measures, road safety education, and public health surveillance, especially targeted towards youth, motorcyclists, helmet use and provinces where injuries occur more frequently, evening hours, Sundays, and holidays, are recommended. The DR has the potential to reduce its high rates of road traffic injuries to fatalities by 2030 if effective prevention strategies are developed, thus meeting the targets of the Sustainable Development Goals.

It is important to highlight that this study has certain limitations. First, it only looked at data collected by state agencies, which can affect data quality. Second, the data used was limited to the years 2017-2021, so the study cannot account for long-term trends or changes over time.

Overall, the findings of this study provide important insights into the road safety profile of the Dominican Republic and highlight the need for targeted road safety measures to reduce the number of road traffic injuries, injuries, and fatalities in the country. The findings of this study underscore the need for targeted interventions to reduce the incidence of road traffic injuries and deaths, particularly among high-risk groups and in areas with high prevalence rates. Future studies could expand on this research by examining additional factors and considering longer-term trends.

Availability of data and material

The datasets generated and/or analyzed during the current study are available in the OPSEVI repository, https://opsevi.intrant.gob.do/dinamica/

Declaration of potential conflicts of interests

All authors declare that they have no conflict of interest for the development of the study, nor for the analysis of results nor writing this manuscript.

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