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A spatial analysis of urban transit accidents assisted by Emergency Mobile Care Services: an analysis of space and time

Análise espacial dos acidentes de trânsito urbano atendidos pelo Serviço de Atendimento Móvel de Urgência: um recorte no espaço e no tempo

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ABSTRACT: ***Introduction:*** Urban transit accident are a global public health problem. The objective of this study was to describe the profile of the victims and the occurrences of urban transit accidents attended to by emergency mobile care services (*Serviço de Atendimento Móvel de Urgência- SAMU*) in Recife, and their distribution based on spatial analysis. ***Methodology:*** An ecological study, developed through secondary data from emergency mobile care services in Recife, referring to the total number of occurrences of urban transit accidents attended to from January 1 to June 30, 2015. The spatial analysis was performed using the Moran index. ***Results:*** Basic support units performed most of the emergency services (89.2%). Among the victims, there was a predominance of males (76.8%) and an age group of 20 – 29 years old (31.5%). Collisions were responsible for 59.9% of the transit accidents, and motorcycles for 61.6% of the accidents among all means of transportation. Friday was the day that showed the highest risk for treatment, and there was a concentration of events between 6:00 am – 8:59am and 6:00pm – 8:59pm. The MoranMap identified critical areas where calls came from traffic accidents during the period analyzed. ***Discussion:*** The records of the mobile service from the spatial analysis are an important source of information for health surveillance. ***Conclusion:*** The spatial analysis of urban transit accidents identified regions with a positive spatial correlation, providing subsidies to the logistical planning of emergency mobile care services. This study is groundbreaking in that it offers such information about the region.

Keywords: Traffic accidents. Emergency medical services. Spatial analysis. Health services research. Uses of epidemiology. Descriptive epidemiology.

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RESUMO: ***Introdução:*** Os acidentes de trânsito urbano são um problema de saúde pública mundial. Objetivou-se descrever o perfil das vítimas atendidas pelo Serviço de Atendimento Móvel de Urgência (SAMU) no Recife e das ocorrências por acidentes de trânsito urbano, bem como sua distribuição a partir de análise espacial. ***Metodologia:*** Estudo ecológico, desenvolvido a partir de dados secundários do SAMU no Recife, referentes às ocorrências dos acidentes de trânsito urbano de 01 de janeiro a 30 de junho de 2015. A análise espacial se deu por meio do índice de Moran. ***Resultados:*** As unidades de suporte básico realizaram a maioria dos atendimentos (89,2%). Entre as vítimas, houve predomínio do sexo masculino (76,8%) e da faixa etária de 20 – 29 anos (31,5%). A colisão foi responsável por 59,9% dos acidentes de trânsito, e as motos representaram 61,6% das ocorrências entre os meios de locomoção. A sexta-feira apresentou maior risco e houve concentração de acidentes das 06h00min. às 08h59min. e das 18h00min. às 20h59min. O MoranMap identificou áreas críticas para a ocorrência de atendimentos durante o período analisado. ***Discussão:*** As fichas de atendimento do SAMU, a partir da análise espacial, configuraram-se como importante fonte de informação para a vigilância em saúde. ***Conclusão:*** A análise espacial dos acidentes de trânsito urbano identificou regiões com correlação espacial positiva, proporcionando subsídios ao planejamento logístico do serviço de atendimento móvel de urgência. Este estudo é pioneiro ao contribuir com tais informações na região.

Palavras-chave: Acidentes de trânsito. Serviços médicos de emergência. Análise espacial. Pesquisa sobre serviços de saúde. Aplicações da epidemiologia. Epidemiologia descritiva.

INTRODUCTION

For several years, the United Nations (UN) has recognized urban traffic accidents as a serious public health problem worldwide, because they are accompanied by high morbidity and mortality rates[1,2]. Approximately 1.2 million deaths a year result from traffic accidents. Of those deaths, 90% occur in low- and middle-income countries[3].

Brazil is one of the leading countries in mortality rates from urban traffic accidents. The majority of deaths and hospitalizations caused by these accidents are observed among males, black people, young adults, individuals with low education and motorcyclists[4-8].

The high rate of urban traffic accidents in the country may be associated with the Brazilian culture of people using public spaces as if they were their own, so that motor vehicles are seen and used as an instrument of power, lead to civil disobedience with regard to traffic laws and are connected to alcohol consumption[9,10].

States in the Northeast of the country had increased mortality rates from urban traffic accidents[11]. There were also reports of less frequent seat belt use in both the front and rear seats, greater proportions of accidents involving bicycles and motorcycles, in addition to victims who claimed to have stopped performing usual daily activities due to injuries resulting from traffic accidents[12].

In Pernambuco, there was a growth of 875% in the mortality coefficient of motorcyclists per 100,000 inhabitants between 1996 and 2006. The observed increase in the

production of motorcycles is a possible explanation for the increased accidents involving this type of vehicle[13].

Pedestrians, cyclists and motorcyclists are groups of victims who, in addition to representing half of all deaths by traffic accidents worldwide[3], greatly impact the frequency of occurrences (about 89%) in emergency hospital units and the Emergency Mobile Care Services (*Serviço de Atendimento Móvel de Urgência*-SAMU) [14,15].

SAMU, an important mobile pre-hospital component of the National Emergency Care Policy, launched in 2003[16], is a 24-hour free service that provides guidance and sends manned vehicles containing trained staff. It is accessed through a telephone number and activated by an Emergency Regulation Center[17].

Currently, SAMU serves 75% of the Brazilian population[17]. In Recife, SAMU was inaugurated on December 21, 2001. As the capital of Pernambuco, Recife hosts the headquarters of the Metropolitan SAMU Medical Regulation Center of Recife. The headquarters regulates 17 municipalities in the Metropolitan Region[18].

In Brazil, the Ministry of Health (MoH) has supported states and municipalities to increase their ability to implement surveillance interventions and prevent deaths and injuries caused by traffic accidents[19]. An example of this support is the Life in Transit Project, (*Projeto Vida no Trânsito*), which is part of a bigger project called Traffic Safety in Ten Countries (*Segurança no Trânsito em Dez Países*)[20], which has the objective to aid managers through training, planning, monitoring, follow-up and intervention evaluation[11].

In order to subside possible policies for the prevention of urban traffic accidents, spatial analysis is considered a powerful public health tool. It makes spatial patterns of a phenomenon visible, even with sparse data, [21] through the construction of maps, and through the mapping of risk factors in the population [22,23]. The spatialization of traffic accidents is important in order to provide subsidies for the planning and execution of public policies, which increase the effectiveness and efficiency in reducing and preventing these injuries[24].

The present study had the objective of describing the profile of victims served by SAMU in Recife and the occurrence of urban traffic accidents, as well as their distribution based on a spatial analysis.

METHODS

The present study was of ecological design and was developed through the collection of secondary data from Recife's SAMU database. It looked at the total number of urban traffic accidents from January 1st to June 30th of 2015.

The study site was the municipality of Recife, the capital of Pernambuco. The city was divided into 94 clustered neighborhoods and into 6 political-administrative regions (PARs)[25]. In 2010, the municipality had a population of 1,537,704 inhabitants distributed among 218.435 km^2 and a population density of 7,039.64 inhab/km^2[26]. The reference population

was estimated by the Health Department of Recife for 2015, and had 1,598,096 inhabitants. The study included 1,225 victims of urban traffic accidents that were attended to by the SAMU of Recife.

The following were described: the type of ambulance, the destination facilities, the victim's condition (gender, age range, means of transportation) and the nature of the accident (collision, vehicle tipping or rolling over, crashing into fixed objects, being run over and falling in/from the vehicle). Relative frequencies and relative rates were calculated considering the resident population (incidence rate: IR; number of occurrences/population exposed for every 10,000 inhabitants).

The statistical analysis was performed using the BioEstat 5.3 program. Poisson's regression was used in order to estimate the relative risk (RR) and the confidence interval values of 95% (95%CI) of the association between days of the week, time and neighborhood of the accidents. Tuesdays were considered the reference day (for week days) and the period from 12:00am to 2:59am (for operating hours), due to the low flow of people who could influence the occurrence of the accidents.

The neighborhood was the spacial unit adopted. Maps were constructed with the absolute distribution of the total numbers of visits (equal intervals) and of RR (quartile). Subsequently, a spatial analysis was performed, with the objective of identifying clusters with statistical significance, which allow for the prioritizing of injury control actions. The Moran index was adopted, with a variation from -1 to 1. The values close to zero indicate the absence of spatial correlation – difference among neighborhoods close to each other. The positive values indicate positive spatial autocorrelation, meaning that there are similarities between neighborhoods close to each other, and negative values have negative spatial autocorrelation[13,27]. In general, the Moran index is a test whose null hypothesis is of spatial independence. In this case, its value is zero. Positive values (between 0 and +1) indicate direct correlation, and negative ones (between 0 and -1) indicate inverse correlation[28]. The analysis of spatial distribution of the services had three stages. The first stage identified critical transition areas and used Moran's spreading diagram to compare the spatial dependency of each neighborhood. In this stage, the quadrants are interpreted as: Q1 (positive values, positive means); Q2 (negative values, negative means), which indicates the points of positive spatial association or points that are similar to their neighbors; Q3 (positive values, negative means); and Q4 (negative values, positive means), which indicates points of negative spatial association, and neighborhoods with values different from other neighborhoods close by. This stage is visually represented with a BoxMap[13,27,28].

In the second stage, a local indicator of spatial association (LISA) is used, which detects regions that have a significantly different local correlation compared to the rest of the data. This is possible through the application of local spatial autocorrelation statistics. A significance evaluation is done by comparing the values observed with a series of values obtained through the permutation of values of neighboring areas. Local rates are classified as non-significant and with significance of 95, 99 and 99.9%[13,27].

The third stage merges zones with positive spatial relation identified by the BoxMap (with spatial significance above 95%) and those with positive spatial relation identified by the LisaMap. The combination of these two groups generated the MoranMap. Critical areas were those that consisted of neighborhoods classified as Q1 in the MoranMap[13,27].

The spatial exploratory analysis for the identification of transition areas and critical areas of the events studied were performed with the help of electronic Excel© spreadsheets and TerraView software, version 4.2.2. The results were represented in the digital cartographic base of Recife.

This Project was approved by the Research Ethics Committee in agreement with Resolution No. 466/2012, which regulates research with human beings, and which is from the *Instituto de Medicina Integral Professor Fernando Figueira* (IMIP), CAEE: 53175716.2.0000.5201.

RESULTS

In the period studied, 1,225 victims of urban traffic accidents were attended to by SAMU in the city of Recife, Pernambuco. This value corresponds to 45.4% of the total number of services performed by SAMU (n = 2,698), considering all causes.

The Basic Support Units (*unidades de suporte básico* – USBs) performed most of the services. Most of the victims were taken to public health network units, mainly the Municipal Emergency Care Units (*Unidades de Pronto Atendimento* – UPAs) (Table 1).

Table 1. The characterization of victims of urban traffic accidents assisted by the Emergency Mobile Care Services of the city of Recife, Pernambuco, Brazil (January to June, 2015).

Variable	n (1,225)	%
Type of ambulance		
Basic support unit	1,093	89.2
Advanced support unit	79	6.4
Not informed	53	4.3
Destination units		
UPA Imbiribeira	169	13.8
UPA Caxangá	151	12.3
Restoration hospital	131	10.7
UPA Torrões	124	10.1
Other public units	266	21.7
Private units	157	12.8

Continue...

Table 1. Continuation.

Variable	n (1,225)	%
Military hospitals	11	0.9
Other situations[a]	67	5.5
Not informed	149	12.2
Gender		
Male	941	76.8
Female	259	21.1
Not informed	25	2
Age range (in years)		
0 – 9	7	0.6
10 – 19	119	9.7
20 – 29	386	31.5
30 – 39	296	24.2
40 – 49	180	14.7
50 – 59	89	7.3
60 or more	47	3.8
Not informed	101	8.2
Nature of the accident		
Collision	734	59.9
Vehicle tipped or overturned	17	1.4
Crashed into fixed objects	17	1.4
Victim run over	131	10.7
Victim fell in/from the vehicle	170	13.9
Not informed	156	12.7
Means of transportation of the victim		
Car	92	7.5
Motorcycle	755	61.6
On foot	83	6.8
Bicycle	43	3.5
Others	5	0.4
Not informed	247	20.2

a: signed a refusal term or was not taken to a health unit; UPA: *Unidade de Pronto Atendimento* (Emergency Care Unit).

Victims were mostly males (a ratio of 3.6 men for each woman). The most common age range was from 20 to 29 years old, and the least frequent age range was from 0 to 9 years old. Approximately 60% of the cases were caused by a collision. As for the victim's means of transportation, motorcycles were most frequently involved in urban traffic accidents (Table 1).

When observing the distribution of care per day of the week, with Tuesday as the reference, it was found that Friday had a 29% higher risk of urban traffic accidents. Assistance occurred about 5 times more often from 6:00am to 8:59am and from 6:00pm to 8:59pm, in relation to the reference time period of 12:00am to 2:59am (Table 2).

Table 2. Absolute and relative distribution, incidence rate, relative risk, confidence interval and p-value of urban traffic accidents assisted by the Emergency Mobile Care Services, according to day of the week and time of the occurrence in the city of Recife, Pernambuco, Brazil (January to June, 2015).

Variable	n (1.225)	%	IR[a]	RR[b]	95%CI[c]	p-value
Day of the week*						
Sunday	175	14.3	1.10	1.14	0.92 – 1.41	0.24
Monday	183	14.9	1.15	1.19	0.96 – 1.47	0.11
Tuesday	154	12.6	0.96	1.00		
Wednesday	159	13.0	0.99	1.03	0.83 – 1.29	0.77
Thursday	183	14.9	1.15	1.19	0.96 – 1.47	0.11
Friday	198	16.2	1.24	1.29	1.04 – 1.59	0.01
Saturday	173	14.1	1.08	1.12	0.90 – 1.40	0.29
Time**						
12:00am- 2:59am	40	3.3	0.25	1.00		
3:00am- 5:59am	41	3.3	0.26	1.02	0.66 – 1.58	1.00
6:00am- 8:59am	207	16.9	1.30	5.17	3.69 – 7.26	< 0.00
9:00am- 11:59am	160	13.1	1.00	4.00	2.83 – 5.66	< 0.00
12:00pm-2:59pm	179	14.6	1.12	4.47	3.18 – 6.30	< 0.00
3:00pm-5:59pm	186	15.2	1.16	4.65	3.30 – 6.54	< 0.00
6:00pm-8:59pm	224	18.3	1.40	5.60	4.00 – 7.84	< 0.00
9:00pm-11:59pm	142	11.6	0.89	3.55	2.50 – 5.04	< 0.00
Not informed	46	3.8				

[a]IR: incidence rate (number of occurrences/population exposed per 10,000 inhabitants); [b]RR: observed incidence/expected incidence IC: incidence coefficient (cases/10,000 inhabitants); [c]95%CI: confidence interval of 95%; *Tuesday was the day of reference; **reference period considered: 12:00am to 2:59am.

The neighborhoods with the highest frequency of traffic accidents were: Ibura (n = 76; 6.2%), located in the southern zone of the municipality; followed by Santo Amaro (n = 62; 5.1%), in the central zone; and Boa Viagem (n = 54; 4.4%), in the south zone (Figure 1A). The incidence of traffic accident assistance in the municipality was 7.67 times per 10,000 inhabitants. The neighborhoods with the highest RRs for the occurrence of traffic accidents were: Santo Antônio (RR = 43.76; 95%CI [23, 74; 80, 72]), followed by the neighborhood in Recife (RR = 23.17; 95%CI [12, 87; 41, 75]), which are both from the central zone of the municipality, and the University Campus (RR = 19.82; 95%CI [11, 52; 34, 08]), in the northwestern region of the municipality (Table 3 and Figure 1B).

When exploring the spatial dependency of this kind of occurrence using the BoxMap, positive correlation areas were identified in the south and northeast zones of the municipality (Table 3 and Figure 2A). The BoxMap also shows areas with negative spatial autocorrelation, represented by regions Q3 and Q4, which may indicate potential critical nodes (Figure 2A).

Finally, the MoranMap statistically confirms that the south regions of the municipality have the highest relevance for the occurrence of services provided after urban traffic accidents during the period analyzed. Transition regions in the vicinity of critical areas are also kept in the final model (Table 3 and Figure 2B).

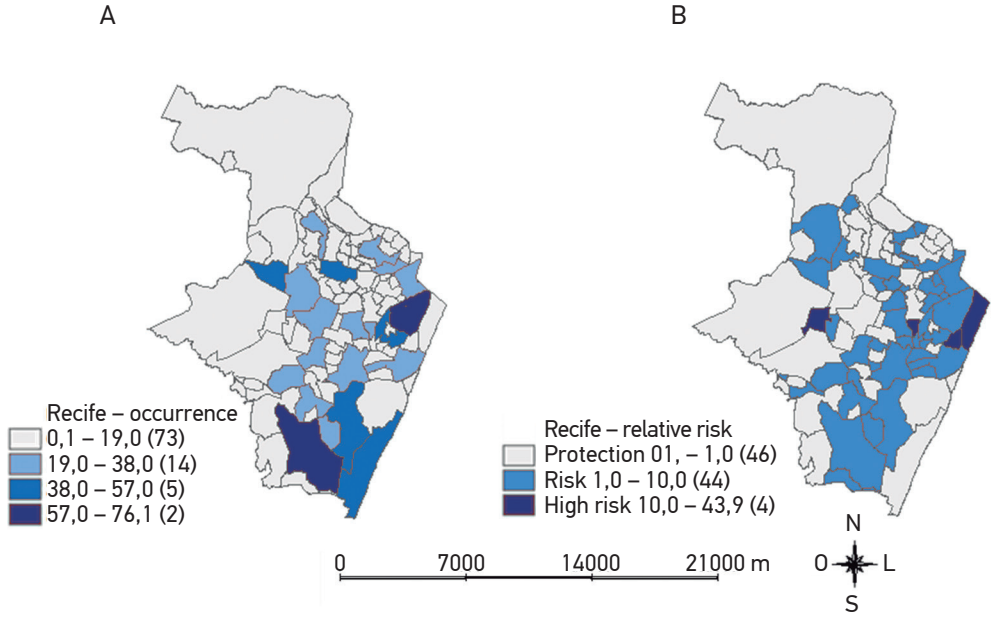

Figure 1. Occurrence (A) and relative risk (B) of urban traffic accidents, according to neighborhood. Recife, Pernambuco, Brazil (January to June, 2015).

DISCUSSION

This study observed that most of the assistance provided to victims of urban traffic accidents was performed by the USBs. This corroborates studies carried out in the state of Paraíba, whose findings reveal that more than 90% of services were performed by basic ambulances[29,30]. These are similar results to those found in other studies[31-33]. One of the possible

Table 3. Incidence rate, relative risk and confidence interval of urban traffic accidents assisted by the Emergency Mobile Care Services of the main neighborhoods. Recife, Pernambuco, Brazil (January to June, 2015).

Neighborhoods	IR(i)	RR(ii)	95%CI(iii)
Areias[b]	7.99	1.04	0.69 – 1.57
Barro[a,b,c]	4.20	0.55	0.32 – 0.93
Boa Viagem[a,b,c]	4.20	0.55	0.42 – 0.72
Boa Vista[a,b]	30.66	4.00	2.99 – 5.35
Bomba do Hemeterio[a,b]	16.93	2.21	1.33 – 3.67
Campo Grande[a,b]	23.18	3.02	2.00 – 4.57
Cidade Universitaria[a]	151.93	19.82	11.52 – 34.08
Derby[a,b]	124.63	16.26	11.13 – 23.76
Engenho do Meio[a,b]	14.98	1.95	1.19 – 3.20
Espinheiro[a,b]	12.82	1.67	0.99 – 2.83
Estancia[a]	13.45	1.75	1.02 – 3.03
Ibura[a,b,c]	14.35	1.87	1.49 – 2.36
Imbiribeira[b,c]	8.47	1.11	0.81 – 1.51
Ipsep[b,c]	8.40	1.10	0.70 – 1.70
Iputinga[a,b]	4.21	0.55	0.36 – 0.83
Jardim Sao Paulo[a,b]	8.16	1.06	0.71 – 1.58
Jordao[b,c]	8.28	1.08	0.68 – 1.72
Recife[a]	177.63	23.17	12.87 – 41.75
Santo Amaro[b]	21.21	2.77	2.14 – 3.57
Santo Antonio[a]	335.44	43.76	23.74 – 80.72
Município	7.67	1.00	–

[a]statistically significant neighborhoods to increased relative risk ($p < 0.05$); [b]neighborhoods with positive values and means by BoxMap; [c]neighborhoods with spatial significance ≥ 95% by MoranMap; (i)IR: incidence rate (number of occurrences/population exposed* 10,000 inhabitants); (ii)RR: observed incidence/expected incidence; IC: incidence coefficient (cases/10,000 inhabitants); (iii) 95%CI: confidence interval of 95%.

explanations is the fact that the municipality has the mostly this kind of ambulance. There are five times more USBs than advanced support units (*unidades de suporte avançado* – USAs).

As for destination units, the results observed were consistent with other studies[29-31], in which most victims were taken to a trauma hospital in the city. Especially in Recife, the high number of referrals to UPAs is due to their connection with one other, ever since January 2010, when they were integrated into the state emergency network.

Males and young adults deserve special attention in regard to the promotion of actions that prevent urban traffic accidents, since these groups are the most affected. Similar results were found in other studies[4-7,14,31,33,34]. According to the World Health Organization (WHO), these groups are about three times more likely to die in a transportation accident than young women[3].

This data may be a consequence of the young male population's exposure to traffic. Based on social and cultural behaviors, this group takes more risks when driving vehicles. These risks include driving at high speeds, using inappropriate maneuvers and drinking alcohol[14]. Those and other foolish behaviors are determinant characteristics for the alarming transportation accident rates in this population[35]. Potential social security expenses may be generated, raising costs to public coffers, due to the victims' impossibility to work and complete rehabilitation at the same time[36].

Collision is one of the most common types of accidents, especially when they include motorcycles[29,30,37,38]. Other studies displayed similar results, with motorcycles in first place in the involvement in traffic accidents[14,29,30,33,39].

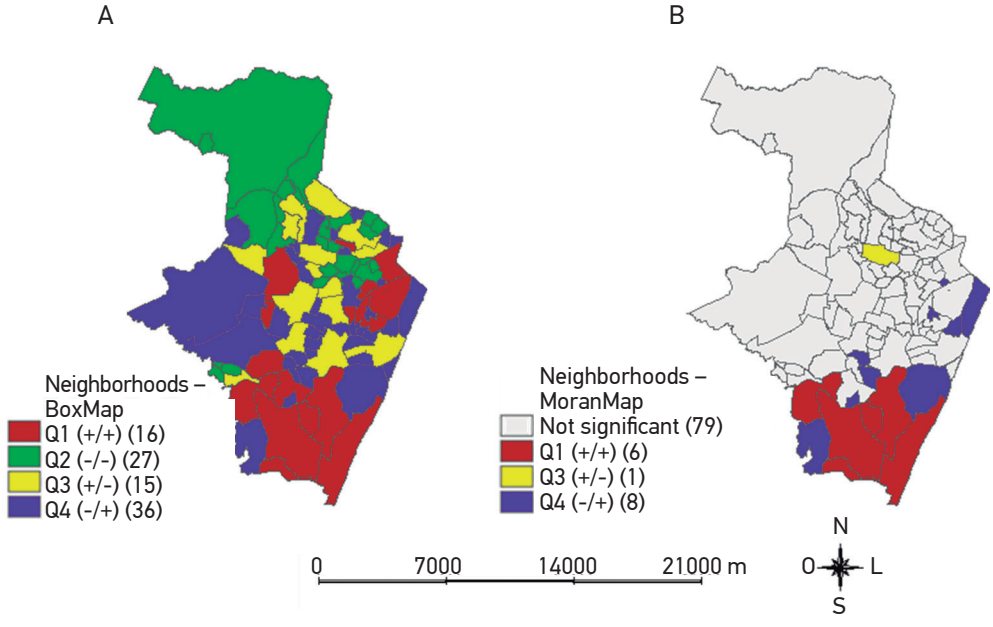

Figure 2. BoxMap (A) and MoranMap (B) of urban traffic accidents, according to neighborhood. Recife, Pernambuco, Brazil (January to June 2015).

Motorcycles became a very popular automotive vehicle for many reasons, including the ease with which they can be acquired and paid for, their agility in slow traffic in large metropolises and the money they saves on fuel and maintenance. All of these factors may directly influence the populations' choice, resulting, thus, in an increased number of motorcycles and, consequently, an increased frequency of motorcycle accidents. It should be considered that this increase in the purchase of motorcycles is not accompanied by appropriate investment for drivers' safety [40-42].

When observing services according to day of the week and time of the accident, Friday had the most occurrences. However, other studies[33,34,42,43] reported that the highest frequency of transportation accidents occurred on Sundays, probably due to a greater number of commemorative events, among other factors, such as alcohol consumption, passing at high speeds, and risky maneuvers.

The times with the most occurrences are probably related to the rush hour times of the city, i.e., the time when the most vehicles are in movement, going back and forth from work, college and school. Similar studies carried out in the municipality of Olinda[14], observed a predominance of occurrences between 6:00pm and 11:59pm, which could be explained by fatigue as well as physical and mental exhaustion, which make people more vulnerable to accidents.

When analyzing the frequency of accidents by neighborhood, it is possible to suggest some hypotheses regarding the neighborhoods with the highest numbers of urban traffic accidents. For example, the neighborhoods are traversed by large high-traffic vehicle highways, which access important parts of the city, such as universities and airports. Some neighborhoods also connect the central and northern zones of Recife, with access roads marked by retention points.

Another important neighborhood, in addition to being touristy and having the city's main beach also has most of the hotel network and a significant amount of schools, restaurants, doctors' offices and a shopping mall. These factors contribute to increase the flow of vehicles on main avenues.

Commercial neighborhoods that are known for their cultural and tourist programs, such as Carnival and Christmas festivities, are located in the central region of the city. They have a greater risk of transportation accidents, which is expected, considering the high vehicle flow and low resident population. A similar result was found in another study[29], in a commercial neighborhood in the municipality of João Pessoa, Paraíba, which had the highest risk for SAMU services.

The highest risk areas for urban traffic accidents pointed out by the BoxMap and the MoranMap show that there is a pattern for the occurrence of such events. When observing Q1 neighborhoods in both spatial analysis techniques, it was found that the high occurrence of accidents in both (statistically significant) situations takes place in the southern region of the municipality.

A possible hypothesis for the high rates found in this region is that it contains the main traveling routes toward Suape's Industrial Port Complex, which, since 2007, consists of one

of the largest industrial and port hubs in northeastern Brazil. The complex began to attract large public and private investments, and became, along with its surroundings, a massive "construction site"[44], resulting in a greater flow of vehicles circulating the southern region of the capital city.

Spatial analysis studies on urban traffic accidents have proven useful in order to identify risk areas of occurrences, that is, places where surveillance actions should be revisited. They should encourage the implementation of a preventive approach in addition to provide a support tool for traffic safety actions[36,45]. Another study[14] performed using spatial analysis ratified the importance of integrating the Municipal Health Department and related organs for the implementation of preventive and corrective measures.

Research carried out in Teresina, Piauí, emphasized the importance of spatial analysis in order to determine priority areas and encourage actions from public management and professionals inserted in different health programs of different groups of users, particularly those who are most vulnerable[46].

In the present study, spatial analysis was proven feasible to identify risk areas for the occurrence of transportation accidents, by using secondary SAMU data, similarly to what was found in other studies [29,30]. One of the limitations of this research project regards the incomplete recording of data, especially concerning greater details on the location of the occurrences, making it impossible to carry out pertinent analyses. Incidence estimates of RR, calculated based on the population living in the neighborhoods may have been affected by victims living in other municipalities, leading to an overestimation of cases in some neighborhoods. Although this is expected when it comes to metropolitan regions and when the estimated population around the municipality is not taken into account. In addition, despite the fact that SAMU covers 100% of the municipality, there are victims attended by the Fire Department or even by third parties, and these data were not considered in this study.

It is important to organize health assistance appropriately in relation to the surveillance of occurrences attended by SAMU. Furthermore, there must be a balanced approach regarding the problems identified, in agreement with the principles of the Unified Health System (*Sistema Único de Saúde* – SUS)[34]. SAMU's data sheets, based on spatial analysis, were an important source of information for health surveillance.

CONCLUSION

SAMU's services were predominantly carried out by basic support units. Most victims consisted of young, male adults, especially motorcyclists. The spatial analysis of urban traffic accidents identified critical areas for the occurrence of assistance during the period analyzed.

The findings of this study highlight the importance of urban traffic accident prevention actions in an intersectional manner focusing, especially, on the identified risk group.

Identifying critical time periods, which coincide with traffic rush hours in the city, as well as the areas forming significant spatial regions, may be the basis for the implementation of educational actions in places that are most affect. The actions would be geared toward the most vulnerable population, thus increasing their effectiveness.

The spatial analysis of urban traffic accidents, which is unprecedented in the city of Recife, gives SAMU the possibility of using the results found in this study to plan and redistribute their decentralized units, with the objective of streamlining and improving their services.

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