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Traffic accidents in Belo Horizonte: the view from three different sources, 2008 to 2010

Acidentes de trânsito em Belo Horizonte: o que revelam três diferentes fontes de informações, 2008 a 2010

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ABSTRACT: *Objective:* To analyze the contribution of three data sources in the description of traffic accidents in the city of Belo Horizonte, Brazil. *Methods:* Exploratory study of databases: BHTRANS (metropolitan traffic and transportation authority), Hospital Admissions and Mortality Information Systems, with estimation of proportions, coefficients and odds ratios. *Results:* Incomplete data was observed in the three sources, especially regarding alcohol consumption by drivers and use of safety equipment. The victim profile among the sources was consistent: young adults, males, motorcycle riders and pedestrians. In addition to the high mortality rate (19.4 per 100.000 inhabitants), an increase in the number of non-fatal accidents was observed. An increase of 34% in hospital admissions and of 53% in hospital costs was evidenced. The motorcycle accident rate is higher than expected given the fleet composition. Male drivers have the highest risk of injury or death; relative to drivers, passengers or pedestrians have a 1,8 times higher risk of death. There was a 12% increase in the number of deaths at the site of the accident, 55% of which showed positive evidence of alcohol use and 50% higher risk of fatal accidents on weekends. *Conclusions:* Despite some incomplete record keeping and non-specific death registry codes, it was possible to characterize the main factors associated with accidents: elderly pedestrians, motorcycle riders, alcohol consumption and speeding. The study demonstrated the complementarity of the three data sources, with their different goals, and revealed important features of the traffic accident event-chain and victim profile, providing key data for the development of mitigation strategies.

Keywords: Traffic accidents. Data sources. Information systems. Hospitalization. Mortality. Assessment.

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RESUMO: *Objetivo:* Analisar a contribuição de três diferentes fontes de informações na descrição de acidentes de trânsito em Belo Horizonte. *Métodos:* Estudo exploratório dos Sistemas de Informação da Empresa de Transportes e Trânsito, de Internações Hospitalares e Mortalidade, com análise de proporções, coeficientes e medidas de associação. *Resultados:* Preenchimento inadequado nas três fontes, destacando o uso de equipamentos de segurança e de álcool pelo condutor. Perfil de homens, jovens, ocupantes de motocicleta ou pedestres semelhante nos três sistemas. Além do alto coeficiente de mortalidade dos residentes em Belo Horizonte (19,4 por cem mil habitantes) no período, observou-se aumento dos acidentes e de vítimas não fatais com concomitante elevação na taxa de internação (34%) e custos hospitalares (53%) e maior envolvimento de motocicletas, proporcionalmente à frota. Os homens condutores apresentaram mais chance de serem feridos ou mortos. Passageiros ou pedestres apresentaram 1,8 vezes a chance de morrer, comparados aos condutores. Verificou-se aumento (12%) das mortes em via pública com 55% de positividade nos exames toxicológicos e 50% mais chance de acidentes fatais nos finais de semana. *Conclusão:* Apesar da incompletude dos registros, foi possível caracterizar como principais fatores associados aos acidentes os pedestres idosos, motociclistas, o uso de álcool e excesso de velocidade. O estudo demonstrou a complementaridade das três fontes de dados, com seus diferentes objetivos e permitiu revelar importantes aspectos da cadeia de eventos relacionados aos acidentes e vítimas de trânsito, desde sua ocorrência até a eventual evolução fatal, fornecendo informações relevantes da magnitude do problema para guiar estratégias de controle.

Palavras-chave: Acidentes de trânsito. Fontes de dados. Sistemas de informação. Hospitalização. Mortalidade. Avaliação.

INTRODUCTION

Traffic accidents (TA) are an important public health problem worldwide that requires joint efforts for effective and sustainable prevention[1]. Brazil ranks fifth among countries with the highest rates for traffic accident-related deaths, with estimation of 40,000 deaths per year[2] that, added to seriously injured victims, account for over 150 thousand people and total costs around R$ 28 billion per year[3]. The most relevant impacts of CA morbimortality are seen among young males[4], with great repercussion to the health system.

The development and implementation of traffic accident prevention policies depend directly on information aimed for surveillance and monitoring systems, and on the analysis of situations in order to determine the magnitude of occurrences, victims' profile, means of transportation involved, and the mapping of risk areas[5]. Such information is not fully available in most countries, Brazil included.

Measures adopted in the country to reduce CA morbimortality have not presented the expected results[3]. Among the reasons pointed in literature, data about victims, which can support planning and monitoring, are spread in different databases and, in isolation, are not able to show the actual magnitude of the problem. The World Health Organization (WHO) recommends that more than one data source be used in such cases as a shorter and less tortuous path to a broader understanding of health problems[6]. Traffic accidents with victims are routinely registered by local police authorities in police reports (BO, in

Portuguese). This legal tool brings information on type of accident, number of people involved, and presence of injured or fatal victims. Cases that demand hospitalization are registered in medical reports. Fatal victims, regardless of the length of time between the accident and one's death, are registered in death certificates issued by the Institute of Legal Medicine (IML), a mandatory procedure in cases of death by external causes.

Records managed by different institutions must be fully considered to better understand this contemporary phenomenon which strongly impacts Public Health.

This study, as a part of *Avaliação do Projeto Vida no Trânsito*[7], seeks to evaluate the completeness of different information systems in order to improve characterization of road accidents and victims in Belo Horizonte, Minas Gerais, Brazil.

METHODS

Exploratory study performed with three databases: Information System of BHTRANS, Belo Horizonte's Transportations and Traffic Company (BH10), Hospital Information System (SIH) and Mortality Information System (SIM), from 2008 to 2010.

BH10 includes all traffic accidents that happen within the limits of the municipality based on police reports issued at the moment and place of accident, covering information about all people involved and the accident circumstances.

All people included in the Police reports were considered involved in cases (drivers, victims, witnesses, car owners). If applicable, information about age, gender, presence of injury, deaths, condition of passenger or driver, use of safety equipment (seat belt, helmet, child seat), license, and alcohol intake were made available when it came to drivers. Data about type and circumstances of the accident included: type of accident (collision, run over, fall); vehicles involved (car, bicycle, bus, motorcycle, truck); severity (fatal or non fatal); month, day of the week or weekend (Saturday and Sunday) of occurrence, time and place; highway conditions (traffic signs, paving – asphalt or others); weather conditions (good, rainy, cloudy).

SIH holds information about Hospital Admissions (AIH) for payment of services delivered by the National Public Health System (SUS). Records containing primary or secondary diagnosis of traffic accident according to codes V00 to V89, based on the 10th International Disease Classification (IDC-10) were selected. Records whose discharge was marked as "permanence" were excluded from the sample, once they corresponded to an administrative act performed while the patient was still hospitalized, but submitted to new treatment procedures. However, these records were also used in analysis of costs, type of procedures used and need of intensive care assistance. The following variables related to patients admitted to hospitals of the SUS network (hired or associated) were: age group, gender, educational level, occupation, city of living and of hospital admission (Belo Horizonte, others). In order to obtain data about the highway user (pedestrian, cyclist, motorcycle riders, car drivers, bus drivers, truck drivers, unspecified vehicle), IDC-10 codes at secondary diagnosis were used.

Data about hospitalization included reasons for admission (primary diagnosis), date of admission and discharge, reason for discharge (cure, improvement, death, referral, other), type of procedures (clinical or surgical), and cost of hospitalization, assistance at intensive care unit, and legal nature of the institution (public, hired, associated).

Information about deaths was obtained from death certificates and reports issued by the IML and registered at SIM. Data was selected in databases with the codes V00 to V89 of IDC-10.

Variables analyzed were age group, gender, educational level, marital status (single, married, widow(er), divorced or legally separated), ethnicity (white, black, brown) and place of death (hospital, health institution, scene of accident). Type of highway user was selected as basic cause. Variables related to city of living and city of accident were grouped as Belo Horizonte and others.

Post-mortem relation to alcohol, marijuana, cocaine and crack was assessed based on investigative reports issued by IML, obtained in active search and included in SIM by the epidemiological surveillance Committee. Results of toxicology tests were classified according to IDC-10. Positive blood alcohol level was identified by Y90.0 to Y90.9; blood marijuana metabolites level, by F12.0 to F12.9, and cocaine/crack, by F14.0 to F14.9.

Analyses included absolute and relative frequencies, estimates of accident rates and fatal victims per 10,000 vehicles ration, considering Belo Horizonte's fleet as denominator of due years[8], and hospitalization rate per traffic accident among Belo Horizonte inhabitants[9], by city of death occurrence.

Univariate analysis and risk estimates with 95% confidence interval (95%CI) for fatal accidents on weekends (Saturdays and Sundays); deaths on the scene of accident — driver or passenger/pedestrian — and injury or death on the scene of accident as regarding gender of drivers. Data were organized and statistical analyses were made in EpiInfo 3.5.1.

The study was approved by the Ethics Committee of UFMG and by the State Health Department of Belo Horizonte, protocols 158.014/2012 and 182.177/2012.

RESULTS

Each database provided information that was essential to the understanding of traffic accidents with victims (Table 1).

The traffic information system allowed a characterization of accidents and provided data about people involved in accidents: identification of injured or fatal victims, gender and age, as well as the drivers' characteristics. These form blanks were fulfilled in 93% of cases. Although this was the only source of variables relevant for the identification of factors associated with accidents (use of safety equipment, alcohol intake by the driver, highway conditions, local traffic signs, type of driver license), these blanks were found incomplete more often, which limited the analysis. There were no data available about socioeconomic status and place of residence of people involved, nor information about severity of injuries, being the record limited to registration of death occurrence on the scene of accident of within the first hours after the happening (Table 1).

Table 1. Availability of data on Traffic accidents according to source, Belo Horizonte, 2008 – 2010.

Variables	BH10	SIH	SIM
Accident's characteristics			
Type	S	±S	±S
Date and time	S	N	N
Place	S	N	±
Local traffic signs	±	N	N
Weather conditions	S	N	N
Road conditions	±	N	N
Vehicles involved	S	±	±
Drivers' characteristics			
Age	S	N	N
Gender	S	N	N
Driver license	S	N	N
Alcohol use	±	N	N
Victims' characteristics			
Age	S	S	S
Gender	S	S	S
Place of living	N	S	S
Occupation	N	±	±
Educational level	N	±	S
Skin color	N	N	S
Marital status	N	N	S
User of the road	S	±S	±S
Driver/passenger	S	±	±
Use of safety equipment	±	N	N
Toxicology test/blood alcohol level	N	N	±
Work-related accident	N	N	±
Consequences			
Type of lesion	N	S	S
Severity of lesion	±	±S	S
Date of hospital admission	N	S	N
Date of death	N	S	S
Impact on Health services	N	S	±S
Outcome	±	S	S

S: available in database; ±S: can be derived from database; ±: limited data; N: not available; BH10: BHTRANS Information System; SIH: Hospital Admissions Information System; SIM: Mortality Information System.

Databases on hospitalizations and mortality covered more complete data about victims characteristics, as socioeconomic variables (educational level, ethnicity / skin color) were only fully available at SIM and presented high completeness rates (above 96%). Fulfilling of information about educational level and occupation at SIH was satisfactory (below 10%). Hospitalization costs, procedures, and assistance at intensive care unit were able to estimate the impact on health services in SIH. Use of less specific codes (IDC-10) in secondary diagnosis at SIH and primary cause at SIM limited the analysis of accident characteristics. The absence of this information and non correlation to hospitalization or death by traffic accidents underestimates the number of victims and makes accidents characterization more difficult (Table 1).

At SIM, records about occupation and work-related accidents were inadequately fulfilled. The place of accident was not informed in 80% of the records between 2008 and 2009, and in 55% of records in 2010. SIM also allowed identifying deaths on public highways and out of the city. Between 2008 and 2010, 48,918 traffic accidents with victims happened within the limits of Belo Horizonte, including roads crossing the city, thus accounting 109,322 people involved in accidents and 61,950 victims, according to BH10. All 10,374 hospital admissions (SIH) and 1,869 deaths (SIM) were related to accidents inside and out the city. Deaths occurred on the scene of accident or at health institutions.

ACCIDENTS WITH VICTIMS ACCORDING TO POLICE REPORTS – BH 10

There was an increase of 6% in number of victims, especially males (72%), Young people aging 18 to 29 (45%), or adults aging 30 to 39 (22%). Table 2 shows a reduction in the ratio fatal victims and obits among pedestrians (41%).

Cars (46%) and motorcycles (34%) were the vehicles more often involved in accidents with pedestrians, to which 18% of the elderly and 15% of teenagers younger than 15 years fall victim. Males were more often among injured drivers (OR = 1.66; 95%CI 1.59 – 1.73) or those dead on the scene of accident (OR = 3.25; 95%CI 1.87 – 5.67). Pedestrians or passengers were almost twice more likely to die on the scene of accident (OR = 1.81; 95%CI 1.58 – 2.08) when compared to drivers. Increase in traffic accidents (7%) was below the increase of vehicle fleet (20%), with a reduction in the accidents / fleet ratio from 142 to 126 per 10,000 vehicles (Table 2). Considering the fleet, the proportion of 6.8% of motorcycles involved in accidents was quite superior to that related to cars (1.6%).

Severity of motorcycle accidents was evidenced by the proportion of fatal victims, which is nearly three times higher than fatal victims by car accidents (Table 2). Car collisions (70%) and accidents with pedestrians (19%) were the most common types of accident. While accidents were more frequent on Fridays (16%) and between 12p.m. and 9p.m. (54%), fatal cases were 50% more likely to happen on weekends (95%CI 1.20 – 2.05), mostly (42%) between 9p.m. and 6a.m. Good weather conditions (91%) and paved roads (97%) were registered in the vast majority of Police reports.

Table 2. Fatal and non-fatal traffic accidents, number of people involved, number of victims and deaths on the scene of accident; Accident and Fatal accident rates per 10,000 vehicles, total and stratified by automobile and motorcycle, Belo Horizonte, 2008 – 2010.

Year	2008	2009	2010
Accidents with victims	15,719	16,377	16,822
Accident rate*	141.96	134.22	126.26
Accidents with fatal victims	268	274	249
People involved in accident	34,934	36,838	37,550
Victims	19,948	20,874	21,137
Number of deaths[†]	273	288	262
Accident with pedestrian	104	123	111
Car collision	43	52	52
Motorcycle	105	88	83
Others	21	25	16
Fleet	1,107,259	1,220,125	1,332,381
Automobiles	785,904	863,760	937,819
Motorcycles	131,800	149,046	163,489
RVF** per vehicle	2.46	2.36	1.97
RVF per automobile	0.50	0.60	0.55
RVF per motorcycle	7.96	5.90	5.08

Source: BH10 database; Vehicle fleet composition: SisMob-BH[8]/BHTRANS/PBH.
*accident rate per 10,000 vehicles; [†]mostly at site of accident; **fatal accident rate per 10,000 vehicles.

TRAFFIC ACCIDENTS VICTIMS ACCORDING TO HOSPITAL ADMISSIONS – SIH/SUS

Three public hospitals held more than 90% of admissions due to TA. The progressive increase in hospitalization due to TA in the years studied and predominance of males (81%), young people aging 18 to 29 (39%) or adults aging 30 to 39 years (19%) among victims validate information obtained from BH10. Among residents of the city capital (47%), hospitalization rates increased from 6.2 to 8.3 per 10,000 inhabitants. Table 3 shows predominance of motorcycle riders among victims of traffic accidents. In this period, hospital admissions due to car accidents increased by three times, as well as those involving motorcycles (43%) and pedestrians (13%), with reduction in cases involving bicycles.

Head and neck trauma (31%), lower limb trauma (28%), and polytrauma (6%) were the leading causes for hospital admissions, as 23% required intensive care. Surgical procedures were performed in more than 70% of cases. In this period, an increase of 12% was seen in the proportion of hospital discharge due to healing or improvement, and reduction

of 20% in deaths. In 2010, 3,191 (79%) of hospital admissions had favorable outcomes and 283 (7%) patients died. Referrals and other reasons accounted for 543 (14%) of all hospital admissions (Table 3). Costs increased by 53% between 2008 and 2010, going from R$ 9.3 to 14.2 million due to admissions in intensive care units, accounting for more than half of all costs in 2010.

TRAFFIC ACCIDENTS FATAL VICTIMS ACCORDING TO SIM DATA

1,869 deaths by TA occurred in the period, accounting for 26% of deaths by external causes. Most fatal victims (53%) were residents of Belo Horizonte, males (79%), young people aging 18 to 29 (30%) or adults aging 30 to 39 (18%), single (60%), brown or black-skinned (62%), with less than eight years of study (56%). The level of the aged among deaths due to TA (21%) was higher than that regarding hospital admissions (7%) or police reports (6%). About 30% of deaths of Belo Horizonte residents happened in other cities. There was a 40% increase in mortality rates among residents, from 13.9 to 19.4 deaths per 100,000 inhabitants, when deaths in other cities were included.

Among annual deaths by TA, more than two thirds (479 on average) of cases happened in Health Institutions, almost exclusively in public hospitals (96%). There was a 12% increase in deaths on public highways, on the scene of accident (129 in 2008 to 145 in 2010). A higher rate of death of pedestrians was also found, followed by the death of motorcycle riders and car drivers (Table 3). In 2009, an increase in deaths by "unspecific" TA was reported, as related to 2008 and 2010, reaching 26% of total number of deaths. However, the distribution of road users was similar in all years. In 2010, automobiles were mostly involved in accidents with pedestrians (28%), followed by heavy vehicles such as bus and trucks (22%), and motorcycles (21%).

The leading injuries reported in death certificates were polytrauma (53%), head and neck trauma (35%), and chest and abdominal trauma (6%).

In the course of this three-year study, toxicological test was positive for alcohol, marijuana and / or cocaine / crack in 348 (18.6%) cases of death. Among 432 fatal victims on the scene of accident, 55% were positive for toxicology, while among obits in hospitals (1,437) only 11% of tests were positive. In 275 (79%) of positive tests, alcohol was detected in isolation. Association of alcohol and illicit drugs (marijuana, cocaine / crack) was found in 38 death cases (11%), and illicit drugs only were detected in 35 cases (10%).

DISCUSSION

This study allowed a broader understanding of traffic accidents in Belo Horizonte, for it brought information from different sources: police officers at the scene of accident, health

Table 3. Distribution of hospital admissions due to traffic accidents, according to reason for hospital discharge and cause of deaths by type of road user, Belo Horizonte, 2008 – 2010.

2008							
	Hospitalization (SIH)					Deaths (SIM)	
	Cure/ improvement n = 2,246 (71.26%)	Referral n = 540 (17.13%)	Death n = 277 (8.79%)	Others n = 89 (2.82%)	Total n = 3,152 (100.00)	n = 652	
Road user	%	%	%	%	%	n	%
Pedestrian	21.06	20.00	42.96	22.47	22.84	260	39.88
Motorcycle rider	45.10	45.19	28.88	56.18	44.00	178	27.30
Automobile passenger/ driver	7.48	3.33	0.72	7.87	6.19	114	17.48
Bicycle rider	12.20	4.81	6.50	10.11	10.37	21	3.22
Others	1.69	1.48	2.89	0.00	1.71	23	3.53
Unspecified	12.47	25.19	18.05	3.37	14.88	56	8.59
Total	100.00	100.00	100.00	100.00	100.00	652	100.00
2009							
	Hospitalization (SIH)					Deaths (SIM)	
	Cure/ improvement n = 2,455 (76.60%)	Referral n = 488 (15.23%)	Death n = 254 (7.93%)	Others n = 8 (0.25%)	TOTAL n = 3,205 (100.00%)	n = 592	
Road user	%	%	%	%	%	n	%
Pedestrian	20.65	17.83	46.46	62.50	22.37	216	36.49
Motorcycle rider	47.37	48.57	23.62	12.50	45.59	104	17.54
Automobile passenger/ driver	11.12	12.30	10.63	25.00	11.29	96	16.22
Bicycle rider	10.06	4.30	6.69	0.00	8.89	15	2.53
Others	1.47	1.64	0.79	0.00	1.44	8	1.35
Unspecified	9.33	15.37	11.81	0.00	10.42	153	25.84
Total	100.00	100.00	100.00	100.00	100.00	592	100.00

Table 3. Continuation.

	2010						
	Hospitalization (SIH)					Deaths (SIM)	
	Cure/ improvement n = 3,191 (79.44%)	Referral n = 524 (13.04%)	Death n = 283 (7.05%)	Others n = 19 (0.47%)	Total n = 4,017 (100.00%)	n = 625	
Road user	%	%	%	%	%	n	%
Pedestrian	18.30	20.23	41.70	26.32	20.24	249	39.84
Motorcycle rider	51.80	46.37	27.92	52.63	49.41	156	24.96
Automobile passenger/ driver	13.57	21.56	15.90	10.53	14.76	143	22.88
Bicycle rider	7.74	3.24	4.95	10.53	6.97	19	3.04
Others	1.35	2.10	3.18	0.00	1.57	26	4.16
Unspecified	7.24	6.49	6.36	0.00	7.05	32	5.12
Total	100.00	100.00	100.00	100.00	100.00	625	100.00

Source: SIM and SIH/ Department of Health of Belo Horizonte.
SIH: Hospitalization Information System; SIM: Mortality Information System.

professionals at health institutions, and forensic doctors through death certificates. Our findings show the liability of different sources with different purposes and point of view to collect data, and justify the increasing use of such databases. Linking information from different, more complete and trustworthy sources[10,11] can be a reliable strategy for the assessment and characterization of Information Systems, and also for the improvement of actions to reduce TA.

All three databases lacked some information, which confirms the findings of previous studies on Information Systems[12], reflecting inadequate fulfilling of data regarding important risk factors for severe and fatal accidents: alcohol intake by the driver and misuse of safety equipment[1]. The adequate report of this type of information should be continuously encouraged[12]. The limited availability of information about the place of accident (such as road conditions and traffic signs) suggests the use of tools such as Google Street View to help analyze these features[13]. Although SIH only holds information about hospital admissions at SUS, it covers well the most severe accidents, a gateway to the public health system. Deaths in hospitals may reflect the severity of accidents or poor quality of health care, as well as hospital discharges. Universal coverage of SIM shows total number of deaths, including those happening on the streets, hospitals or out of the city. Fluctuation in death rates due to TA classified as unspecific in the studied period, which increased in 2009, represents a challenge

in continued qualification of secondary databases and points the importance of completing data with information from other sources, including search in newspapers[14] and consultation to legal medical reports and certificates. The distribution of deaths per institutions as found at SIM, allows one to know services with greater demand of care in cases of death.

The reduction in TA in proportion to the city fleet was also seen in Campinas by Marín-León et al.[15], who attributed this finding to the slowness in traffic due to the large number of cars on streets. Isolated analysis of this indicator should be avoided, once it does not point an effective reduction in the risk of injuries and death. Although the increase in number of accidents were not exactly related to the urban fleet increase, the magnitude of the problem was reflected in the annual increase of accidents with fatal and injured victims, which places TA as one of the most significant public health problems not only in Belo Horizonte, but in all cities of Brazil[4]. Besides that, mortality rates due to TA are high, indicating the need for effective interventions to substantially reduce these indexes[3,4]. Despite improvements in legislation, the implementation of traffic control agencies, improvement in automobiles' safety, and use of electronic monitoring in traffic, no reduction in accidents, deaths and disabilities resulting from them were seen in our study[3].

The profile of victims identified in these Information Systems was similar to that reported in literature[3-5]. The high rate of fatal victims compared to hospital and traffic reports suggests high severity of lesions in this population as a result of fragility and presence of comorbidities common to this group of people[16]. Moreover, most of the victims were pedestrians, that is, more vulnerable to direct impact by cars[16].

The finding of predominantly black/brown-skinned or less educated fatal victims points to inequity in TA deaths, rooted in social determinants[17,18]. This information, made available only by SIM, is essential for the definition of public policies and strategies aimed at the most vulnerable groups.

The greater involvement of young male motorcycle riders or car drivers, on weekends[3], suggests a relation between TA and the use of psychoactive substances, evidenced by blood alcohol and drugs level detected in more than half of death cases on the scene of accident. A study on fatal victims in the Federal District showed high rates of alcohol use (43%)[19]. A survey on alcohol intake in Brazil pointed a 35% prevalence of drinking-driving relation, 6 times higher chances of males drive after using alcohol, and 7 times higher chances of previous involvement in alcohol-related accidents[20]. More rigidly in road monitoring with the use of breath alcohol analyzers could reduce these numbers[19,21]. Previous use of illicit drugs in 21% of fatal victims point to the need of surveillance aimed at these substances, as there are laws on the subject already[22].

The range of motorcycles in cities and the vulnerability of riders, ranking first in hospital admissions and second in death cases, have made them target in prevention

actions[23]. Motorcycles are used as work tools, and some riders are subjected to long workshifts and low wages by clients and employers[24].

The study showed that motorcycle riders have been responsible for an expressive portion of accidents with pedestrians[3,25], which happen especially with people under the age of 15 and with the elderly. The authors gave emphasis to the double risk of accidents with pedestrians by motorcycle riders compared to car drivers[25]. Freitas et al. analyzed traffic accidents involving children and reported that 76% of them resulted from accidents with pedestrians or with bicycle riders[26]. A study about victims of trauma suggested that accidents with pedestrians are the second leading cause of trauma among the elderly, being fall the first[16]. Vulnerability of pedestrians was shown in the analysis of hospital admissions and deaths[3].

The large number of fatal victims in the scene of accident, including passengers or drivers, reinforces the idea that, despite the increase in cars' safety and the presence of speed radars, most severe accidents resulted from overspeeding, even on urban streets[27]. The increase in hospitalization rates reflects the severity of traffic accidents, as well as the types of injury found in death certificates and hospital admission reports. Polytrauma was the main cause of death, mostly immediate, and head trauma were the leading cause for hospital admission. In literature reviews, head/neck was the second mostly affected region of the body in accidents, preceded by upper/lower limbs injuries[28]. The high rate of hospital discharge by improvement of patient's condition and the decrease in death rates among patients admitted to hospitals may suggest a better pre-hospital and hospital care. However, the large number of deaths on the scene of accident reveals the need for further specific studies on this theme.

The public health emergency and urgency network in Belo Horizonte has three reference trauma centers, where almost 100% of patients were admitted due to TA, which points the need of actions aimed at improving the assistance to these victims at these institutions[6]. The correct codification of diagnosis at AIH must also be stimulated, for these data generate accurate information about hospital admissions by TA, a significant public health problem in Brazil.

High costs of hospitalization, especially for the public health network, were also found in other studies[29,30]. These costs arise from complex procedures such surgeries and intensive care assistance. Hospital admissions by external causes were shown to have higher costs than those by natural causes, and admissions by TA have a higher average cost[29]. Reduction in hospital admissions, severity of injuries and costs could be reached if prevention measures were taken, correct use of safety equipment included[3].

In 2001, the Ministry of Health issued the National Policy for the Reduction of Morbidity and Mortality from Violence and Accidents[31], implemented in Belo Horizonte, based on the magnitude, risk and importance of TA in overall mortality rates[4,32], which was confirmed by our findings. In 2010, these proposals were broadened and strengthened with the creation of Project Life in Traffic[7].

Although there was no reduction in mortality related to TA, it is important to note the mobilization of the Municipal Health Department and intersectorial articulations that allowed integration of data from Police reports and Health reports. This initiative allowed implementing inspection and educational actions regarding traffic, with special emphasis to the most vulnerable groups.

The use of secondary databases with inadequate fulfilling of information limited the analysis of important features such as alcohol and safety equipment use by car drivers. Isolated assessment of different databases cannot assure analysis of the same individuals. Not all injured victims reported in Police reports were admitted to hospitals, nor did hospitalizations and deaths within the limits of the city exclusively correspond to TA that took place in the city, that is, the ones that can be managed by local traffic agencies.

Linking data from different sources allows completing information available at each database, and also relating victims' reports to the type of accident and outcomes, expanding understanding of this relevant public health issue.

CONCLUSION

Our study was able to show the completeness of all three sources of information used, with their respective purposes, and allowed pointing out important aspects of the events related to traffic accidents, from the moment they happen to possible death occurrences.

Differences in the estimates of number of injured and fatal victims found in databases represent a difficulty in measuring the actual magnitude of traffic accidents. Despite incompleteness of data and the use of unspecific codes in records, which hinders the exact listing of all victims, our study showed the vulnerability of young males, especially motorcycle riders, and pedestrians, namely the elderly. Our findings could also show the severity of accidents, reflected by the large number of fatal victims on the scene of accident and the type of lesions reported, raising the hypothesis of overspeeding as associated factor, as well as alcohol and/or drug abuse, related to more than half of deaths on the scene of accident.

The increase in mortality coefficient related to TA among Belo Horizonte inhabitants, added by deaths occurred out of the city limits, mostly on roads administered by State or Federal entities, underlies the need for broader policies and the importance of intersectoral and interinstitutional actions.

The identification of vulnerable groups and risk factors related to traffic accidents are essential to the development of public policies based on evidence, supporting planning and more effective interventions aimed at the reduction of TA morbimortality.

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