Webology (ISSN: 1735-188X)
Volume 19, Number 6, 2022

Analysis Of Traffic Accidents And Determination Of Accident Rates In The City Of Bucaramanga In Northeastern Colombia

Fernando Jove-Wilches[1], Jorge L. Argoty-Burbano[2], Edilberto E. Contreras-Sierra[3]

[1] Department of Civil Engineering, Universidad de Sucre, Sincelejo, Sucre, Colombia
https://orcid.org/0000-0002-2080-4036

[2] Department of Civil Engineering, Universidad de Nariño, San Juan de Pasto, Nariño, Colombia
https://orcid.org/0000-0001-6661-1398

[3] Faculty of Mathematics and Engineering, Institute of Mathematical and Computational Engineering, Pontificia Universidad Católica de Chile, Santiago, Chile
https://orcid.org/0000-0003-2358-3977

Abstract: Traffic accidents claim hundreds of thousands of lives, leave millions of people injured and enormous economic losses each year worldwide, becoming a public health problem, being one of the main causes of death in some populations and more frequently, in countries with medium and low income, as is the case of Colombia. Hence the importance of carrying out controls and measurements of the accidents that occur on the roads, to create databases that help determine the possible causes and facilitate the work of finding patterns within traffic accidents, in order to implement mechanisms and actions that reduce the causes of traffic accidents and thereby produce a reduction in them, fatalities, injuries and material damage that they cause. The objective of this study is to analyze the traffic accidents that occurred in the city of Bucaramanga, located in the northwest of Colombia, in a period of 10 years, between 2012 and 2021. To carry out this study, data sources from accident rate, demographics and vehicle fleet, which were collected from free access online repositories of data published by the government entities in charge of collecting and maintaining them. As a final product, eight accident indicators could be obtained, which can be very useful for government entities in charge of traffic management and road safety in the city, in the generation of policies and measures to improve road safety of its inhabitants.

Keywords: Traffic accident, Motorcycle accidents, Accident Indicators, Urban Accidents

1. INTRODUCTION

Traffic accidents represent one of the biggest problems worldwide. According to the World Health Organization (WHO) reports, approximately 1.3 million people lose their lives each year because

of a traffic accident and the most alarming thing is that 90% of deaths from this cause occur in low-income and middle-income countries. Additionally, the number of people who suffer non-fatal injuries ranges from 20 to 50 million people and a larger number suffer some disability because of the accident [1]. It is also worth mentioning that among the main causes of death for children and young adults, there are injuries derived from traffic accidents, being the first cause of death for people between 5 and 29 years of age. In addition, approximately half of the fatalities for this cause are vulnerable users of the public highway, that is, pedestrians, cyclists, and motorcyclists [2].

The rate of deaths in traffic accidents in high-income countries is at an average value of 10.3 per 100,000 inhabitants. While in low-income and middle-income countries, this value oscillates between 19.5 and 21.5 per 100,000 inhabitants, a value quite high if we take into account that most of the traffic accidents occur in these countries, which have close to 50% of the global vehicle fleet [3]. The number of deaths from traffic accidents worldwide is constantly increasing and it is estimated that by 2030 it will be the fifth leading cause of death [4].

In the case of Latin America, it is observed that the mortality rate is 16.0, which is very close to the world average and is lower compared to countries in Africa and Asia, but at the same time, it is higher than that of European countries with good performances, where its mortality rate does not exceed 10.0 [5]. Based on this information, the countries of Latin America and their mobility agencies, continue to work on policies to reduce this value, following the guidelines of the United Nations and giving recognition to Road Safety as a development priority [6].

Colombia is classified by the World Bank as a middle-income country [7], which places it, according to the data reported by the World Health Organization, as a country of great vulnerability in the field of traffic accidents. According to the accident rate balances presented by the National Road Safety Observatory for 2021, it was found that in Colombia 7,270 deaths reported in road accidents; of which approximately 60% of the deaths correspond to motorcyclists, 22% to pedestrians, 12% to vehicle users and 7% to bicycle users [8]. Here it can be seen that the figures shown in this balance of accidents are consistent with the figures worldwide, where the most vulnerable road users correspond to the highest percentage of fatalities, where it can be highlighted the fact that more half of the people killed in road accidents correspond to motorcycle users.

The objective of this work is focused on carrying out a descriptive analysis of the traffic accidents that occurred in the city of Bucaramanga, located in the Northeast of Colombia, for which the information registered and reported by the traffic authorities of the city was used, corresponding to traffic accidents between 2012 and 2021. Through this information, it was possible to carry out an analysis of the accident rate during that period, where it was possible to obtain the behavior of those involved in the accidents. Additionally, the Accident, Morbidity and Mortality rates of traffic accidents that occurred in the city were determined, using demographic databases that provided information about the number of inhabitants of the city. Finally, the evolution of the different calculated accident rates was analyzed in order to observe their behavior over the years and how it relates to national and international figures.

2. EXPERIMENTAL DESIGN, MATERIALS AND METHODS

2.1. Study area description. Bucaramanga is the capital of the Department of Santander, it is located in the northeastern part of Colombia, in the Andean region, where the relief of the territory is determined by the eastern mountain range and the Magdalena River valley [9]. It is very close to the seismic nest or swarm called Los Santos, one of the most active in the world. Regarding its extension, the area of the municipality is 165 km² and it is divided into 17 communes, which include 219 neighborhoods and 36 urban settlements. Figure 1 shows the geographical location of the study area, which includes the urban area of the municipality of Bucaramanga.

Regarding the urban vehicular road infrastructure of the municipality of Bucaramanga, it can be said that it is made up of approximately 500 km of roads, where 23% correspond to first, second and third level arterial roads and the remaining 77% are local level 1 and level 2 roads, the latter being the most representative, with 57% of the total length of the road infrastructure [10]. Additionally, the vehicle park for the year 2021 according to the Dirección de Transito de Bucaramanga was close to 220,000 vehicles [11].

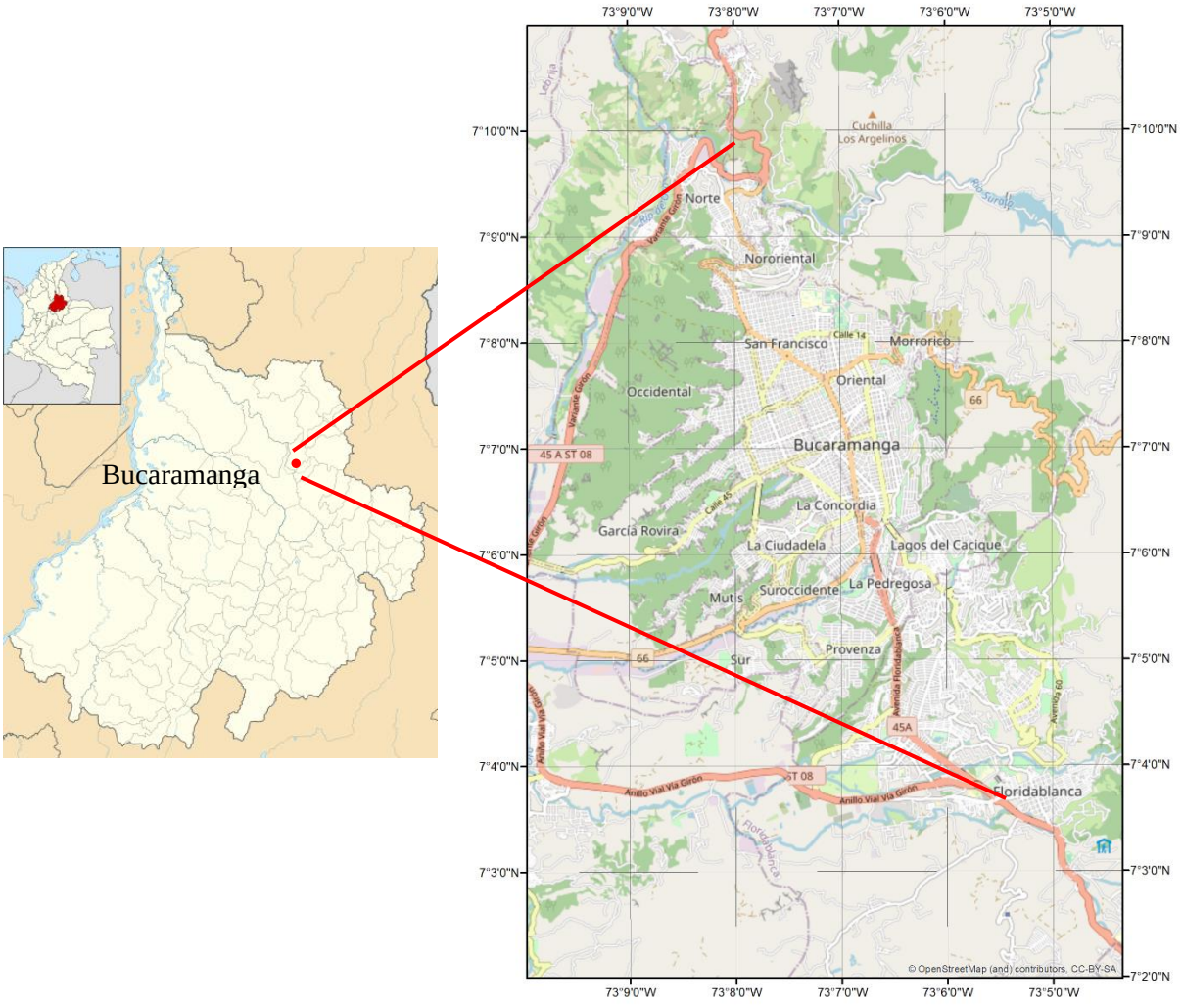

Figure 1. Location of the Municipality of Bucaramanga.

2.2. Material and Methods. The methodology used for the development of this work was divided into two phases; the first phase consisted of the collection, cleaning, treatment and creation of data, for which the work was done with four data sources from three different official organizations in Colombia. The second phase corresponded to an analysis stage, where, based on the data derived in phase 1, accident rate indicators were obtained for the city of Bucaramanga.

Phase 1. Collection, Processing, Cleaning and Creation of Datasets

The data was obtained from four different data sources. The first source corresponds to information about traffic accidents that occurred in the municipality of Bucaramanga. For this case, the data from the open data source of the Government of Colombia was used, provided by the Bucaramanga Municipal Mayor's Office, which were collected by the Dirección de Tránsito de Bucaramanga (DTB) [12], the data was obtained for a period of 10 years, from January 2012 to December 2021. To create the dataset, the most relevant information from the data was filtered, processed and organized, thus obtaining the variables used for the study. The columns selected for the study comprise the first four columns of the data, which contain the dates of the accidents, describing them by year, month, day and day of the week; Other relevant columns for the study correspond to the Accident Severity, Accident Hours, categorized by day or night and finally, the actors in the accidents that were established in various categories and were organized and synthesized into five main categories. : Cars, Buses, Trucks, Motorcycles and Pedestrians. For the present study, the columns referring to the time of the accident and their geolocation were omitted. The second source of data contained the number of deaths produced in traffic accidents; these figures were reported by the Agencia Nacional de Seguridad Vial (ASNV) and were valued by the National Institute of Legal Medicine and Forensic Sciences of Colombia [13].

Regarding the third source of data, this corresponds to demographic data of the municipality of Bucaramanga, which were obtained from the Departamento Administrativo Nacional de Estadística (DANE), which is in charge of carrying out population censuses in Colombia. From the demographic database with census and projected information, it was possible to obtain the population of the area of interest for the years from 2012 to 2021 [14]. The fourth source of data corresponds to information from the Bucaramanga Municipality Automotive Park, which is collected and provided by the Dirección de Transito de Bucaramanga (DTB) and where the data referring to the Class of Vehicles and Number of Vehicles are presented for the study area and period; data published on the entity's website and disclosed on the website of the Bucaramanga news newspaper, Vanguardia [11] [15] [16].

For the execution of this first phase, the Excel worksheet and the Power BI data analysis and visualization tools were used in the desktop version, with the use of both software, it was possible to obtain a processed dataset and the graphs of the data.

Phase 2. Determination of Accident Rate Indicators

In this Phase, some accident rate indicators were determined, in accordance with the criteria proposed in the article Defining a common set of indicators to monitor road accidents in the European Union published in BMC Public Health [17]. These accident rate indicators were taken as a reference, taking into account that they are widely accepted worldwide and the aforementioned document compiles the most relevant for the study of traffic accidents.

Table 1 presents the indicators that will be used for this work, as well as the equation used to determine said indicator and the data source for its calculation. It should be noted that some equations were adjusted to be applied for an annual period and only for the city under study. Additionally, some indicators were calculated year by year for the entire 10-year study period, while others were only calculated for a determined period based on the available information.

Table 1. Specific gravity test for mixed material

No.	Indicator	Computation	Data Sources
1	Mortality rate due to traffic accident	**(M**t **/P)*100,000** **M**t is the total number of deaths due to traffic accidents **P** is the total population	**Data on deaths** are based on **ASNV** records and d**ata on population** are based **DANE** records.
2	Death/motor vehicles	**(Mt/V per year)*10,000** **M**t is the number of deaths due to traffic **V** motor vehicle fleet during the period of interest	**Data on deaths** are based on **ASNV** records and **motor vehicle** are based on **DTB** records
3	Deaths/accident	**(M**t **/A)*1,000** **M**t is the total number of deaths due to traffic **A** is the total number of road traffic accidents	**Data on deaths** are based on **ASNV** and **numbers of road traffic accidents** are based on **DTB** records
4	Death/km of road	**(M**t **/l** r **)*1,000** **M**t is the total number of deaths due to traffic **l**r is the length of the roads in Km	**Data on deaths** are based on **ASNV** records and **data on km of road** are based on **POT**
5	Injury rate by traffic accident	**(I**t **/P)*10000** **I**t is the total number of injured due to traffic accidents **P** is the total population	**Data on injured** are based on **DTB** records and **Data on population** are based **DANE** records
6	Fatality rate	**(M**t **/M**t **+I**t **)**	

No.	Indicator	Computation	Data Sources
		Mt is the total number of deaths due to traffic accidents **I**t is the total number of injured due to traffic accidents	**Data on deaths** are based on **ASNV** records and **injured** are based on **DTB** records
7	Accident/vehicle	**(A/V)*10000** **A** is the total number of road traffic accidents **V** is the total amount of vehicle	**Data on road traffic accident** and **data on vehicle** are based on **DTB** records
8	Vehicle fleet or (Motoritation index)	**(V/P)*1000** **V** is the total number of vehicles **P** is the total population	**Data on vehicles** are based on **DTB** records and **data on population** are based **DANE** records

Source: Defining a common set of indicators to monitor road accidents in the European Union

3. RESULTS AND DISCUSSION

The datasets referring to traffic accidents, demographic data and vehicle fleet, were analyzed and figures were elaborated that describe the conditions over time based on the information collected from the historical records of 10 years, between the years 2012 and 2021.

Figure 2 presents the distribution of vehicles/users involved in traffic accidents, registered in the period 2012 – 2021. The accidents are grouped by year and the analysis categories are: cars, motorcycles, buses, trucks and pedestrians. This last category was added, taking into account that there is a large number of pedestrians involved in traffic accidents.

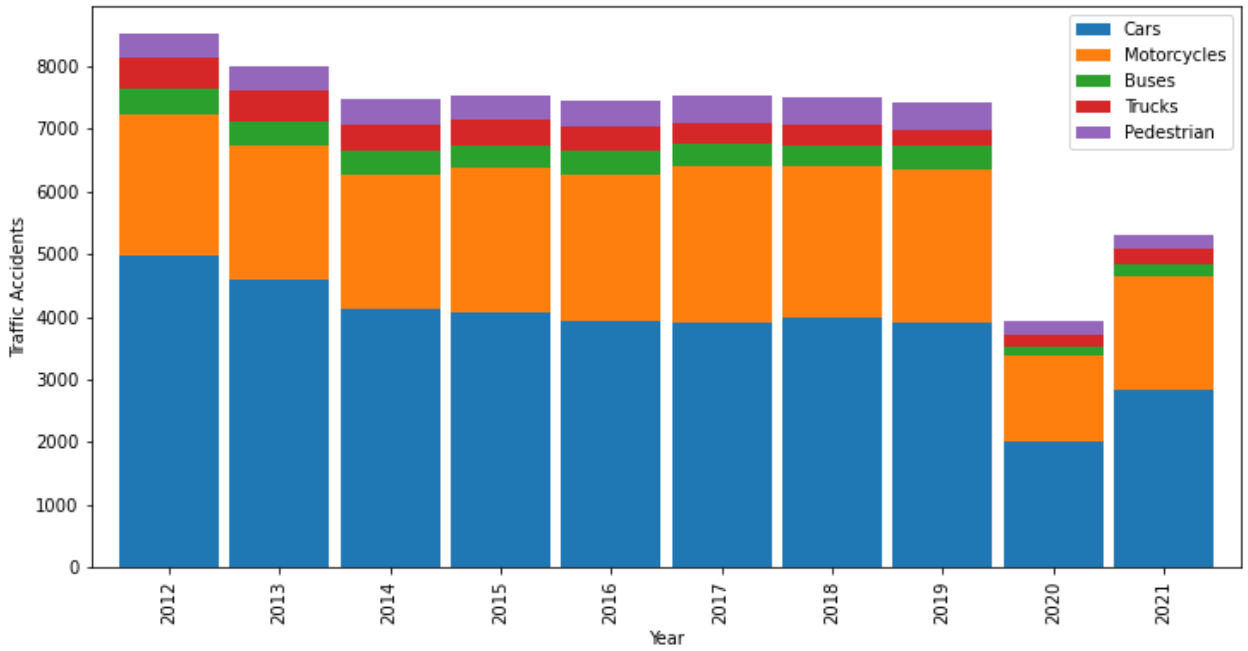

Figure 2. Vehicles/users involved in accidents by year

As can be seen in Figure 2, the year 2012 saw the highest number of accidents during the entire period evaluated; meanwhile, during the years 2014 to 2019, the total number of registered accidents did not present significant differences within this period. It is worth noting the situation presented in 2020, where there is a significant decrease in the number of traffic accidents, representing approximately 50% of the average number of traffic accidents in previous years. This is explained by the confinement measures that were established by regulations in the cities of Colombia, due to the Covid-19 pandemic, which significantly restricted the mobility of people in the cities, resulting in a decrease in the number of traffic accidents. Subsequently, by the year 2021, an increase in the number of accidents can be observed, compared to 2020, which can be explained by the gradual lifting of mobility restrictions, which allowed greater vehicular and pedestrian flow in the cities. , notably from the second half of 2021, when the country's population began to be massively vaccinated.

Figure 3 shows the distribution of vehicles/users for the same period of time (2012 - 2021) and the same categories, but in this case, the information has been grouped by month, recording the monthly average. From Figure 3, it can be said that there is little difference between the number of monthly accidents for the study period; however, it can be seen that the month of June was the one with the lowest accident rate and the months of March and September were the ones with the highest accident rate, with average values per month greater than 600 vehicles/users involved per month.

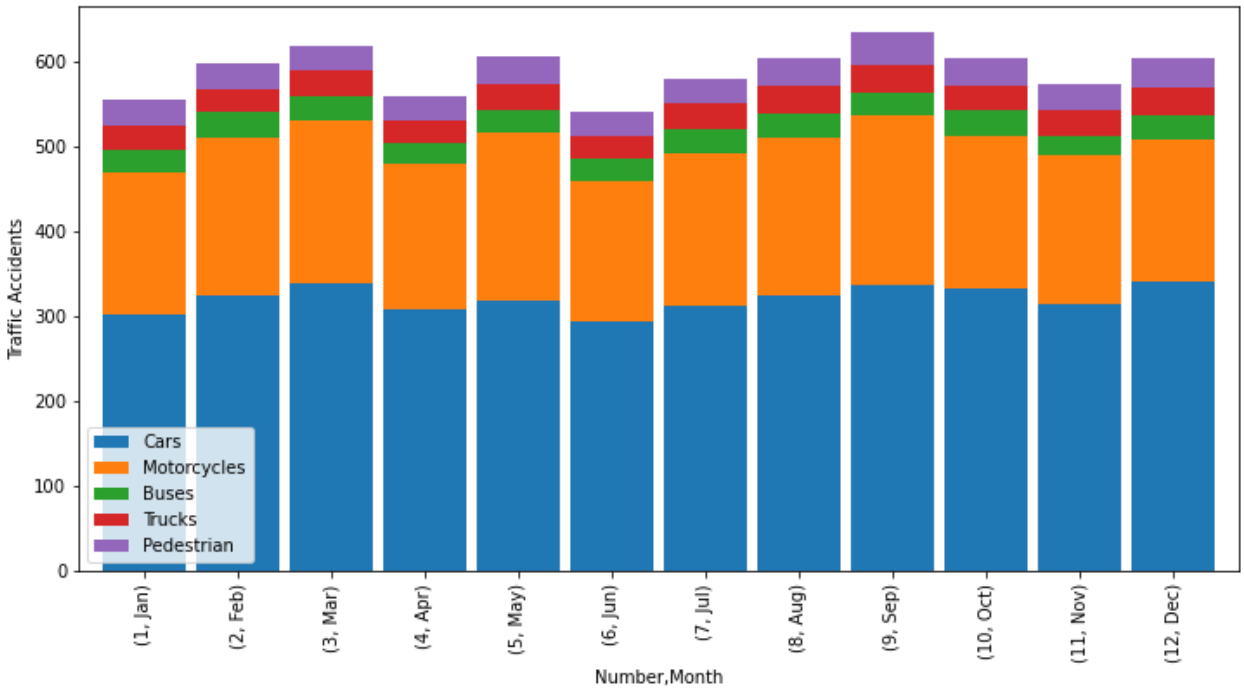

Figure 3. Mean vehicles/users involved in accidents grouped by month

From Figures 2 and 3, it can be seen that the types of vehicles that are involved in the greatest number correspond to Cars and Motorcycles, participating in more than 80% of the accidents of registered transits, which is expected, due to the conditions of the study area, as it is characterized as an urban area where most of the vehicle fleet is made up of private modes of transportation that fall into the category of cars and motorcycles; while the types of vehicles such as buses and trucks, because it is an urban area of the city, are limited both in quantity and in speed of operation.

Therefore, it is interesting to carry out an analysis of traffic accidents involving Cars and Motorcycles, since they represent more than 80% of the accidents in the urban roads of the municipality under study and focusing on the years between 2012 and 2019, where there was no external factor that had an impact on the number of traffic accidents. Figure 4 shows the number of vehicles involved in traffic accidents discriminated by Cars and motorcycles. From this figure it can be seen that the number of cars involved in traffic accidents has a tendency to decrease or stabilize, even when the city's vehicle fleet increases year by year, while in the case of motorcycles the behavior is quite the contrary, the tendency is to increase as the years go by.

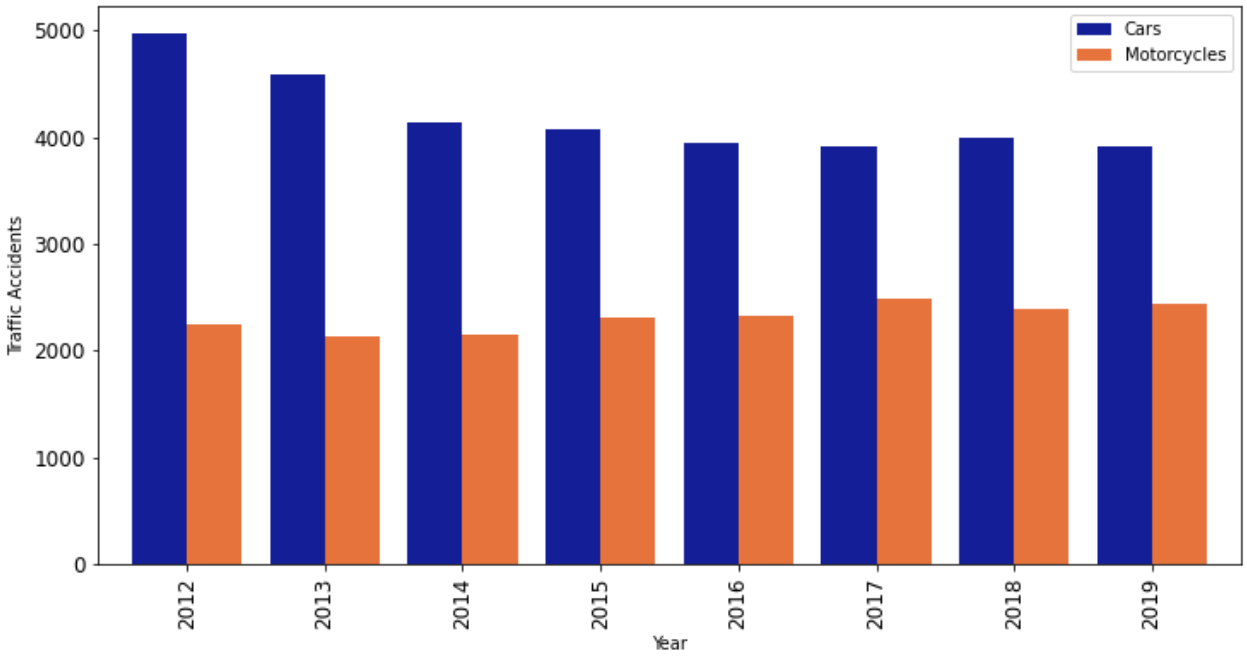

Figure 4. Trend of vehicles involved in traffic accidents

Figure 5 presents the severity of traffic accidents, analyzing the categories of Accidents that only caused damage and where Injuries were caused. This graph does not show the number of deaths, which are another of the Accident Severity categories, because they will be analyzed later and their values are much lower compared to these. Figure 5 is a type of graph that groups the values and places in the upper part the series that has the highest value for each abscissa, in this case, for each year, for which it is quite clear to observe that in the case of Accidents with injuries, buses and trucks turn out to be the ones with the lowest incidence, while pedestrians represent a significant number, which exceeds the two previous categories, even when combined. On the other hand, it is observed that the two categories most involved in accidents correspond to Motorcycles and Cars.

In the case of only damages, since there are no records of pedestrians and the participation of Buses and Trucks is low, again Cars and Motorcycles are the ones that register the highest number of traffic accidents. Additionally, if the two situations are analyzed at the same time, it can be noted that in the case of Accidents with Injuries, motorcycles are the ones that lead this category and have a tendency to increase over the years; meanwhile, in the case of Only Damages, it is observed that the Cars category is the one that is most involved in this type of Accidents, representing more than 60% in all cases, although a tendency to decrease with the years is observed.

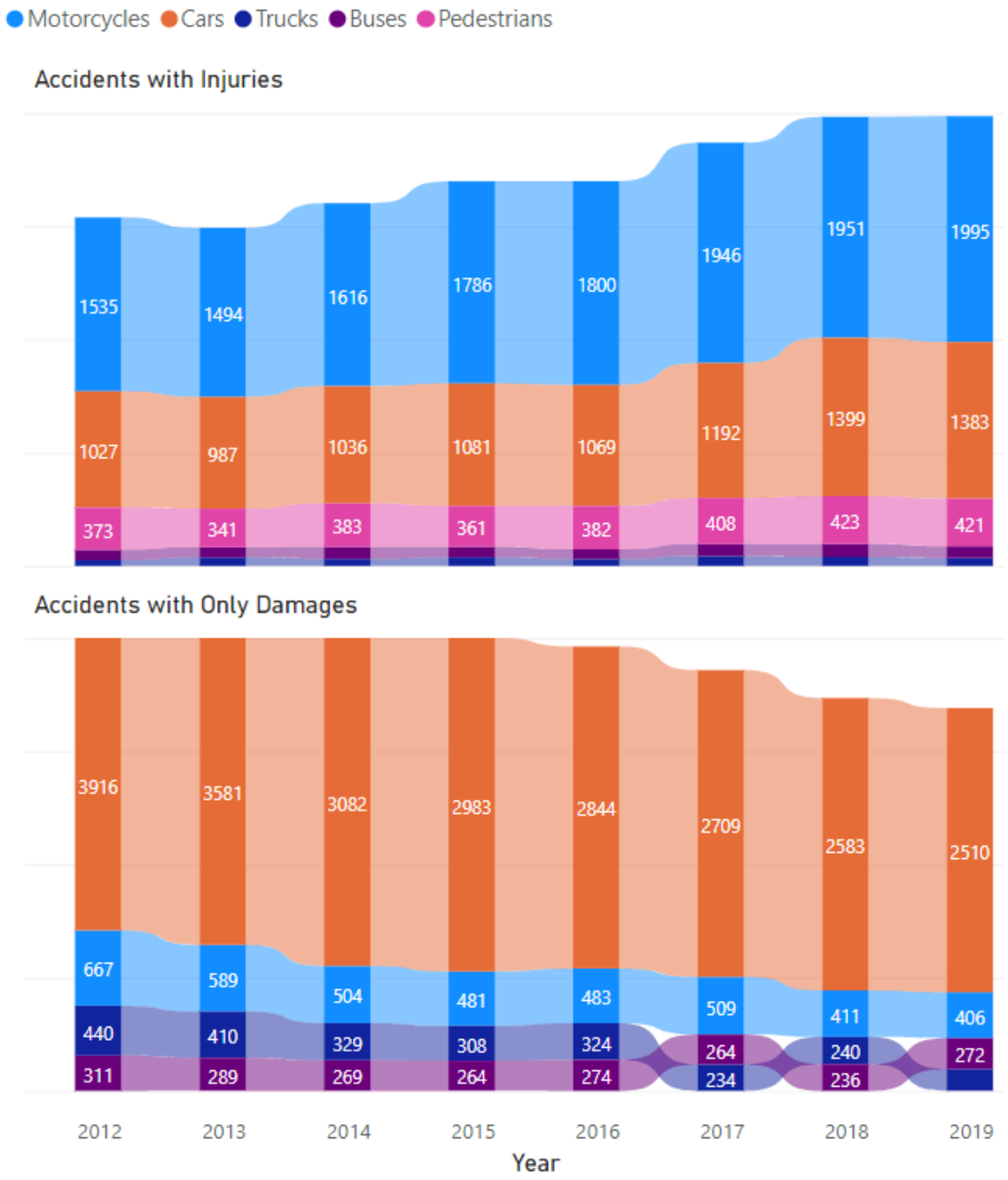

Figure 5. Seriousness of traffic accidents

Figure 6 shows the distribution of traffic accidents by hours, divided into two categories: daytime, for hours between 6:00 a.m. and 6:00 p.m., and night, for hours that go from 6:00 p.m. until 6:00 a.m. As can be seen, the largest number of accidents occur during the day, and it can be noted that the occurrence of accidents is more than 2.5 times compared to accidents that occur at night.

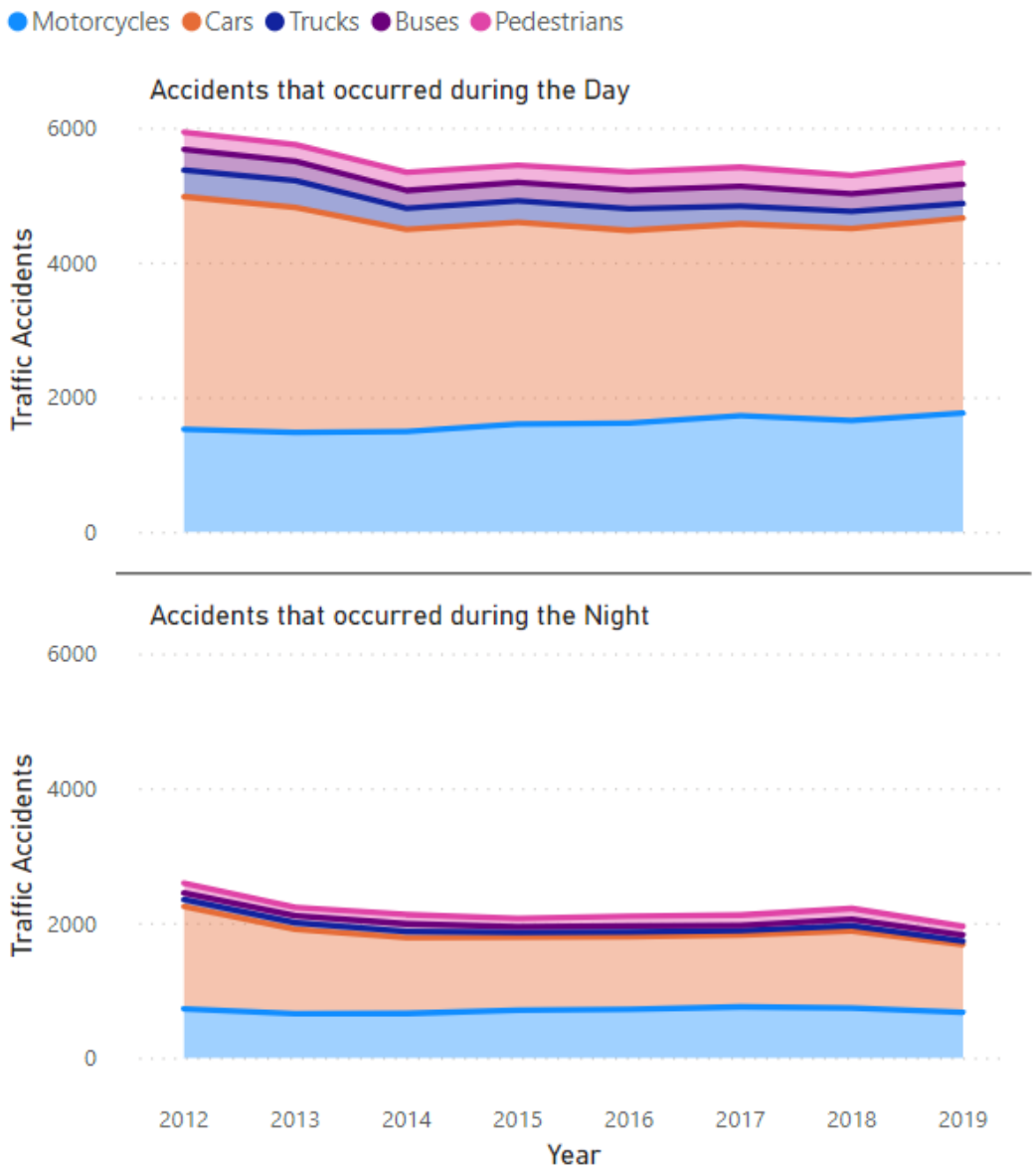

Figure 6. Distribution of traffic accidents by time

Table 2 presents the number of fatalities from traffic accidents. In this, a color pattern is observed, which goes from blue to red, being strong blue the values with fewer fatalities and the values with strong red, those with the highest number of people killed in traffic accidents. As can be seen, for all the years, except in 2014 and 2017, motorcycle users made up the ones with the highest number of fatalities in accidents, and in second place, there are pedestrians, who present values very close to the aforementioned category, even though the number of pedestrians involved in accidents is relatively low compared to Cars and motorcycles (Figure 3). This is because pedestrians are the most vulnerable road users and do not have any protection during the occurrence of a traffic accident. On the other hand, in the case of vehicle users, relatively low values are observed, which are close to 10% of the total number of fatalities, and bicycle and unidentified users present even lower values.

Table 2. Historical victims in traffic accidents

User of the Via	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Motorcycle user	44	36	20	29	38	18	28	29	31	51
Pedestrian	30	35	24	19	30	30	28	27	25	14
Vehicle user	2	7	6	1	5	2	1	2	2	5
Bicycle user	3	1	2	3	1	0	3	3	4	2
Other Users	2	0	0	0	0	1	1	0	0	0
Without Information	1	2	1	1	1	0	1	0	0	0
Total	**82**	**81**	**53**	**53**	**75**	**51**	**62**	**61**	**62**	**72**

Source: Agencia Nacional de Seguridad Vial

After describing the behavior of the Accident data in Bucaramanga, we next present the processed data that will serve as input for the determination of the different accident rate indicators. Table 3 shows the number of traffic accidents registered in the municipality of Bucaramanga, as well as the number of people injured and killed during these events. Additionally, the columns corresponding to the population recorded and projected by DANE and the characteristics of the vehicle fleet of the municipality under study are added. The information is registered for the period between 2012 and 2021, although in the case of the vehicle fleet data, only records for the period 2015 – 2021 were found

Table 3. Annual distribution of traffic accidents, population and vehicle fleet

Year	Number of Road Traffic Accidents	Number of Injured	Number of Deaths	Population (DANE Projections)	Total number of vehicles
2012	4,343	1,587	82	535,617	158.965
2013	4,054	1,519	81	542,098	169.166
2014	3,724	1,617	53	548,447	179.268
2015	3,765	1,705	53	554,885	189.339
2016	3,733	1,705	75	562,123	198.145
2017	3,807	1,903	51	570,253	203.522
2018	3,910	2,100	62	581,130	205.884
2019	3,724	1,993	61	595,635	210.933
2020	2,018	1,122	62	607,428	217.682
2021	2,685	1,381	72	614,269	219.682

The values in Table 3 serve as a starting point for calculating the different traffic indicators that are listed in Table 1. The objective is to determine these indicators and analyze the results. Following this procedure, Table 4 is constructed, which contains the traffic accident indicators.

Table 4. Specifications of cement

Year	Mortality rate due to traffic accident	Death / motor vehicles	Deaths / accident	Death / km of road	Injury rate by traffic accident	Fatality rate (%)	Accident / vehicle	Vehicle fleet or (Motoritation index)
2012	15,31	5,16	18,88	164,33	29,63	4,91	273,20	296,79
2013	14,94	4,79	19,98	162,32	28,02	5,06	239,65	312,06
2014	9,66	2,96	14,23	106,21	29,48	3,17	207,73	326,86
2015	9,55	2,80	14,08	106,21	30,73	3,01	198,85	341,22
2016	13,34	3,79	20,09	150,30	30,33	4,21	188,40	352,49
2017	8,94	2,51	13,40	102,20	33,37	2,61	187,06	356,90
2018	10,67	3,01	15,86	124,25	36,14	2,87	189,91	354,28
2019	10,24	2,89	16,38	122,24	33,46	2,97	176,55	354,13
2020	10,21	2,85	30,72	124,25	18,47	5,24	92,70	358,37
2021	11,72	3,28	26,82	144,29	22,48	4,96	122,22	357,63

From Table 4, it can be seen that in the case of the mortality indicator, the values for the years 2012 and 2013 are close to 15.0, while for the other years they are close to 10.0, except for the year 2013 and 2021, which presents slightly higher values. If these values are compared with the country's average, it can be seen that they are below the national average, which is 15.4 deaths in traffic accidents per 100,000 inhabitants (Figure 7).

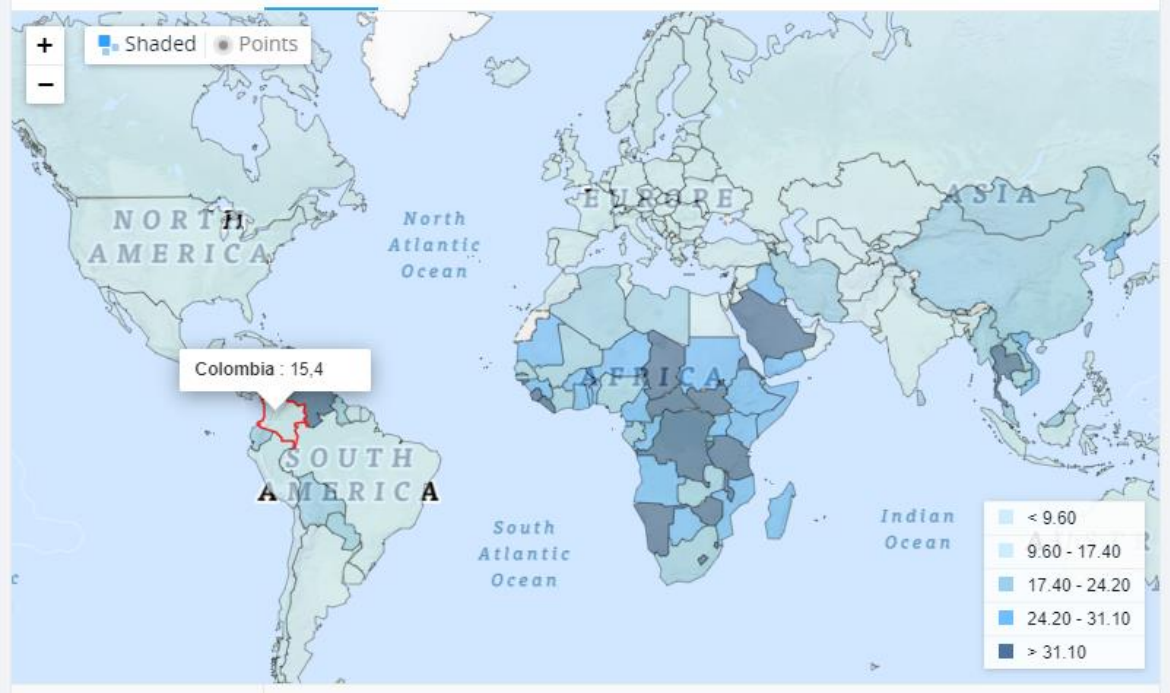

Figure 7. Mortality caused by injuries due to traffic accidents

Source: World Bank data

For the other indicators shown in Table 4, it can be said that in the case of Death / motor vehicles, the values oscillate between 2.51 and 5.16, presenting the highest value in the year 2012 and the lowest value in 2017; for Deaths / accident, there is a range of 13.40 (2017) to 30.72 (2020) deaths per 1,000 traffic accidents; for Death / km of road, there are 102.20 to 164.33 deaths per 1000 kilometers traveled; for the case of Injury rate by traffic accident, the values range between 18.47 (2020) and 36.14 (2018); in the case of Fatality rate, the values are between 2.61 and 5.24 for the years 2017 and 2020, respectively; in the case of Accident / vehicle, the values oscillate between 92.70 (2020) and 273.24 (2012) for every 10,000 vehicles and finally, for Motoritation index, the values oscillate between 296.79 (2012) and 358.37 (2020) traffic accidents for every 10,000 vehicles. From the previous data, it can be highlighted the fact that in 2020, although there were fewer traffic accidents compared to the other years and the Accident / vehicle was the lowest, indicators such as the fatality rate, deaths from accidents and the motorization index, were the highest compared to the other years studied.

4. CONCLUSIONS

From the data analyzed, related to the accident rate presented in the city of Bucaramanga during the period 2012-2021, it was possible to obtain valuable information, supported by the eight accident rate indicators shown, which makes it possible to make available to the corresponding government entities, a very important reference for the generation of policies aimed at taking measures that can improve the road safety of its inhabitants. Among the relevant results in the present study, it can be highlighted the significant decrease in the number of traffic accidents registered in the city during the year 2020, which was due in particular to the strong restriction on mobility that was imposed by the government, due to the crisis generated by the Covid-19 pandemic. Notwithstanding the foregoing, for that same year, the highest rates related to Deaths /accident ident were presented, where 30.72 deaths were recorded for every 1000 traffic accidents and Fatality rate, where a value of 5.24 was recorded, which is indicative of a greater severity in the accidents that occurred during the mobility restrictions of 2020, probably due to the greater stress suffered by the population during the Pandemic era.

REFERENCES

[1] World Health Organization (WHO). (2022, Jun). Road traffic injuries. Retrieved from World Health Organization: https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries)

[2] World Health Organization. (2022, Jun). Traumatismos causados por el tránsito. Retrieved from World Health Organization: https://www.who.int/es/news-room/fact-sheets/detail/road-traffic-injuries)

[3] World Health Organization (WHO). (2009). Global Status Report on Road Safety Time for Action. Retrieved from Youth For Road Safety: http://www.youthforroadsafety.org/uploads/tekstblokken/global_status_report.pdf

[4] World Health Organization (WHO). (2008). World health statistics 2008. Retrieved from World Health Organization: http://www.who.int/whosis/whostat/2008/en/index.html

[5] Organización para la Cooperación y el Desarrollo Económicos (OECD). (2017). Benchmarking de la seguridad vial en América Latina. Foro Internacional de Transporte. Retrieved from Organización para la Cooperación y el Desarrollo Económicos: https://www.itf-oecd.org/sites/default/files/docs/benchmarking-seguridad-vial-america-latina_0.pdf

[6] Naciones Unidas. (2018). La Agenda 2030 y losObjetivos de Desarrollo Sostenible: una oportunidad para América Latina y el Caribe (LC/G.2681-P/Rev.3), Santiago. Retrieved from Comisión Económica para América Latina y el Caribe (CEPAL): https://repositorio.cepal.org/bitstream/handle/11362/40155/24/S1801141_es.pdf

[7] The World Bank (2022). Income level. Retrieved from Data World Bank: https://data.worldbank.org/country/CO

[8] Ministerio de Transporte. (2021). ANSV presenta balance oficial de siniestralidad vial 2021. Retrieved from Ministerio de Transporte: https://www.mintransporte.gov.co/publicaciones/10578/ansv-presenta-balance-oficial-de-siniestralidad-vial-2021/

[9] Universidad Pontificia Bolivariana (UPB). (2022). Sobre la Ciudad - Bucaramanga, la ciudad Bonita. Retrieved from UPB: https://www.upb.edu.co/es/universidad/nuestro-campus/sobre-la-ciudad/bucaramanga

[10] Alcalde de Bucaramanga. (2020). Bucaramanga, ciudad de oportunidades. Plan de Desarrollo 2020 – 2023. Retrieved from UNAL: http://ieu.unal.edu.co/images/Planes_de_Desarrollo_2020/Bucaramanga_Plan-de-Desarrollo-2020-2023-2.pdf

[11] Pineda, J. (2021, 5 de agosto). 147% aumentó en Bucaramanga y su área el parque automotor. Vanguardia. Retrieved from: https://www.vanguardia.com/area-metropolitana/bucaramanga/147-aumento-en-bucaramanga-y-su-area-el-parque-automotor-CX4088712

[12] Alcaldía de Bucaramanga. (2022). Accidentes de tránsito desde enero 2012 a septiembre de 2022. Retrieved from Datos Abiertos Gobierno de Colombia: https://www.datos.gov.co/Transporte/03-ACCIDENTES-DE-TRANSITO-DESDE-ENERO-2012-A-SEPTI/7cci-nqqb

[13] Agencia Nacional de Seguridad Vial. (2022). Observatorio Estadificas – Histórico de víctimas. Retrieved from ANSV: https://ansv.gov.co/es/observatorio/estad%C3%ADsticas/historico-victimas

[14] Departamento Administrativo Nacional de Estadística (DANE). (2022). Proyecciones de Población. Retrieved from DANE: https://www.dane.gov.co/index.php/estadisticas-por-

tema/demografia-y-poblacion/proyecciones-de-poblacion

[15] Espinosa, H. (2018, 23 de septiembre). Así ha crecido el parque automotor en el área metropolitana de Bucaramanga. Vanguardia. Retrieved from: https://www.vanguardia.com/area-metropolitana/bucaramanga/asi-ha-crecido-el-parque-automotor-en-el-area-metropolitana-de-bucaramanga-ABVL445775

[16] Dirección del Tránsito de Bucaramanga (DTB). (2022). Parque Automotor. Retrieved from DTB: https://transitobucaramanga.gov.co/dtb/atencion-y-servicios-a-la-ciudadania/movilidad/parque-automotor/

[17] Farchi, S., Molino, N., Giorgi Rossi, P. et al. (2006). Defining a common set of indicators to monitor road accidents in the European Union. BMC Public Health 6, 183. https://doi.org/10.1186/1471-2458-6-183