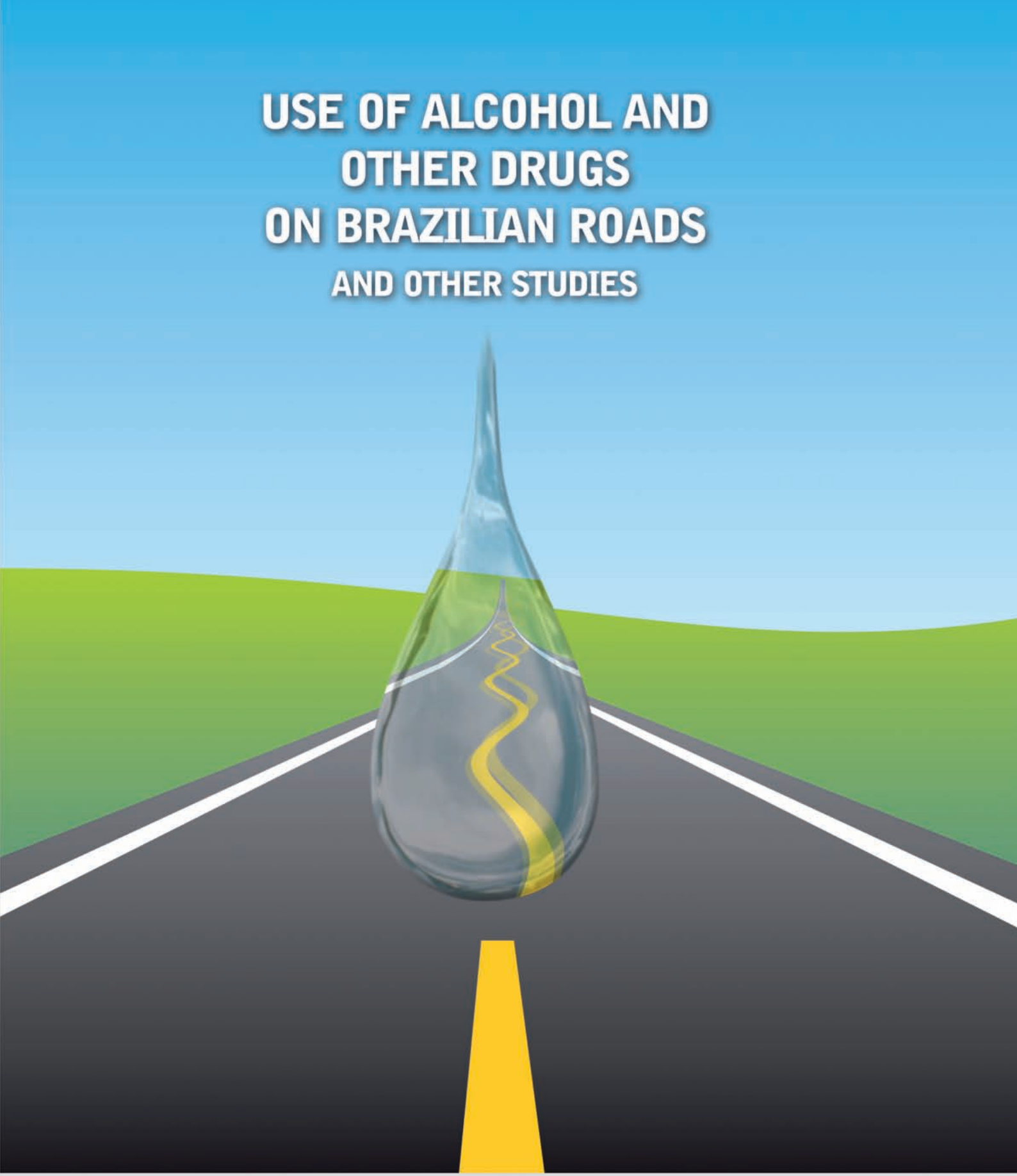
USE OF ALCOHOL AND OTHER DRUGS ON BRAZILIAN ROADS

AND OTHER STUDIES



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Introduction

There is much evidence of the high economic and social costs of inappropriate consumption of alcoholic beverages. These costs are a direct consequence of the damage to individual and collective health, of the high number of accidents, and of cases of violence, early disability, and, unfortunately, a large number of deaths.

Other psychoactive drugs besides alcohol, consumed by drivers, are a constant concern for the government and society at large. The association between drugs and accidents impacts not only on the number of traffic accidents but, above all, in their severity.

Being aware of this reality, and in accordance with the principles of the National Policy on Drugs and the National Policy on Alcohol, the Federal Government sponsored the "Study on the impact of the use of alcoholic beverages and other psychoactive substances on Brazilian traffic". This study is unprecedented in Brazil and presents information on the extent and pattern of use of alcohol and other drugs by private and professional drivers, its impact on the number and severity of traffic accidents, besides producing an estimate of social and economic costs related to the problem.

Developed by the National National Secretariat for Drug Policies (SENAD), in partnership with the National Program of Public Security with Citizenship (PRONASCI), the Federal Police Department, the Federal Highway Police Department, the National Health Surveillance Agency (ANVISA) and the National Traffic Department (DENATRAN), this study, conducted by the Federal University of Rio Grande do Sul (UFRGS) will certainly be an important asset to foster scientific knowledge on the subject, in addition to guiding and legitimizing global public policies, capable of preventing and reducing damage caused by the dangerous association between alcohol, other drugs, and traffic.

JORGE ARMANDO FELIX

Minister of the Institutional Security Cabinet of the Office of the President and President of the National Drug Policies Council - CONAD

Foreword

This book is the product of the collective effort of more than 130 professionals. From the initial contacts until its publication, approximately four years have passed. The idea was born from a common interest between the National Secretariat for Drug Policies – SENAD, and the Federal University of Rio Grande do Sul – UFGRS. After initial discussions, it was developed into a huge nucleus for the production of information and innovative research technologies in the field of traffic and alcohol in Brazil. For the implementation of the many studies described in this book, SENAD developed a specific managerial structure to follow this large project, including the allocation of professionals specially assigned to it in full time. The UFRGS created the NEPTA group – The Nucleus for the Study and Research on Traffic and Alcohol, now a formal research group of the National Council on Research (CNPq) ,which gathers professionals engaged on this area of knowledge. The NEPTA group could be created thanks to the involvement of the Hospital de Clínicas de Porto Alegre (HCPA) where the UFRGS Center for Drug and Alcohol Research (CPAD) was established five years ago. A permanent organization, NEPTA will not cease to exist when the data collection and analysis of this project ends. It will continue to develop knowledge and research methodology, gathering professionals, and establishing partnerships with other institutions, for the purpose of contributing to the advancement of science.

The book presented here comprises 15 chapters divided into two main sections. Section A introduces the subject alcohol/other drugs/traffic, and has six conceptual chapters, ranging from the political and technical issues involved in implementing the project at a local and national level, to the description of the data collection scenarios, aiming at placing the reader inside the peculiar reality of obtaining research information in an atypical environment such as national highways. It also presents chapters on the history of alcohol related to traffic in Brazil, on the theory that studies the economic impact of traffic accidents, and on the delicate ethical and legal aspects of this type of study. There is also a chapter on the toxicological essays used to obtain biological samples of the drivers studied in the different projects.

Section B is mostly practical. It has nine chapters that describe in detail the data data collections routine of the different studies and the main findings analyzed until the date when this book was finalized. The main focus is not a large and detailed theoretical dissertation on each of the subjects researched, but rather a minute description on the methods – what will entitle other research groups to repeat and improve data collections of this kind – as well as the main findings.

For the sake of concision, all the annexes mentioned in the footnotes are available for full access to the reader in the website of the Brazilian Observatory on Drug Information – OBID (www.obid.senad.gov.br) and the CPAD website (www.cpad.org.br)

The partnership between the many branches of government – especially the Presidency, Ministry of Education, Ministry of Justice, Ministry of Health and Ministry of Cities, through different organs and Departments – has proved that interdisciplinarity is an achievable goal. Different players participated in the intense articulation necessary to complete eight research projects in little over two years, in some cases encompassing all State capitals.

It is impossible, in this introductory note, to thank all of those who so diligently dedicated time and effort to the appropriate implementation of the research steps anticipated for the project. A complete list of partners can be found at the end of this book. Above all, we would like to acknowledge the dozens of data collectors and support personnel – as well as the group that performed the data collections in the state capitals - for their dedication in accomplishing their task. The special effort of Fernanda Cubas and Sinara Santos in the editorial supervision of this book should also be emphasized. Certainly the quality of this material mirrors the motivation and dedication of those professionals throughout the period of the studies.

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Summary

Section A

Section B

USE OF ALCOHOL AND OTHER DRUGS ON BRAZILIAN ROADS

AND OTHER STUDIES

Section A

The research project as element in the construction of the National Policy on Alcohol

Paulina do Carmo Arruda Vieira Duarte and Vladimir de Andrade Stempliuk

The study entitled Global Status Report on Alcohol, published by the World Health Organization – WHO in 2004, estimates that there are about 2 billion drinkers of alcoholic beverages worldwide. Brazil holds the 80th position compared to 185 other countries in annual consumption of liters of pure alcohol per inhabitant aged over 15 years. However, the same study indicates that Brazil holds the 25th position in growth of alcoholic beverage consumption. Between the 1970s and 1990s drinking increased by more than 70% in the country.

In Brazil, the "2nd Household Survey of the Use of Psychotropic Drugs", performed in 2005, in the 108 largest cities of the country (Senad/Cebrid, 2005), points to alcohol as the psychoactive substance most consumed by the population. It is estimated that 74.6% of Brazilians aged 12-65 years have already consumed alcoholic beverages at least once in their lifetime, which corresponds to 37,953,000 individuals.

The same study indicates that in the 12-17 years age group, 54.3% of the adolescents have already consumed some type of alcoholic beverage at least once in their life, which corresponds to 4,327,000 young people, and the proportion of men to women is practically the same. When alcohol dependence was analyzed, the prevalence was 7%, corresponding to 554,000 young people, 7.3% for men and 6.0% for women (Senad/Cebrid, 2005).

The comparison between this 2nd Household Survey and the 1st performed in 2001 ((Senad/Cebrid, 2001) indicates that the number of alcohol dependents increased, from 11.2% of the population to 12.3%, corresponding to 6,268,000 people. The data also point to drinking at increasingly early ages, and suggest the need to review the measures for control, prevention and treatment.

Concerning this issue, the 5th National Survey of Elementary and Secondary School Students, performed in 2004, indicated the early use of this substance. The age informed for the first use was around 12 years and it occurred predominantly in the family environment. According to this survey, 44.3% of the students surveyed reported that they had consumed some alcoholic beverage at least once in the last 30 days which preceded the survey (Senad/Cebrid, 2004). Other findings of the study indicated that 11.7% of these young people reported frequent use (six or more times a month) and 6.7%, heavy use (twenty or more times in a month).

In 2007, the 1st Survey of Alcohol Consumption Patterns in the Brazilian Population, performed on a representative sample of municipalities without excluding any part of the national territory, including rural areas, found that 52% of Brazilians above the age of 18 years drink alcoholic beverages at least once a year. Considering all adult men, 11% drink every day, and 28% from 1 to 4 times a week. As to the intensity of alcoholic beverage consumption, the same study indicates that 24% of the population drink often, and heavily (at least once a week, 5 or more doses) (Senad/Uniad, 2007), and 40% of the men and 18% of the women consumed 5 or more doses of alcoholic beverages on a single occasion at least once in the last year. This pattern, defined as "heavy episodic use", also referred to as "binge-drinking", was initially described by Wechsler et cols in 1992 and defined as the consumption of 5 or more doses of alcohol for men and 4 or more doses for women on a single occasion; it presents a positive association with problems in the different life domains of individuals, and also accidents and violence of all kinds (Wechsler e Isaac, 1992).

The complex and multidimensional relationship between alcohol consumption and its consequences on the life of the population has been pointed out by studies showing that problems related to the excessive consumption of alcoholic beverages are not limited to the vulnerable populations, and indicate an association with the morbidity and mortality rates of the population at large, but governments lack specific policies for this issue. In the last 50 years, there has been considerable progress in the scientific understanding of the relationship between abusive alcohol consumption and its impacts on the life of populations. Scientific evidence increasingly provides a foundation for the public debate and indicates the need to formulate government policies. The World Health Organization (WHO) recognizes the importance of specific policies for this issue and recommends several different strategies that can be implemented by governments to reduce the negative impact of alcoholic beverage consumption (Babor, Caetano et al., 2003).

Aware of this reality, and in response to public outcry, the Brazilian Government, already in 2003, began the process of constructing a National Policy on Alcohol. That year, the President of Brazil created an

Interministerial Working Group. Its purpose was to discuss alternatives, within the scope of the Government, to reduce

the negative impact of alcohol consumption on the Brazilian population. Based on the results of this study, and aiming to guarantee and increase the space for social participation in the discussion of such an important topic, in 2004, within the sphere of the National Drug Policies Council - CONAD (CONAD), the Special Chamber of Public Policies on Alcohol – CEPPA was established, comprised of different government agencies, specialists, lawgivers and representatives of civil society.

In 2005, the Brazilian Government promoted and fully funded the 1st Pan American Conference of Public Policies on Alcohol. With the institutional support of the Pan American Health Organization (PAHO) this conference gathered researchers and government representatives of 26 countries, and culminated in the Brasília Declaration of Public Policies on Alcohol. This document, which is a consensus among the participants, recommends that all countries of the Americas implement Specific Policies on Alcohol (Senad, 2005).

At the same time as the political actions, and following the recommendations of the World Health Organization to provide evidence on which to base the process of constructing its alcohol policy, the Brazilian Government progressively invested in the diagnosis of the consumption situation in the different segments of the population, including young people, indigenous populations and other more vulnerable groups. Nationwide studies have been performed by the most respected teaching and research institutions in the country, and the results have progressively portrayed reality, and indicate the direction to be taken by public policy.

In this scenario, in 2007, the Federal Government, through Presidential Decree nº 6,117/07, presented the National Policy on Alcohol to Brazilian Society, in a clear demonstration of responsibility and political will concerning a difficult and relevant issue.

The National Policy on Alcohol, balanced, and without any ideological bias of fundamentalism or trivialization of consumption, reflects the Government concern about the issue, and its main purpose is to sustain strategies for dealing collectively with the problems related to alcohol consumption, by means of fundamental principles which take into account intersectoriality and also integrality of actions to reduce social damages, for health and life, related to the use of this substance, as well as situations of violence and criminal behavior associated with the prejudicial use of alcoholic beverages among the Brazilian population.

The Policy defines the term "alcoholic beverage" as one that contains a concentration of 0.5 º Gay-Lussac or more. This includes distilled drinks, fermented drinks and other preparations, such as the mixture of soft drinks and distillates, besides pharmaceutical preparations with an alcohol content equal to or higher than 0.5º Gay-Lussac.

The National Policy on Alcohol, recognizing the urgency of providing answers on the topic, initially presented nine measures to be implemented by the government agencies within their spheres of competence, and others concerning articulation with the Legislative Power and other sectors of society. Among these measures, we highlight those that support implementing the study which has led to this publication, and refer to increasing knowledge concerning the impact of drinking on the Brazilian population.

The relationship between drinking and traffic accidents is already clearly established in the international literature. It is known that the consumption of even relatively small amounts of alcoholic beverages affects cognitive abilities needed to drive safely (Moskowitz, Burns et al.,1985), and, episodic heavy consumption is strongly associated with traffic accidents (Cherpitel, 1989; Duncan,1997; Quinlan, Brewer et al., 2005). Furthermore, drunken drivers are more likely to become involved in fatal accidents (Hingson and Winter, 2003). According to the WHO bulletin, for every 0.02% increase in the serum alcohol level, there is a two-fold increase in the risk of becoming involved in a fatal accident. .

There is a linear correlation between the increase in blood alcohol level and the risk of traffic accidents.

a) with a blood alcohol level of 0.05 – 0.09 mg/dl the risk of traffic accidents is four times higher;

b) with blood alcohol levels above 0.15% the risk of traffic accidents is forty-five times higher (Hingson e Winter, 2003; Kelly, Darke et al., 2004).

Alcohol is not the only psychoactive substance that influences traffic-related behaviors significantly. The illicit drugs – including marijuana – have been strongly associated with traffic accidents (Fergusson e Horwood, 2001; Kelly, Darke et al., 2004; Blows, Ivers et al.,2005).

According to WHO data, currently 1.2 million people die annually in traffic accidents caused by drinking (WHO, 2004[a]). The French Government informs that 34% of traffic accidents with fatalities are caused by alcohol. In the young population (between 18 and 24 years) this item rises to 42% of the accidents. The proportion of fatal accidents related to drinking, caused by men and women is 17,000 and 2,000, respectively (Issues, 2008).

The costs of property damages caused by traffic accidents under the influence of alcohol, in the European Union in 2003, is calculated as around 10 billion Euros (Issues, 2008), while studies on the social costs of drinking in the United Kingdom consider drinking to be the key reason for requests for social benefits due to disability (Confederation, 2010).

In Brazil, in 2004 alone, traffic accidents caused the loss of 35,674 lives – and they were the ninth main cause of

death, and the second among the external causes (homicides are the first). It is also the main cause from the age of 5 to 14 years, and the second from 15 to 29 years (Ponce e Leyton, 2008). Also corroborating this information, Leyton (Leyton, 2009) says that the use of alcohol is closely related to deaths from traffic accidents, homicides and other deaths from external causes.

It is known that traffic accidents with fatalities occur mainly among the younger fractions of the population. Among young Brazilian males, aged 15 to 34 years, the different types of traffic accidents are the second main cause of death, the first being homicides (Waiselfisz, 2004).

Traffic accidents with victims also have a high economic impact in Brazil; although they represent only 14% of the total number of traffic accidents in urban areas, they cause 69% of the overall costs. An accident with a victim costs 11 times more than a victimless accident, and may cost 44 times more if a death occurs (Ipea, 2003).

In 2003, traffic accidents led to a total of 114,189 admissions to hospital in our country, i.e., 15.56% of the hospitalizations due to injuries and poisoning. Besides the impact of human losses, whose costs are immeasurable, there is also the financial impact of this type of accident in terms of costs to the State. Based on the statistics of the Instituto de Pesquisa Economica Aplicada (IPEA- Institute of Applied Economic Research), the economic losses from traffic accidents are between 1 and 2% of the GDP, somewhere between R$ 11.67 and 23.34 billions a year (Souza, Minayo et al., 2007).

The best example that based on legislation and enforcement and control policies it is possible to reduce the occurrence of events that can be avoided are the results achieved with the enactment and implementation of Law n° 11. 705, of June 2009, sanctioned by President Luiz Inácio Lula da Silva, which changed Law nº 9,503 of September 23, 1997, instituting the Brazilian Traffic Code, modifying the accepted limit of blood alcohol levels of the driver of a motorized vehicle from 0.6 to 0 gram of alcohol per liter of blood. Known as the "Dry Law", the new law determines that the driver who is caught in the act above this new limit is subject to paying a fine, losing his driver's license for a year and having his vehicle seized. Besides, if caught with a blood alcohol level higher than 0.6 gram of alcohol per liter of blood, he will be subject to arrest in flagrante delicto. Another important aspect is the qualification of homicides committed by drunken divers as a felony. Now it is also forbidden to sell alcoholic beverages on the rural stretches of federal highways.

This new law met with great popular approval. It was necessary and important, and placed Brazil in the forefront as regards the implementation of public policies on alcohol, since it has led to a reduction in the behavior of driving under the influence of alcohol in our country.

Several surveys already show positive results in the reduction of traffic accidents and emergency calls related to them. Between the second semester of 2008 and the second semester of 2007, a survey by the Ministry of Health in brazilian capitals showed a 23% reduction in the total number of hospital admissions and 22.5% of deaths due to traffic accidents (Ministério da Saúde, 2009).

It is in this context that the Secretaria Nacional de Políticas sobre Drogas (National Secretariat for Drug Policies) – a government agency responsible for coordinating the National Policy on Alcohol based its justification for performing the national research study called "Study of the impact of using alcoholic beverages and other psychoactive substances on brazilian traffic" . Coordinated by the Federal University of Rio Grande do Sul – UFRGS, and divided into eight different stages, the study, besides looking at the impact of the use of alcoholic beverages and other psychoactive substances on Brazilian traffic, it considers the development of a state of the art methodology which enables training various research centers to carry out studies with the same characteristics and standards, subsidizing the elaboration and planning of regional and national public policies in accordance with the needs of the Brazilian population in the different regions of the country.

Considering the size and innovation of the proposal, this study was only possible based on a large political-institutional articulation which ensured funding and enabled the full implementation of the planned goals. Its size and the continental dimensions of Brazil required interdisciplinary and interinstitutional action. Researchers, police officers from different organizations and managers of various public agencies shared responsibilities in producing the new data now presented.

The success achieved by the consortium formed by agencies of the Federal Public Administration – Presidency of the Republic, through SENAD; Ministry of Education through the Federal University of Rio Grande do Sul; Ministry of Justice through the Department of Federal Police, Federal Highway Police Department, and the National Program of Public Security with Citizenship; Ministry of Health, through the National Health Surveillance Agency and Ministry of Cities, through the National Traffic Department, showed that it is possible to make progress in defining and implementing the public policies, even when the issue is complex and difficult to work with. This, however, does not allow us to consider the work complete. On the contrary, the relevance and volume of information produced give us the exact dimension of our responsibility and many other elements to implement actions that emanated from the guidelines of the National Policy on Alcohol.

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A brief history of the relationship between alcohol and traffic in Brazil

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Throughout the history of humankind, men have sought solutions to make their lives easier and more comfortable. They produced weapons, adornments, garments and, among other things, transportation. Walking, however, is the most rudimentary and the oldest existing means of transportation. People walked barefoot for days and days, carrying their possessions until a kind of shoe was invented from animal skins to protect their feet (Marconi and Presotto, 1986). Thus, by much trial and error, human beings created what appears to have been the first land transportation, similar to a sledge, made out of a tree trunk. The first signs appeared in the Mesolithic period, in Finland, and also on the plains of the Near East, around 4000 BCE. When people realized that they could domesticate animals, such as elephants, oxen or camels, they understood that this would make it easier to transportation more loads than they could themselves. Then, in Mesopotamia, around 3000 BCE, the wheel was invented or discovered. It was a great advance for people who were always on the move. In the beginning it was heavy, solid and it was adapted to be pulled by large animals such as oxen (Marconi e Presotto, 1986; Rozestraten, 2005). Finally, as transportation advanced, it became necessary to create and improve the paths on which people travelled. As the wheel evolved, it became necessary to build roads for more dynamic access to towns. Around 3,300 BCE, in some cities of India, brick roads were already being built using asphalt as a binder. In 312 BCE, the Romans began to build the Via Appia, and as they conquered lands,. The Persians and Romans, in order to unite their Empires, are examples of these constructions: that is why the saying exists "All roads lead to Rome". The Roman road system, unpaved, comprised about 350,000 Km, and since then it has been necessary to implement laws to minimize traffic problems. During the 1st Century BCE, Julius Caesar forbade wheeled traffic in downtown Rome for several hours a day, allowing only official and patrician vehicles to circulate (Modernell, 1989; Vasconcellos, 2006).

The Roman roads united several countries on the European Continent. However, with the fall of the Roman Empire, the roads became invasion routes and they were abandoned for centuries. It was only after the 12th century that some cities in Western Europe underwent a resurgence and, with increased trading, roads in Europe and in China were restored by Marco Polo at the end of the 13th Century. Then, when the Hundred Years War between England and France ended, there was traffic on the roads again. It was at the end of the 19th Century, and throughout the 20th Century, that the greatest development occurred, with the invention of the automobile ((Rozestraten, 2005). The first steam car was built in 1769 by Cugnot, in France. But Karl Benz and Gottlieb Daimler are considered the inventors of the automobile, since they tested their ideas until they arrived at something that was socially accepted as useful to move people. From then on, the automobile grew exponentially, until it became what it is today – an element that defines most of our lives and our social relations.

Traffic in Brazil

The first steam vehicle only arrived in Brazil in 1871: it was a huge, unwieldy and noisy machine connected to a car that had a place for passengers – nowadays it would be considered a "street train". In 1886 Daimler and Benz were already experimenting with new models run by internal combustion engines, and thus, the steam vehicle was soon replaced by real automobiles. The first of them was brought from Paris to São Paulo in 1891 by Henrique Santos Dumont, the brother of Alberto Santos Dumont. This automobile was a Peugeot with a Daimler engine and had 3 and a half horsepower. In those days there was no driving license to use cars, nor an exam to issue the driving license to motorists.

Slowly horse-drawn carriages gave way to automobiles in Brazil. In 1907 automobiles began to be used during Carnival, with merrymakers parading in cars, throwing confetti, perfume and paper ribbons. In the same year, the Automobile Club of Brazil was founded, intending to develop the taste for automobile driving, with a special interest in importing new machines, training drivers and opening new roads.

The first automobile was built in Brazil in 1908, by the Italian immigrant Cláudio Bonardeli. The vehicle was made by hand, and it took two years to gather all the parts. Thus an exclusive car was created. Up to World War I, in 1917, the Brazilian fleet consisted of European vehicles. Due to the war, imports diminished and finally Brazil approached the North American carmakers who realized that here there was an attractive market. Then, in 1919, with the amount of US$ 25,000.00, Ford Brazil began assembling imported vehicles in São Paulo. At the time, the motto of the Governor of São Paulo . Washington Luiz, was "governing is road-building", and in 1921 he inaugurated the Capital (São Paulo)- Campinas highway; at that time the national fleet consisted of 30,000 units.

In 1925, it was the turn of General Motors to inaugurate their first assembly lines in the country. Brazil began

importing trucks in 1934, when the first Volvo trucks and cars were brought in. In 1953 it was forbidden to import vehicles to Brazil, and imports only were started again, years later, during the Fernando Collor Administration (1993). During the 1960s, vehicle manufacturing was already 100% national.

In 1939 the first long distance highway was inaugurated, linking Rio de Janeiro to Bahia (BR 393/116). This was the first real national integration route. Regis Bittencourt highway, linking São Paulo to Curitiba (BR 116) was inaugurated in 1961. At the time, the highway was designed for 8,000 cars/day – now it receives more than 32,000 vehicles, of which 25,000 trucks/day. In 1999 Brazil had 436 highways, 150 of them federal. Unfortunately, according to DETRAN, the National Traffic Department, only 9.52% of them (164,244 Km) were paved at the time, and approximately 1,560,000 Km have not yet been paved in Brazil. Besides the low rate of paving, there are no current data available – the information available on the site of the DNIT- Departamento Nacional de Infraestrutura de Transportes (National Department of Transportation Infrastructure) is ten years old (Brazil). The Brazilian Traffic Code was only enacted in 1941, and the last changes in the Code were made in 2008.

Traffic accidents, alcohol and drugs

As the car became widespread, without too many laws or safety rules, the first traffic accident in the world occurred. The driver was William James Lambert, in the city of Ohio, in 1891. Lambert hit a tree root, lost control of his vehicle and crashed against a tying post (Society, 2006). In Brazil, the first accident occurred with the car belonging to José do Patrocínio, in Rio de Janeiro, as it was driven by Olavo Bilac. The car crashed against a tree on the Estrada Velha da Tijuca road (Rozestraten, 2005). On the other hand, the first reported accident involving drinking alcohol occurred in 1897, when George Smith, a taxi driver, crashed his car against a building and admitted that he was driving under the influence of alcoholic beverages (Society, 2009). The first US state to enact drunk driving laws was New York in 1910, followed by California. However, the laws did not specify the drinking limit (Webb e Llc ,2009).

Already in the 19th Century, the authorities concerned themselves with alcohol consumption and its consequences. At the time, the only way found was to detain the individual until he recovered from the effects of intoxication. The problem became worse during the 20th Century, when motorized vehicles began to be used. Over time, as industries were created and complex machinery handled by workers, and also with the beginning of high-speed transportation, it became necessary for businesses to verify possible alcohol consumption by their drivers and workers, in order to prevent employees under the effect of alcohol from performing high-risk work or driving in a state of drunkenness.

In 1940, the only way to verify a person's blood alcohol was by urine or blood tests. However, these were considered very slow and inaccurate methods. Besides, collecting a urine or blood sample for later examination was not at all practical to detain drivers suspected of being under the effect of alcohol. The need to detect the presence of the substance in the blood quickly and non-invasively was an important factor for Robert Borkenstein - a police officer and former college professor- to create a breathalyzer in 1953. This equipment allowed detection of levels of alcohol in the air exhaled from the lungs. The instrument was easy to use, and more accurate than the balloon called Drunkometer, and thus a better test to check for people who were driving under the influence of alcohol.

In 1962 a study was performed which provided an initial parameter for cutoff points of blood alcohol concentration levels, the Grand Rapids Study, one of the largest epidemiological studies in this field (H. Moskowitz, 2000). Its main contribution was to establish the close relationship between the use of alcoholic beverages and the growing impact of blood alcohol concentration in traffic accidents. It was a landmark in research on the topic, and even today is still referred to as one of the main contributions to this field. Norway was the first country to establish a maximum limit of 0.5 g/L for blood alcohol levels in 1936, and currently its limit is 0.2 g/L. In Sweden the limit is 1.5 g/L.

In the 1970s, one of the first studies related to alcohol in traffic in Great Britain was performed by Ross (Leyton, 2009). This resulted in a 23% drop in accidents with deaths and 11% in accidents with injuries three months after the traffic laws were implemented. Three years later, it was noticed that the rates had risen again. These data show the importance of enforcement, since when the individual knows that he will be checked, he probably will behave more carefully. Similar studies were performed in the United States, Australia and Norway. All of them showed a reduction in the number of accidents, initially, but they also showed that the levels rose again, after a while. That is when there should be more intensive and continuous inspection of drivers, (Wilde, 2005; Leyton, 2009).

In countries such as Norway, the Netherlands and Canada, studies on the consumption of alcoholic beverages combined with driving are often performed, but in Brazil these studies are just beginning. One of the forerunners of studies on human behavior in traffic was psychologist Reinier Rozestraten, who dedicated his academic life to this topic. The author recalls the importance of strict inspection and enforcement in traffic, because less accidents occur in countries where there is intensive policing and traffic laws

are enforced. He emphasizeds that for appropriate traffic there should be what, is called in the U.S. as the tripod of organized traffic (3 Es). This model aims at integral Education, Engineering and Enforcement . In other words, education beginning at home, and thence to school and from there to the entire community, especially for drivers; engineering, helping safety and improving the road and the vehicle; and enforcement of the laws with active and constant inspection (Cubas, 2009). According to Rozenstraten, [...] It is important to ensure that Brazilians realize that the traffic laws are not authoritarian impositions. They are internationally valid and were created to keep all those who participate in traffic safe [...] (Rozestraten, 1986 p.23).

Traffic accident rates are a public health problem and, in Brazil, they have been increasing epidemically. Accidents injure from 20 to 50 million people every year. In European countries and in Japan, traffic accidents began to be noticed after World War II. On the other hand, in Brazil accidents began to be seen as a problem for society in the 1970s, as the result of a process of dependence of the transportation of human beings and goods on roads and highways (Vasconcellos, 2006). According to the author, besides deaths, physical and emotional sequelae, there are also high costs which become a heavy burden on all of society. A few studies in Brazil are beginning to measure this harsh reality.

In 1995 a study was performed by the Center of Studies of Drug Abuse at the Federal University of Bahia, which correlated the consumption of drinks in leisure situations in bars and on the Salvador sea front, and data were found showing that approximately 38% of the participants in accidents who had been driving a vehicle had taken alcoholic beverages on the day of the accident.

Another study on traffic accidents and drinking alcoholic beverages was performed in 1997, by the Associação Brasileira dos Departamentos de Trânsito (Brazilian Association of Traffic Departments) in four Brazilian capitals: Brasília, Curitiba, Recife and Salvador. Of the 865 participants, 27.2% presented alcohol blood levels greater than 0.6 g/l, which today would be considered a crime by Law 11,705/2008, which changed the Brazilian Traffic Code of 1997 (BRASIL, 2008). Alcohol is connected to at least 50% of traffic accidents, and results in various social and economic problems (Rozestraten, 1988; Galduróz and Caetano, 2004; Leyton, 2009).

The history of research on traffic and alcohol in Brazil is still recent. Compared to the international contribution to the topic, the country is only beginning to produce studies in this field in a regular manner, in an attempt to form an appropriate framework of epidemiological information which can guide the public policies that are so necessary to deal with this issue.

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Ethical, legal and methodological aspects of research on the use of alcohol and other drugs

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Introduction

One of the main challenges in setting up any project is to look for an appropriate connection between the ethical and methodological aspects. Bioethics, as a place for exchanges between different fields of knowledge (O'Neall, 2002), allows for extending these aspects by including legal issues associated with the act of conducting research on people.

Studies discussing sensitive issues such as the use of alcohol and other drugs by drivers added several factors to ideas on how valid consent could be obtained in different environments and situations. Data collected from private and professional drivers, using direct interaction or by telephone, from people who are receiving medical care after an accident or in usual police procedures, required further thinking on how to adapt the informed consent process (Clotet, Goldim et al., 2000).

Further, these studies required understanding the legal and regulatory aspects to improve their performance Therefore we studied the appropriate legislation (e.g.: Federal Constitution, Traffic Code and its modifications, Law nº, 9,503, of September 23, 1997; Civil Law Code Law nº 10,406 of January 10, 2002; Criminal Code, Decree-Law 2848 of December 7, 1940 and resolutions of the National Council of Health, etc.), until the elaboration of ethical and legal criteria whose authorship was previously delimited based on Copyright Law (Law n. 9,610 of February 19, 1998)., because of the number of researchers involved in this study (see appendix 1)[1].

Characteristics of the Consent Process

All research must be appropriate to the established moral and legal standards. In Brazil the basic guidelines for research involving human beings were established by Resolution 196/96 of the National Council of Health (Brazil, 1996). Later this Resolution was detailed in many others from the same Council.

From the ethical standpoint, informed consent is a moral duty of researchers towards the participants (Clotet, 1995). Likewise, because of the principle of trust the consent process is a legal duty of researchers in relation to the participants. For these reasons, researchers must make information available, especially about the procedures, risks and benefits associated, in a manner appropriate to the participants; they must also acknowledge the possibility that these people are in a vulnerable situation, behaving in a way that will enable minimizing the occurrence of coercive behaviors.

On the other hand, participants should be people who can be informed, i.e., they must be able to access and understand the information provided by the researchers; they should be psychologically, morally and legally able to make decisions, and the fact that they are volunteers should be recognized to be respected, i.e, they must be able to decide in advance whether to authorize the study or not, insofar as possible free of external pressures (see data on coercion in the consent process, below). The voluntary character must be ensured, and this includes the possibility that the participant may want to revoke his authorization, leaving the study without any kind of personal repercussions or need to justify his decision (Goldim, 2002).

Integrated understanding of these characteristics of the consent process generates a perspective that surpasses simply acknowledging and complying with rights and duties, which goes beyond the preservation of the participants' autonomy. Appropriate understanding of the consent process must enable recognizing that this is a relationship of co-responsibility, of ethical co-presence between researcher and participant, based on sharing information and reciprocal trust (Goldim, 2002).

Often there is confusion between the informed consent (TCLE) process and informed consent form. This document should contain the essential information about the project, about the participants' rights, and should also contain identification of the researchers and institutions involved. The Informed Consent Form simply records the authorization given at the end of the consent process, but in no way replaces it.

Brazilian Reseach Ethics Guidelines (National Council of Health Resolution #196/96) in the item IV.3..c, creates the possibility that research situations could occur where it will be impossible to obtain the TCLE. Under such circumstances, the Committee of Ethics in Research may, in special cases, authorize the project to be performed, even without obtaining the TCLE (Brazil, 1996).

[1] *The appendices of this and other chapters of the book are available on the site of Observatório Brasileiro Sobre Drogas - OBID: (Brazilian Observatory on Drugs) www.obid.senad.gov.br*

Studies Involving Alcohol and Other Substances

The ensemble of research projects that were planned to evaluate the impact of using alcoholic beverages and other substances by Brazilian drivers presented many different research situations. A first logistical and ethical challenge was to approach drivers on the road, in bars and restaurants. This involved issues that included the safety of the researchers. Collecting data and biological materials in environments where drivers were being given medical attention after traffic accidents and the need to contact these drivers later by telephone in order to follow up their development and obtain further information, presented other major methodological, ethical, legal and social issues. Professional motorcyclists were also involved in traffic simulations with new specificities. Likewise, collecting information from public safety agency databases led to questions about how it could be obtained and the limits of its use.

Each of these situations had peculiarities that made it difficult to obtain Free and Informed Consent and strict compliance with the usual characteristics of the consent process. Considering the methodological specificity of each of these studies, an individual, detailed survey was performed of how the data were to be collected, outlining a step-by-step flowchart for each situation (see item 4 and figure 1).

Based on the adequate understanding of each of the procedures, the most appropriate form of data collection for the peculiarities of each situation was defined, with a view to ensuring the quality of the consent process, four different approaches were proposed for the process of obtaining consent: availability of verbal information, followed by using informed consent form in its conventional mode and as a deferred consent; rolling consent obtained during the different phases of data collection, using the telephone as a means of contact and tacit consent (see figure 1).

In addition, a Data Use Commitment Form (see appendix)[2] was also used in data collection situations in which only databases were used. In this document the researchers committed to using the data collected only for the purpose of the project, guaranteeing their confidentiality, especially concerning the identification of the people referred to by this information.

The ensemble of methodological, ethical, legal and social issues was broadly discussed with the different research teams involved in the projects as a whole. Methodological, ethical and legal capacity-building activities were performed, which allowed the investigators, with their different professional backgrounds, to appropriate information relevant to understanding the appropriate consent process for each of the projects.

Other organizations were involved, besides those already directly involved in the study in this planning phase. Meetings were held with the different fields of Law, involving jurists, members of the Public Prosecutors' Department, judges and lawyers. Ten preparatory meetings were also held with the security agencies, especially the Federal Police, the Federal Highway Police, the Police of the State of Rio Grande do Sul, and the Instituto Geral de Perícias (Forensics Department), besides the specialized traffic departments, such as the transit authority of the city of Porto Alegre (EPTC). These contacts and meetings enabled increasing the complexity of the situations in which data and biological materials were collected. After these meetings, adaptations were made and new possibilities were tested concerning how consent and data could be obtained from the participants, especially how to protect their privacy. Some data might have a direct effect on the drivers, such as the blood alcohol level measured in the presence of or near police officers.

All the study projects were drafted by the teams of researchers. Before they were submitted to the different Research Ethics Committees of the institutions involved, the ethical and legal aspects of the projects were again reviewed, especially the Informed Consent Form. In the elaboration and internal evaluation of the Informed Consent Form, special attention was given to the structure of the text and the words used, besides the information content. Shorter sentences and paragraphs were used, and words that were difficult to understand for the general public were substituted.

All the projects with the different proposals for approaches to the informed consent process were approved by the Research Ethics Committee of the institutions where they were carried out.

The Different Ways to Obtain Consent

The diversity and complexity of the research situations involving the different project goals led to seeking multiple approaches that would enable ensuring the ethical aspects and the feasibility of the study itself. The regulatory aspects were all taken into account, and indeed approved by the Research Ethics Committee of HCPA..

The consent process is broader than simply signing an

[2] *Available on site www.obid.senad.gov.br*

Informed Consent. This consent will be considered valid when the components of information and consent are appropriately covered.

The information component should take into account whether the participant is informable, and whether he has been adequately informed. A participant is considered informable if he is able to receive information, recognize its relevance and remember facts. The researcher must supply the essential information about procedures, risks and discomforts, and the participants' benefits and rights, including issues concerning privacy, receiving new information, the possibility of withdrawing consent, and being compensated for possible damages resulting from the study.

The consent component includes the decision-making capacity, voluntariness of choice and recording the authorization to participate in the project. Capacity can be established by evaluating the psychological and moral development of the participants. The preservation of voluntariness, i.e., the possibility of choosing between participating or not, with a minimum of outside interference, can be evaluated by the perception of coercion, associated with the procedure of obtaining consent. In some stages of the project, coercion perception measures were used precisely to monitor the voluntariness of the participants, mainly based on the situations in which data and biological materials were collected. The authorization should be recorded, usually, by an Informed Consent Form. Exceptionally, in methodological situations needed to perform the study, other approaches can be used to document this.

Multiple ways of obtaining valid consent from the participants were evaluated. In the project, four different approaches were used: usual consent, a posteriori (deferred) consent, rolling and tacit consent (Summary table 1).

Usual Consent Process

The consent process, in its usual form, using an Informed Consent Form as a document showing prior authorization of the participants, was present in two studies: one involving professional motorcyclists and the one that evaluated the prevalence of alcoholic beverages in drivers who used federal highways.

Summary Table 1 – Different types of consent used.

Consent Process	Informed Consent Form	Studies that used this approach
Usual Consent	Yes In normal situations	Chapter VII – Alcohol and drug use among private and professional drivers in Brazil. Chapter XIII – Motoboys and reckless behavior in traffic. Is there an association with psychiatric disorders?
Deferred Consent	Yes In emergency situations	Chapter IX – Alcohol and drug use among traffic victims attended in emergency rooms in Porto Alegre.
Rolling Consent	Yes In situations in which consent must be often re-consented	Chapter VIII – Psychopathology and Risk Behavior of Private and Professional Drivers in Brazil.
Tacit Consent	No In some situations when identification can be harmful to the subjects researched	Chapter XII – Drinking and driving in a sample of drivers who frequent Porto Alegre bars.

In the study on motorcyclists, the participants were recruited at their workplaces. The professional who spontaneously sought out NEPTA received all the information about the procedures, risks, benefits and rights associated with his participation, from one of the researchers associated with the study, which made it possible to clear up any possible remaining doubts. It was only after this period of personal and verbal interaction that Informed Consent Form was presented, and the participant was told to read it. This document had already been written taking care to provide an adequate text in terms of structure and vocabulary. If the motorcyclist accepted to participate, the consent process ended when he signed the Informed Consent Form. This is the most classic form of obtaining consent. During the study the perception of coercion of the motorcyclists was evaluated, which could vary from zero to five points, using a test that had already been validated for use in Brazil (Gardner, Hoge et al., 1993; Taborda, 2002). The motorcyclists had values that ranged from zero to three points, with greater concentration at one point. The average value obtained from the motorcyclist sample was 1.39+0.89. This value was slightly above that found in other groups of patients who participated in clinical study projects performed at Hospital de Clínicas de Porto Alegre, which had an average of 1.02+0.94 for the perception of coercion (figure 2).

The purpose of the study **"Consumo de drogas entre motoristas privados e profissionais do Brasil"** (Drug consumption among private and professional drivers in Brazil) was to evaluate the use of these substances among drivers using federal highways in all Brazilian states and the Federal District. This study also used Informed Consent Form as a document to record the consent process, but there were some very interesting peculiarities, due to ethical, social and legal aspects associated with the way data and biological materials are collected.

The data collection procedures were planned to take place at Federal Highway Police (PRF) stations, for reasons of security for the research team itself. The logistics of these data collections were strictly coordinated with the collaboration of the Federal Police (PF) and the Federal Highway Police (PRF).

The collection of data and biological material was included in a routine inspection by the Federal Highway Police. Legal and ethical measures were taken as a precaution, to make information obtained in the study scientifically relevant and reliable, and also to ensure the rights of the people investigated and the people who collected the information. Thus, the procedure was established in four stages, as follows:

1. Stop approach by the Police: a highway patrol officer trained by NEPT and aided by other federal Police officers signals a given driver – truck, bus, motorcycle or car (chosen according to research criteria) – to stop his vehicle in an area belonging to the highway patrol station. During this stop, only usual inspection procedures are performed for documentation and looking at the roadworthiness of the vehicle without any breathalyzer test.

2. Invitation to participate in the study: after performing the usual inspection procedures and before measuring the driver's blood alcohol level the highway Police officer informs the drivers that a survey is being performed on "the use of alcohol and other substances by drivers". At this point the police officer simply invites the driver to have contact with the research team, and he is free to choose to accept the invitation or not. The researchers and collectors must always be set up in a different area from the one where the habitual inspection procedures are performed.

3. On refusal to participate in the study, if the driver does not accept the invitation to talk with the researchers, with no question about his denial, the police officer himself refers the driver to a test to check the blood alcohol level using a breathalyzer, in another area of the Federal Highway station (see flowchart 3.a). It should be mentioned that at this time no member of the research team may be present. After the breathalyzer test, the highway police officer will take all the legally required steps (see figure 1-3.b).

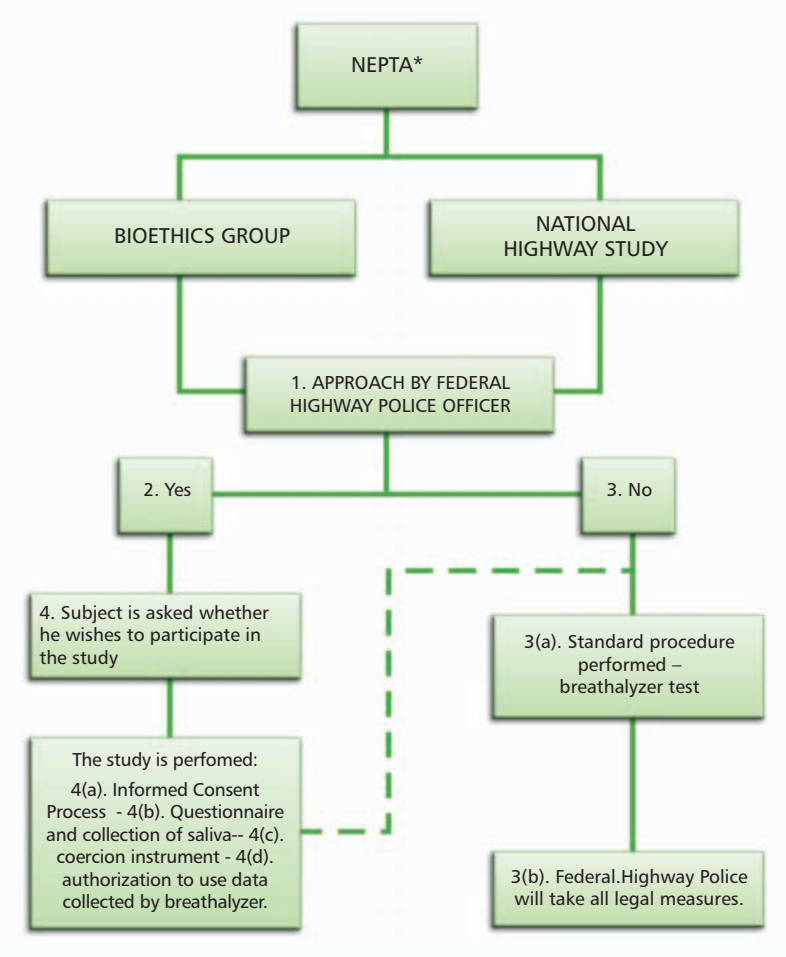
4. Accepting to participate in the study: If the driver accepts the invitation to participate in the study he is taken to one of the researchers, in a specific area set up for this purpose. The researcher introduces himself formally and the survey begins, according to a four stage sequence, as presented below:

   4-a. the process of obtaining consent begins, i.e., verbal information about the procedures, risks, benefits and rights of participants in the study are verbalized by the researcher. Immediately after the appropriate information and explanations are given, the Informed Consent Form is presented. This contains in writing the same information given verbally beforehand. It should be noted that in order for the participant to continue in the study, the Informed Consent Form must be signed.

   4-b. After the Informed Consent Form is signed the study procedures proper begin with a brief structured interview and the collection of saliva for later analysis of substances present.;

   4-c. Then an instrument is applied to measure the perception of coercion in the study;

Figure 1 –Flowchart of the informed consent process.



4-d. Finally the researcher asks permission to collect the data to be obtained by the highway Police officer using the breathalyzer, at the end of the Police procedure (see Figure 1-3 and 3-b).

The Informed Consent Form in this study was used to document the permission given by the driver to collect data appropriately. This included information on blood alcohol level, and biological material, in this case saliva, which would later be processed.

Data collection involving the perception of coercion was used as a control measure to evaluate the impact of collecting data during a routine police procedure. The values obtained, which ranged from zero to five, with a mean of 1.21+1.10 (figure 2), showed that the drivers' perception of coercion was similar to that found in other research environments. This may be due to the complete dissociation, even physical and of the teams involved, between the police procedures and research procedures. Likewise, obtaining data on blood alcohol level as part of the police procedure, not of research, aimed at protecting an item of project information that could require police intervention if the test were positive against undue exposure.

It should be mentioned that some drivers did not accept the initial invitation to participate in the study. This showed the possibility of exercising their voluntariness.

A posteriori (deferred) consent

One of the traditional characteristics of the consent process is that it be obtained before any study procedures are performed with the participant. Studies performed in emergency care situations may not be able take this possibility into account. In such situations, the participant may have a diminished capacity to make decisions due to the physical and emotional impact resulting from the circumstances involved. These situations are examples of the impossibility already foreseen in Resolution 196/96 (Brazil, 1996).

The study **"Consumo de álcool e drogas entre vítimas de acidentes de trânsito atendidas em hospitais de Porto Alegre"** (Alcohol and drug consumption among traffic accident casualties seen in Porto Alegre hospitals)

presented the challenge of obtaining data and biological materials from patients over the age of 18 years at two trauma hospitals in Porto Alegre: Hospital de Pronto Socorro and Hospital Cristo Redentor.

For situations in which it is impossible to obtain prior consent, an alternative to this obstacle was planned, using a deferred consent (Levine, 1995). This mode of consent process allows the biological materials and information needed to perform the study to be collected without any change in the care procedures. The information and biological materials collected are not processed or used until the consent process can be applied to the patient or his legal representative. All procedures already performed were fully presented, specifically informing that if no permission were given, both the information and the biological materials would be discarded, i.e., although they had been collected they would not be included in the study. On the other hand, if permission were obtained, the information already collected would be included and the biological materials sent to the laboratory for processing, and complementary data would be collected.

The ethical justification for using this type of procedure which is clearly exceptional, is based on the potential benefit that these data may generate, with a minimum risk of exposure, and preserving the patient's self-determination, directly or through his legal representative, regarding the possibility of using the data and materials already collected or not. .

Specifically in this study, data were collected on the medical condition of the patients, and an aliquot of urine was collected to evaluate the presence of substances of interest to the study. While obtaining the consent, permission was also requested from the patient to contact him by phone to obtain further information about the outcome and other characteristics needed for other studies associated with the same line of research.

Rolling Consent

In the study **"Psicopatologia e Comportamento de Risco em Motoristas Privados e Profissionais no Brasil"** (Psychopathology and Risk Behavior in Private and Professional Drivers in Brazil) data were also obtained by telephone. This way of collecting information adds other methodological, ethical and legal issues that must be taken into account.

The first issue is related to recording the process itself. Facilities were used that allowed audio recording during these contacts. The team member responsible for the telephone interview began his call explaining the purpose of this intervention, reminding the subject of the permission to call contact that had been given when the subject was seen. After informing that the interview was being recorded, the procedures of the study were explained, which involved a telephone interview, specifying its approximate duration and that the request for consent would be repeated during its course. Permission to perform the study was documented by recording this telephone interaction and could be transcribed for filing purposes. Other situations of permission given by telephone also use this form of documentation, such as banks and other financial institutions.

Repeating consent during the telephone interview characterizes rolling consent, since at every stage of the interview the subject is asked for permission to continue. The lack of visual interaction between researcher and participant reduces the identification of possibly embarrassing situations. Using rolling consent, the participant is free to allow the study activity to continue or not, without compromising the previous stages.

The structured interview used in these studies was set up in such a way that it would be applied gradually and progressively in terms of detailing, consistent set of information and level of personal information disclosed. The text included questions about the possible discomfort that may be caused to the participant by the questions and about the possibility of continuing the interview.

The use of rolling consent in these situations ensures respectful and high quality interaction. This can be verified, at least partly, by the values obtained for the perception of coercion, which ranged from zero to four, with a mean of 0,.8+0.91 (figure 2)

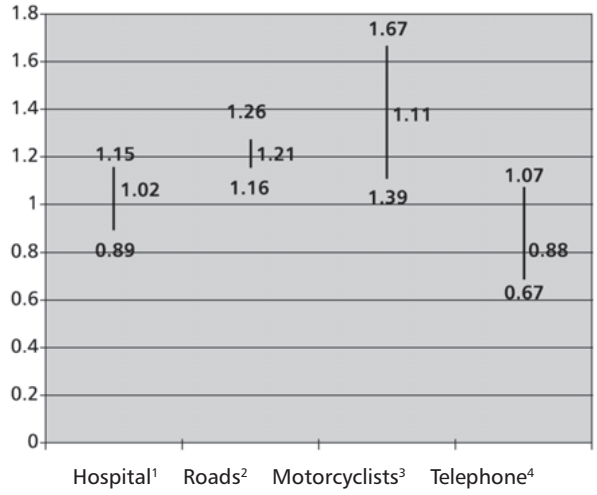
Tacit Consent

Documenting participation in a study by an Informed Consent Form requires appropriate identification of the subject. In some study situations, identification may impair or even prevent the participation of people under specific circumstances. In tacit consent, the entire process of consent is preserved except its documentation via Informed Consent Form. The researcher still has the duty of informing about all procedures, risks, benefits and rights involved in the study. The participant receives an Information Sheet with essential data about the study, but no signature is collected, nor the personal identification data. Permission was considered valid when, after being appropriately informed, the participant voluntarily provided the information and biological materials requested.

In the study **"Beber e dirigir em uma amostra de condutores que frequentam bares em Porto Alegre"** (Drinking and driving in a sample of drivers at bars in Porto Alegre) this strategy of the consent process was used. The data collection procedures included applying a questionnaire and measuring blood alcohol levels using a breathalyzer, besides collecting saliva. Considering the environments in which data collection is performed, brief interaction with the

researchers and possible resulting legal repercussion, non-identification of the participants was considered the least invasive form, with the least effect on voluntariness of the people invited.

Figure 2 –Mean values and confidence interval (95%) of the coercion perception scale obtained in participants in a clinical study performed at HCPA,and with three groups of project participants, in highway data collections, wtih motorcyclists and by a telephone interview.



On the authorship criteria implemented for the project

It is acknowledged that research environments involve many researchers, different stages of studies, several hosting and sponsoring institutions . The authorship criteria can be a significant subject of disharmony in the study. Likewise, - Intelectual Property Law, (Brazilian Fedral Law 9,610 of February 1998) does not typify these criteria, and generically protects the individual's right to be acknowledged as the author of the work.

For these reasons, the Bioethics Group prophylactically presented a suggestion for authorship criteria that should be previously known to all those involved in the research project – from the secretaries of data collectors to the principal investigators and institutions involved.

These criteria were pre-established in four main groups: 1) personal certification and term of individual responsibility; 2) acknowledging the function and responsibility in the goals; 3) acknowledging the participation in all or part of the project., and 4) acknowledging activities that have in effect been carried out (it should be observed that this criterion is subdivided into 3 other subcriteria). Thus, in order for the project participants to also be authors, it was mandatory that they meet all four criteria (see document attached)[3].

Final Considerations

The bioethical evaluation of research procedures should involve many areas of knowledge that present interfaces to each other. The relationship between ethical and methodological aspects is indissociable, as well as the legal and regulatory framework involved. Likewise, other social, political, economic, spiritual, welfare and professional aspects also interfere significantly.

Complex Bioethics enables a broad view of these different and complementary perspectives about the same problem (Goldim, 2009). New research situations require creative and appropriate solutions.

It is fundamental to preserve the basic elements of the informed consent process, but it is equally important to evaluate their impact and the justification for the adjustments needed to perform studies in special and specific situations.

It is essential to integrate different members of the team of investigators to enable adequate understanding of all possible repercussions of the research for the individuals involved and for society as a whole. This will enable an equally appropriate referral of the project to a Committee of Ethics in Research.

The relationship between researcher and participant in a study should be one of ethical co-presence. The researcher's responsibility for the participant is actually to acknowledge a responsibility in itself, enabling a co-responsibility relationship (Souza, 2004).

Co-responsibility was a guideline for the work of the Bioethics team, which was implemented as follows: 1) recognizing the difficulties of each goal advised; 2) harmonizing the objectives of each goal with the central objectives of the project, taking the specific peculiarities into account (for instance, finding different alternatives to obtain informed consent and clear up sensitive topics, such as the Federal Police collecting information in a research environment, relating it to Law); 3) advising on the implementation of specific informed consent processes and respective documentation, when necessary; 4) elaborating specific authorship criteria in advance, for academic production by the group, respecting ethical and legal framework and finally 5) providing advice so that all goals take into account the bioethical consensus developed for the project and relevant legal and regulatory aspects.

[3] *Available on site www.obid.senad.gov.br*

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Economic impact of psychoactive substance – related traffic accidents

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Introduction

The purpose of this pioneering study in Brazil is to examine one of the aspects of the negative impacts caused by consumption and access to psychoactive substances: the economic cost of alcohol consumption-related traffic accidents in the city of Porto Alegre. Another specific purpose is to develop a method to measure costs and a database that will allow better understanding of the socioeconomic impact of alcohol consumption.

Quality of health of a population is essential when discussing economic and social development. According to the definition of the United Nation Millenium Development Goals, a global development program instituted by the United Nations Organization (UNO) involving 191 countries, health is a priority concern.

In this sense, the fight against poverty cannot ignore aspects involving consumption, production and access to psychoactive substances (PAS) due to the profound impact this "industry" has on the health of citizens and, consequently, on the socio-economic performance of countries. It is now clearly understood that PAS consumption has an economic impact that goes far beyond its effect on the individual consumer's health, extending to an increased crime rate, to unsafe sexual practices and syndromes that can cause fetal damage, among other aspects. These negative effects are among the main risk and poverty factors for the economies of emerging and/or developing countries.

Outstanding among these effects is the relationship between the use of PAS and the occurrence of traffic accidents. There is plenty of literature showing that the intake of any amount of alcoholic beverages and other PAS causes cognitive alterations that hinder performance when driving, increasing the risk of traffic accidents (Moskovitz, 1985; Hingson, 2003a).

PAS-related traffic accidents burden society as a whole with a number of economic and social costs. It is an indirect negative impact of the use of PAS that, according to international estimates for New Zealand, can represent up to 4 billion dollars a year due to costs generated by traffic accidents exclusively related to alcohol abuse (Devlin, Scuffham & Bunt, 1997). In Brazil it is estimated that the annual cost of traffic accidents in large cities is R$ 5.3 billion, (IPEA/ANTP, 2003) – approximately 0.4% of the country's GDP.

Access, production and consumption of PAS are amongst the main obstacles to the full and effective development of nations. Therefore sustainable development with social inclusion and equity is only achievable if opinion-setters and decision makers both in the public and private sphere ,as well as the community as a whole, gain a real understanding of the impact of drugs on the socioeconomic development of a country (Singer, M. 2008).

In this context, the need to gain deeper knowledge on the costs generated by PAS use in Brazil must be stressed. The present study is one more step towards this. Although traffic accidents are the second cause of death amongst the young, and international data show the economic impact of such accidents and their relation to PAS use, there is still little data on the socioeconomic cost of driving under the influence of psychoactive substances in Brazil. These costs appear in various ways: cost of first aid and hospitalization of victims, loss of productivity, premature death of a significant portion of the economically active population and distressed families. This study has sought to measure all the costs due to traffic accidents related to alcohol abuse in the city of Porto Alegre, through the development of a method based on national and international studies.

In this chapter we will first provide a brief overview of Brazilian reality and the city of Porto Alegre as far as traffic accidents are concerned. Then we will present the main national and international studies that measure the socioeconomic cost of traffic accidents. Finally and based on the previous sections, the types of costs covered by this study will be presented, as well as the method used to measure them.

1. Traffic accidents: a worrying reality

The World Health Organization (WHO) estimates that the number of deaths due to traffic accidents should reach over one million persons in 2015 and recognizes that one of the main causes of these accidents is the consumption of PAS.

In Brazil, violent death is the second main cause of death among the population (Scalassara et. al.,1998). According to Minayo (2009), traffic accidents and homicides are the main

causes of violent death in Brazil. In the 1990s Brazil had 310 thousand traffic accident related deaths (accidents without fatalities were excluded).

In this context traffic accident related-public policies play an essential role in the management of public resources and therefore in the economic effectiveness of the country. However these numbers are only the visible part of the social costs involved. It is now known that the excess violence of urban and road traffic can be a direct consequence of PAS access and that this may be at the root of serious social questions that compromise the country's economic development.

Traffic accidents involve various factors, including: bad vehicle and road maintenance, psychoactive substance consumption and human failure. Both the causes and intensity of fatal accidents vary considerably from one Brazilian municipality to the other (Minayo, 2009). The mortality coefficient determined in the brazilian city of Maringá for 1992 was 34.6 deaths per 100 thousand inhabitants (Scalassara et. al., 1998). In Londrina, another brazilian city the coefficient was somewhat lower, 29 deaths/100 thousand inhabitants (Andrade e Mello-Jorge 2000). On the other hand, in São Paulo, where a higher mortality coefficient could be expected , since it is a large urban agglomeration the coefficient in the same year was 21/100 thousand inhabitants (CET 1997).

In another study, Scalassara et. al. (1998) draw a profile of the fatal victims of traffic accidents. The results show that most victims lived in urban areas and were male, in the age group from 20 to 49 years – despite the risk of death being higher for people above 65 years. Pedestrians were the main type of victim (29.2%), followed by motorcyclists (27.7%) and bicyclists (18.5%). Most of the accidents were people being run over (30%) – especially people above the age of 65 – followed by collisions between motor vehicles (26.2%) – especially for people between the ages of 20 and 49, and took place in the urban perimeter. (83.1%), on avenues with heavy vehicle flow, on weekends, in the afternoon and at night.

Hingson and Winter (2003) show a profile of alcohol-related traffic accident victims similar to that found by Scalassara et. al. (1998). The main victim characteristics are: male drivers, white, aged between 22 and 45, people with alcohol problems and non-users of safety belts. Another result of the study is that traffic accidents are more prone to cause death if alcohol is present. In 2002 the percentage of traffic accidents with alcohol-related deaths was 4%. Besides, most accidents happen at night and on weekends.

In the last few years traffic accidents have increased in number in Brazil: from 1998 to 2005 the number increased by 46.1% , while the population and number of cars increased 16.8% and 36% - the proportion of non-fatal victims per 10,000 vehicles grew 17.7% in the same period (Table 1).

DATASUS (a database from the Brazilian Unified Health System) data also show that the number of TA related deaths increased in Brazil in the last few years, affecting especially the young population. According to DENATRAN (National Transportation Dept) (2005), 27% of the fatal victims of traffic accidents in Brazil were between 18 and 29 years old and 78.6% of these were male. According to Galduróz & Caetano (2004), reporting data from the study by the Associação Brasileira de Departamentos de Trânsito (Brazilian Association of Traffic Departments), in four Brazilian cities (Brasília, Curitiba, Recife e Salvador), in 1997, 27.2% of the traffic accident victims showed blood alcohol levels above the legal 0.6 g/l.

The city of Porto Alegre showed an increase of about 10% in traffic accidents involving victims, (fatal and non-fatal) between 2000-2006, totaling 5499 events in 2006. This growth trend, as well as the number of accidents with victims in the last seven years is also found in the number of non-fatal victims where the trend is even stronger, with an increase of 22% in the period.

Table 1 – Evolution of Traffic Accidents – Brazil – 1998 to 2005 – Source: Detrans/ SINET - DENATRAN-CGIE

	1998	1999	2000	2001	2002	2003	2004	2005
Accidents with Victims	262,374	376,589	286,994	307,287	251,876	333,689	348,583	383,371
Fatal Victims	20,020	20,178	20,049	20,039	18,877	22,629	25,526	26,409
Non-fatal Victims	320,733	325,729	358,762	374,557	318,313	439,065	474,244	513,510
Fatal Victims/10,000 Inhab,	12.4	13.9	11.8	11.6	12.3	12.8	14.1	14.0
Fatal Victims/10,000 Vehic,	6.5	7.0	6.8	6.3	6.2	6.2	6.5	6.3
Non-fatal Victims/10,000 Vehic,	103.7	111.8	124.1	119.8	104.6	119.8	120.9	122.1
Accidents w/Victims/10,000 Vehic,	84.8	116.5	99.3	96.2	75.1	91.0	88.8	91.1

Another characteristic of the distribution of traffic accidents throughout the year is seasonality, since in January and February when the population leaves town due to vacations there is a considerable reduction in the number of accidents (Figure 1).

According to Rio Grande do Sul Dept of Trasnportation and Empresa Pública de Transporte e Circulação – EPTC (Porto Alegre PublicTransportation Enterprise) data in the period from January/2000 to January/2007 traffic accidents within the city of Porto Alegre caused the deaths, on the average, of 13.3 persons per month. In 2006 there were 156 deaths in traffic accidents (Figure 2).

1.2 Socioeconomic Costs of traffic accidents – international and national experience

Among the various applications of Health Economics is measuring the social and economic costs related to health, as the direct cause of disease, violence, crime, premature death and loss of productivity. Since traffic accidents are a form of violence and are harmful to health its is necessary to understand their causes and their real impact on economic and social welfare. Therefore, traffic accidents deserve attention, not only due to the number of victims they generate, but also due to the social and economic cost to the entire society. Most socioeconomic costs are not easy to determine. This, for instance, is the case of loss of productivity due to accidents that wound or kill victims, medical costs of attending victims and their treatment, damage to public and private property, besides psychological damage. All such costs are difficult to measure but have a real and significant impact on the sustainable development of a country or region.

Figure 1: Number of Traffic Accidents with Total of Victims and Number of Non-Fatal Victims in Traffic Accidents – January/2000 to January/2007 in Porto Alegre – Source: EPTC – Empresa Pública de Transporte and Circulação, Estatísticas (2007).

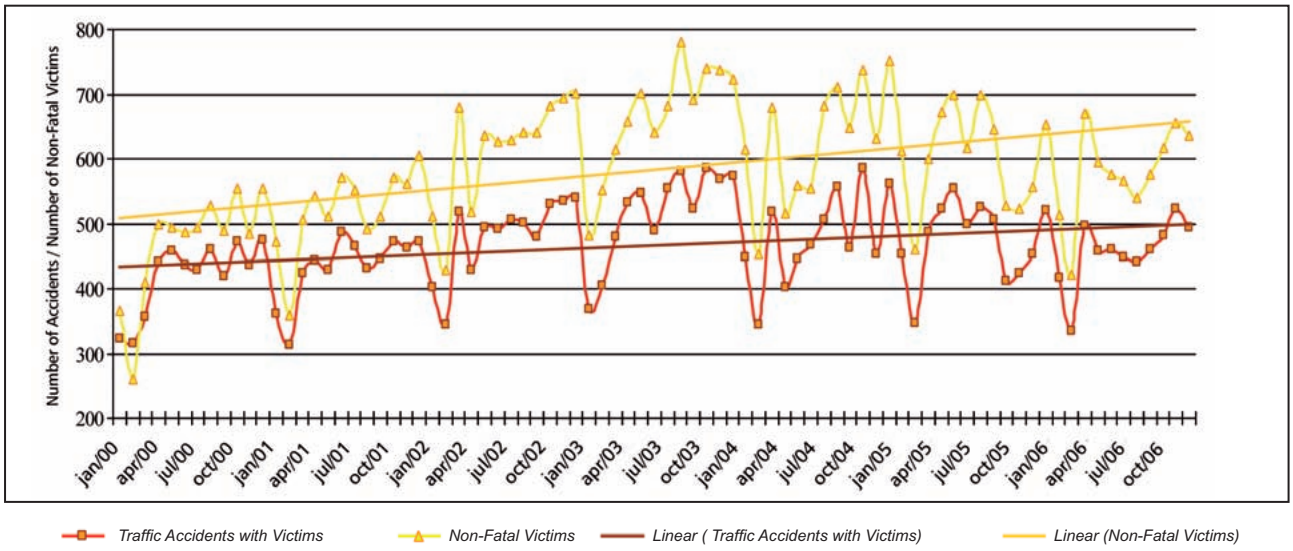
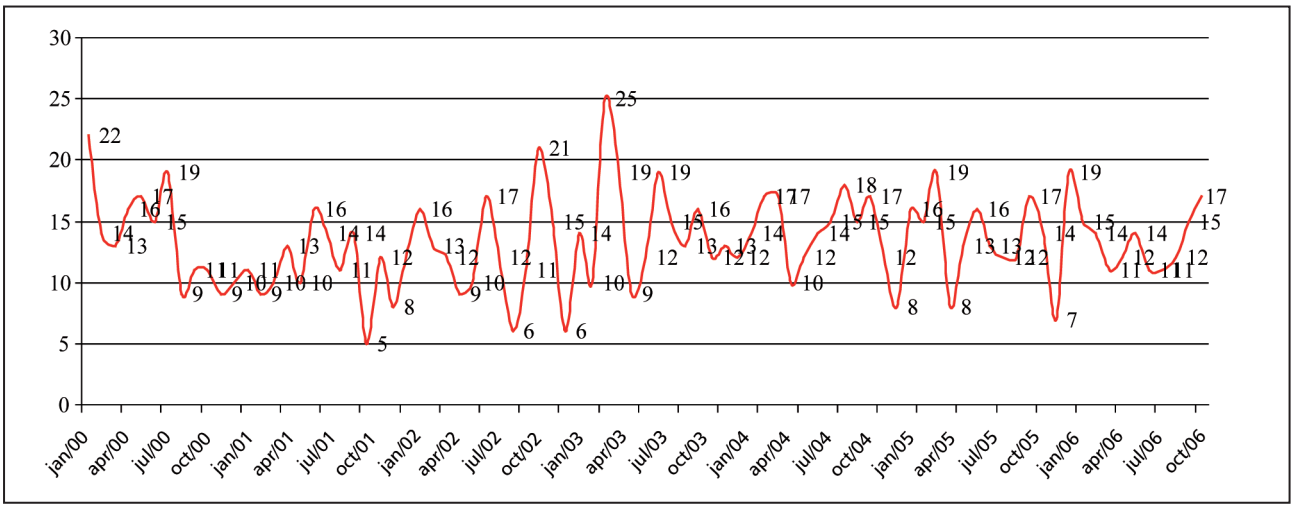


Figure 2: Number of Fatal victims in Traffic Accidents – January/2000 to January/2007 in Porto Alegre. Source: EPTC – Empresa Pública deTransporte and Circulação, Estatísticas (2007).



Several studies record the costs associated with psychoactive substance abuse such as the consumption of alcohol and other illicit, drugs. Most of these studies use the cost of illness methodology, for the purpose not only of recording individual and/or heath system costs, but to adopt broader social perspectives that include all the costs and damage caused by illness. Besides economic costs, recent research also estimates intangible costs related to pain, suffering and the impact on the quality of life of those affected by traffic accidents involving PAS.

The cost of illness methodology has often been used over several decades and the estimated costs supply information describing the resources utilized and the potential loss of resources associated with illness. Together with measurements of prevalence, incidence, morbidity and mortality, the estimated costs allow the impact on society of a given disease to be charted.

National and international literature using cost of disease methodology is extensive and well-established. The perception is that for cases of alcohol and psychoactive substance abuse this methodology has been shown to be adequate, even leading to drafting an International Guideline to systematize and improve Economic Cost estimates for Substance abuse (Single; 1995). Several more recent studies use this methodology to obtain direct, indirect and intangible costs linked to diseases caused by the abuse of alcohol or other substances, as to international studies, in 2002 the U.S. Department of Traffic presented a report showing the costs generated by traffic accidents involving motor vehicles in 2000. The results show an economic cost of 230.6 billion dollars, which represent the economic consequences of 41,821 deaths 5.3 million non-fatal victims and 28 million damaged vehicles.

In the specific case of alcohol abuse, a recent study estimates that in the state of California (USA) in 2005 this abuse generated a total economic cost of 38.5 billion dollars. This cost involves aspects such as medical treatment, loss of productivity and work days, the cost of criminal prosecution, and other costs.

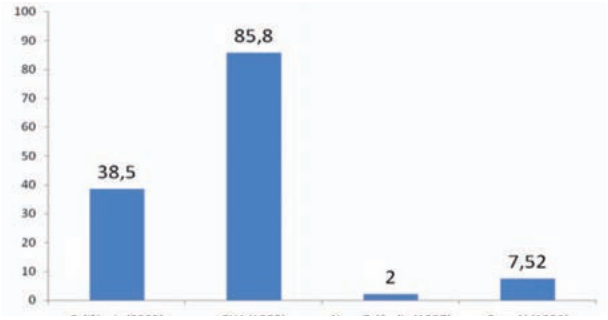
Besides economic costs alcohol abuse is also responsible for significant losses of quality of life: suffering caused by the violence associated with alcohol abuse, loss of years of life due to early death and sequelae of disease or accidents. These comprise the costs due to loss of quality of life, estimated as 48.8 billion dollars for California in 2005.

Rice, Kelman & Miller (1991) estimated the total yearly cost of PAS abuse and mental disease as 273.3 billion dollars in the U.S. in 1988. Of this total cost US$ 85.8 billion refer to alcohol abuse, $58.3 billion to the abuse of other drugs and $129.3 billion refer to mental illness. In New Zealand the yearly cost of alcohol abuse was estimated as between 1 and 4 billion dollars, given a rate of alcohol abuse prevalence of 6.45% for men and 2.15% for women. In order to estimate these costs the authors considered the cost of hospitalization, recovery, absenteeism, excess of unemployment, efficiency reduction, premature death and imprisonment.

Single et. al. (1998) measured the cost of PAS abuse for Canada in 1992, and found a result of more than 18.4 billions dollars, which corresponds to about US$ 694 per capita and 2.7% of the Canadian GDP. Alcohol costs were as high as US$ 7.52 billions of which US$ 4.14 billion were due to loss of productivity, US$ 1.36 billions in legal costs and US$ 1.3 billions to direct health costs. Tobacco costs were US$ 9.56 billions: US$ 6.82 billions due to loss of productivity and US$ 2.6 billions in direct health costs. Finally the costs pertaining to other illicit drugs were US$ 1.4 billions.

Some of these data are presented in Figure 3 (below), which shows the magnitude of the social and economic impact of alcohol consumption on society.

Figure 3: Costs of Alcohol-Related Traffic Accidents in Billions of Dollars



There is lack of data on the cost to Brazilian society of the use of psychoactive substances. The only study – besides this one – that shows the results regarding costs generated by traffic accidents was carried out by IPEA/AN TP (2003).

The results show an annual cost of R$ 5.3 billions – about 0.4% of the GDP of the country. Of this total 42.8% refers to loss of production linked to the premature death of persons or the temporary interruption of their activities, 13.3% refers to medical costs and 28.8% to the cost of repairing vehicles that have been in accidents.

Notwithstanding, these costs are not independent of the relationship with PAS consumption linked accidents. Therefore the relevance of this study can be perceived, insofar as it is a pioneering effort in Brazil, to estimate the economic and social cost of the consumption of psychoactive substances, especially the costs of traffic accidents in the city of Porto Alegre linked to the use of alcohol. The international research data presented in this section are clear evidence of the magnitude of these costs, and therefore of the potential impact of public policies that seek a reduction in the consumption of psychoactive substances.

This study seeks to identify, measure and determine the value of the costs and consequences associated with drunken individuals who were involved in traffic accidents in the city of Porto Alegre, from a social perspective. Two separate methodologies are used for this: the cost of illness methodology and the contingent value determination methodology. The former is used to obtain the direct and indirect costs associated with alcohol abuse in traffic accidents; the latter is used to obtain intangible costs and the readiness to pay for public policies that seek a reduction in the number of traffic accidents. Table 1 summarizes the main costs measured in this survey.

Direct Costs are goods, services and other resources used to deal with the outcome of traffic accidents. Some of these costs are: rescue, medical and hospital, rehabilitation, police and traffic agent services, damage to public and third party property, cost of damage to the vehicle, social security and legal costs.

Indirect Costs or productivity costs are defined in literature as costs related to the loss or reduction of the capacity to work or engage in leisure activities due to morbidity or death (Drummond & McGuire (2001), Gold et. al. (1996), Kobelt (2002) and Drummond et. al. (2005)). These are important cost components when the purpose is to carry out a cost of illness study. Illness can alter the way an individual allocates time, and considering that time is a limited input and its use is related to the cost of opportunity, any change in its allocation due to a traffic accident must be monetarily quantified and added to the social and economic costs. The questionnaire on this subject is based on methodology developed by Van Roijen et al.(1996) and Reilly et al. (1993).

Finally the Intangible Costs, i.e., costs related to changes in health/quality of life, suffering or pain associated with treatment, or the loss of a loved one, reflect states that cannot be easily measured or have values ascribed to them.

Table 1: Summary of the Main Costs – Source: Drawn up by the authors based on Single (1995) and NBR 6061.

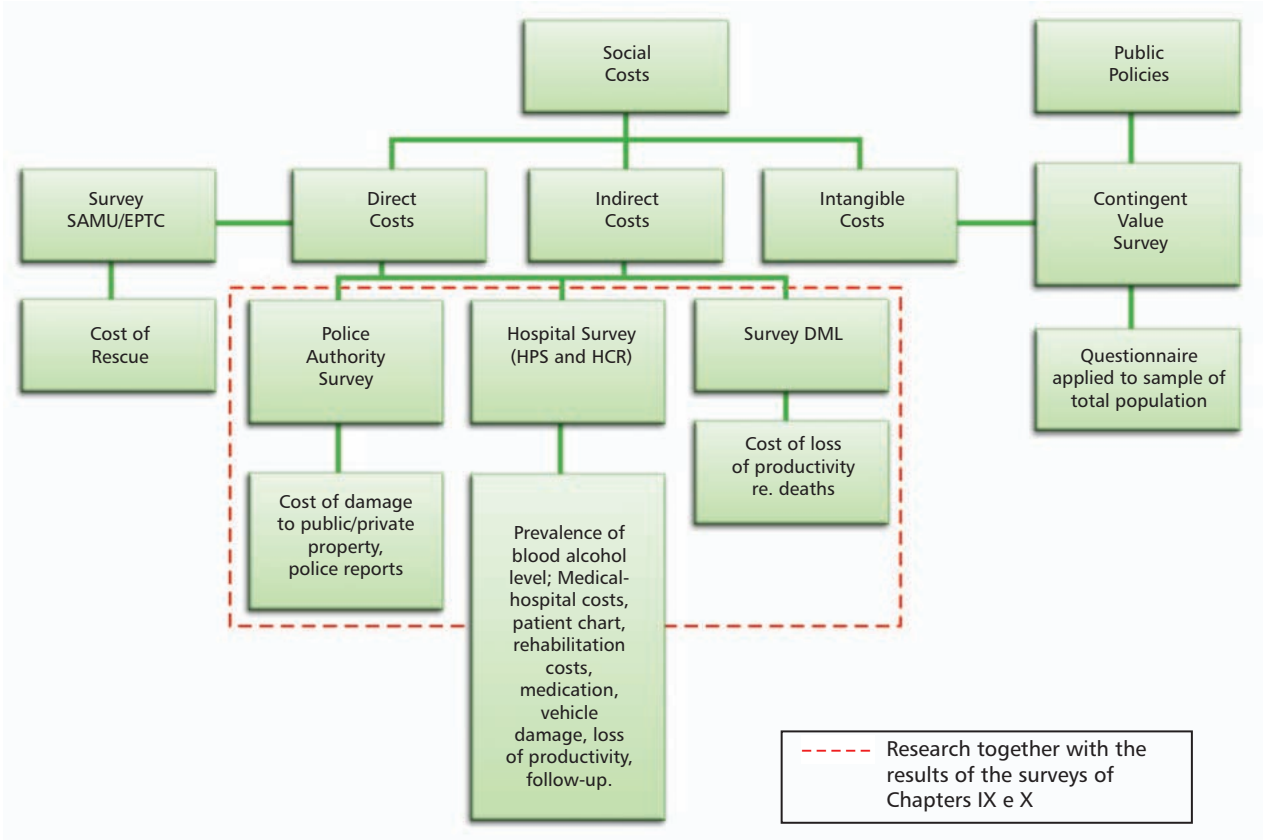
Costs
Direct
- victim rescue
- medical-hospital
- rehabilitation – physiotherapy, etc.;
- outpatient/emergency medication
- damage to vehicles involved;
- damage to public and private property.
Indirect
- loss of work days;
- loss of work days by family members or other;
- not being able to work;
- loss of productivity;
- death.
Intangible
- cost of suffering related to traffic accident.

Notwithstanding, contingent value allocation techniques allow the attribution of monetary values to the possible outcomes. "Declared Preferences of the Disposition to Pay" are used to indicate what individuals would be ready to pay not to undergo the suffering and losses caused by such outcomes (Kowalski & Ferraz, 2005).

The study is structured as illustrated in Figure 4. The direct costs were obtained from three sources: data collected from Empresa Pública de Transporte e Circulação (EPTC), data collected from Police Authorities and data collected at Emergency Room Hospitals (questionnaire applied on site, data collected from Medical Records and phone follow-up of victims). The indirect costs were obtained from two sources: for non-fatal victims by phone follow-up during six months, in the case of fatal victims data collection at the Medico Legal Department. Finally the intangible costs were obtained by phone follow-up. Besides this, a survey was carried out in Porto Alegre to measure the population's readiness to pay for public policies aimed at preventing traffic accidents.

Sampling was performed at the two hospitals that receive most of the casualties: Hospital de Pronto Socorro de Porto Alegre and Hospital Cristo Redentor. To obtain direct, indirect and intangible costs the recorded victims were followed-up by monthly phone calls – monthly periodicity is suggested to avoid memory (accuracy) problems on the description of costs and morbidities caused by the traffic accident.

Figure 4: Study Flow-Chart



In the case of fatal accident victims , the costs of loss of life were calculated based on a survey at the Medical Examiner's Office (Departamento Médico Legal - DML). A cross sectional study was carried out with secondary data from the charts completed during the autopsies carried out in cases of Traffic Accidents. These data are available from the database in that Department. Data collected include all fatal victims whose accidents occurred within the urban area of Porto Alegre during one year. This information is in the DML reports, which provide details on the causes of death, such as blood alcohol level or the use of psychotropic substances, among others. Personal characteristics are also collected such as age, sex, color and profession so that it was possible to obtain more precise information to calculate the social and economic costs associated with TA caused by alcohol abuse. The individuals involved in traffic accidents were defined as drivers (of cars and motorcycles), occupants (people being driver and/or passengers in the case of buses) or pedestrians.

A parallel investigation was carried out on the cost, to public and private entities, of rescues and damage to public and private property defrayed by the Empresa Pública de Transporte e Circulação (EPTC) (Public Transport Organization), which is called to all accidents in the urban area of Porto Alegre, The Military Police which is always called in the case of accidents with victims, the Departamento Estadual de Polícia Judiciária de Trânsito (DEPTRAN) (State Judiciary Police) which records all the occurrences and SAMU which supplies emergency care and transports the victims to the Emergency Hospitals. Besides, a survey was carried out with the Health Insurers (who send rescue services to their policy holders) and the goods and services underwriters (who insure the vehicles and victims' lives) , the cost of rescue and damage and its impact on insurance premiums. The data are secondary since we only sought information which these organizations already have made available.

A cross sectional study was also carried out in Porto Alegre to analyze the perception of traffic accidents by individuals. A specific questionnaire was developed for this purpose based on the related literature. In this questionnaire the interviewee stated whether he had ever been in a traffic accident or if a relative or close friend had been involved, his perception on the problem of alcohol in traffic accidents and other matters pertaining to alcohol consumption (frequency with which he consumes alcohol, how long he has been consuming it, type of beverage, expenditures on alcoholic beverage).

The interviewee also was questioned as to being in agreement with paying for public policies that would reduce traffic accidents, in which hypothetical scenarios of public policy establishment or not were presented (see Silva &

Lima (2006); Amim & Khondoker (2004); Kowal- ski & Ferraz (2004); Santana & Mota (2004)).

All these data are obtained based on standard forms and questionnaires according to the appropriate literature. The following instruments are used to collect data: questionnaires applied to accident victims in the Emergency Hospitals, data collection forms to obtain information from the medical records of accident victims applied by phone during the six months of the follow up of non-fatal victims, data collection forms on the rescue costs at EPTC, data collection form on fatal victims at the Medical Examiner's office (DML) and questionnaire applied in a random sampling of the Porto Alegre inhabitants (contingent value of public policies) . The results of the data collected and their analyses can be examined in chapters XIV e XV.

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Toxicological assays to measure psychoactive substances in drivers

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General aspects and relevant legislation

Stop approaches made by police officers are classified in the field of Forensic Toxicology and follow the recommendations of international forensic guidelines such as SOFT/ AAFS (Soft/ Aafs, 2006), of the American Academy of Forensic Sciences (AAFS) and the Society of Forensic Toxicology (SOFT). Such large scale approaches require the use of easily performed techniques that deliver quick responses, such as screening tests, followed by the confirmatory step, which should be performed with a more specific technique and based on a different detection principle. Whenever possible, gas-liquid chromatography (GC and HPLC), coupled with mass spectrometry, (MS) or mass/mass (MS/MS)detector, should be the technique of choice, since they provide enough specificity to be used to begin criminal proceedings when necessary (Soft/Aafs, 2006).

The strictness required for confirmation depends on the importance of the analytical finding, as well as the circumstances of the case. Nevertheless, as a matter of general, scientific and ethical principle, even in screening assays where false positives are unlikely, a second analytical system is highly recommended. Regardless of the circumstances, the final report of the analysis should clearly indicate the methodology applied (e.g. immunoenzymatic assay for benzodiazepines; GC-MS(-MS) for cocaine), the technique sensitivity, its limitations and, when applied, a note that the results were not confirmed, describing what might have interfered.

At the international level, some specialists representing different institutions such as NIDA (National Institute on Drug Abuse – USA), European Commission (EU – ROSITA project), European Observatory of Drugs and Toxic Substances (OEDT), the French Society of Analytical Toxicology (SFTA), International Council on Alcohol, Drugs and Traffic Safety (ICADTS) and The International Association of Forensic Toxicologists (TIAFT) have been working intensively to demonstrate the risks associated with driving under the influence of other drugs (DUID) besides alcohol. These groups have been gathering efforts to establish guidelines that enable the standardization of specific procedures to be adopted in routine law-enforcement approaches (Walsh et al., 2008).

Among the current trends successfully implemented in some countries is the use of quick tests such as automated immunochromatography or immunoenzymatic assays for screening and GC-MS(-MS) or HPLC-MS(-MS) for confirmation, the matrix of choice being oral fluid obtained from drivers. Mainly because it is difficult to tamper with, has a good correlation with blood levels demonstrating the recent use of the drug, is easy to collect, not embarrassing and not invasive, and since it provides at least preliminary identification in loco, it renders the action of the traffic policeman feasible at allowing the traffic officer to act at the time of the stop approach.

In Portugal, for instance, with the enactment of regulations that monitor driving under the influence of alcohol or other psychotropic drugs, the procedures used by the traffic police were updated and the brands and models of preliminary tests of oral fluids approved for use on Portuguese territory were defined. For this purpose, it is necessary to meet the requirements of Article 14, n°3 of the regulation that monitors driving under the influence of alcohol or psychotropic drugs. In other words, in that country there is a legal way of detecting the use of drugs in traffic, as well as specific legislation guiding the methods and procedures that may be used by the authorities concerning drivers. The screening tests for the use of PAS can be performed with urine, saliva or sweat (the latter not yet regulated), the confirmatory assays being restricted to blood, which is drawn when the preliminary test is positive.

In many states of Australia, quick tests of oral fluid are applied using equipment approved by the Australian government (Road Legislation Amendment Act 2009). In that country, the detection of psychoactive substances is performed by the police at random, meaning that the police authorities have legal power to stop drivers randomly with no need for any previous traffic violation (Drummer, 2008).

In Brazil some trials have been conducted aiming at creating methodologies to verify the use of psychoactive substances in traffic, Outstanding among them is the work by Yonami ne (2004), which used saliva samples from volunteer truck drivers over 21 years old(n=561) who were driving on the São Paulo state highways, as a biological matrix to analyze ethanol, amphetamine, cocaine and tetrahydrocannabinol (THC). Samples were taken using Salivette® and the analysis conducted in laboratories by means of enzymatic immunoassay screening (ETS Plus, Dade Behring), followed by confirmation using solid phase microextraction (SPME) and gas chromatography coupled to mass spectroscopy (GC-MS; HP6890/5972, Hewlett Packard, Little Falls, USA).

According to the Brazilian Traffic Code (Brazil, 2008), driving under the influence of alcohol (at any concentration per liter of blood) or psychoactive substances which may cause dependence is a very serious offense, subject to fines, suspension of the driver's license for twelve months, seizure of the car until an authorized driver is presented, and retention of the driver's license (Brazil, 2008). Nevertheless, despite the legal means to monitor drivers suspected of being under the effect of psychoactive substances, currently only the estimated amount of ethanol can be assessed in loco by means of breathalyzers (ethylometers, known popularly as "bafômetros", breath meters).

Oral fluid as a biologic matrix for the analysis of psychoactive substances in traffic

The expression "oral fluid" specifies a mixture of saliva (the secretion of three main glands, the submandibular, the parotid and sublingual) and other substances present in the mouth comprising water, enzymes (mainly amylase), glycoproteins (mucines) and electrolytes (Aps e Martens, 2005). Its composition and the volume produced vary inter and intra individually (around 1 to 3 ml.min-1), and may be affected by many factors such as circadian rhythm, diet, age, systemic diseases such as cystic fibrosis and diabetes mellitus, as well as the use of some drugs or medications such as tricyclic antidepressants, and other anticholinergic drugs that decrease oral secretion (UNDCP, 2001; Drummer, 2008).

The use of this biologic matrix in police stop approaches to monitor the use of psychoactive drugs in drivers has been considered internationally since it is considered the only one that can be compared to blood concentration, once oral cavity contamination has been excluded (UNDCP, 2001), allowing a correlation between the concentrations obtained and the likely behavioral changes. Appropriate reviews of the applicability of oral fluid to analyze psychoactive substances can be found in the scientific literature, with special mention of the work of KIDWELL (Kidwell, Holland et al., 1998; Drummer, 2005; 2008).

Generally speaking, most drugs reach the saliva by means of simple diffusion. For that, the molecule must have adequate liposolubility, be in its non-ionized form and not bound to plasmatic proteins, in such a way that the drug concentration in the saliva represents its plasmatic, non ionized free fraction. Therefore, weak bases will accumulate in the saliva, with a predominance of the original drug and not of its biotransformation components, since the pH of saliva is more acid than the pH of blood, which causes it to ionize and prevents it from returning to the plasma (Kidwell, Holland et al., 1998). As in the plasma, the detection period may be affected by many factors such as dose, frequency of use, and sensitivity of the analytical methods (Cone and Huestis, 2007; Walsh et al., 2008). The low concentration of the analyte and the small volume of oral fluid that can be collected may be circumvented by the use of highly sensitive analytical techniques such as GC-MS(-MS) and HPLC-MS(-MS).

Sampling, transport and storage of oral fluid samples

Oral fluid sampling is done non-invasively, under direct supervision, making it difficult for the donor to tamper with the sample. It may be done by drainage, suction or absorption in appropriate material, followed by centrifugation to retrieve the sample. Many collecting devices may be found in the domestic and international markets, including those which display the volume obtained (usually 1.0 mL) and stimulate saliva production, making sampling feasible even in the case of people suffering from xerostomy ("dry mouth"), commonly mentioned by drug users, patients with diabetes or Parkinson disease, menopausal women, people suffering from stress, depression, dehydration, and others (Aps e Martens, 2005).

Since these are forensic toxicological analyses, all the procedures, from obtainig to disposal have to be documented to allow for traceability of the whole process. That will constitute the "Chain of Sample Custody", a document that should be available in case any questions develop concerning the work (Soft/ Aafs, 2006).

International organizations recommend the data collection of oral fluid within up to 3 hours after the stop approach, and storage at -20ºC for up to 12 months, in identified and sealed bottle, so that inviolability is guaranteed. In order to preserve analytical results, whenever possible the sample should be divided into two bottles, one for proof and the other for counterproof. The first part of the sample (proof) will undergo toxicological analysis and the vial for counterproof will be stored for a new analysis, in case the result on the proof is challenged (UNDCP, 2001; Soft/Aafs, 2006; Walsh et al., 2008).

Main methods to detect PAS in traffic

The detection of the use of psychoactive substances in traffic is a subject that has been widely discussed in many countries. Currently, with the discovery of new analytical methods, most PAS can be immediately detected by means of sensitive and quick yet low specificity screening techniques, used to separate negative samples from the potentially positive ones for one specific drug or class of drugs, followed by highly specific chromatographic techniques such as GC-MS(-MS) or HPLC-MS(-MS).

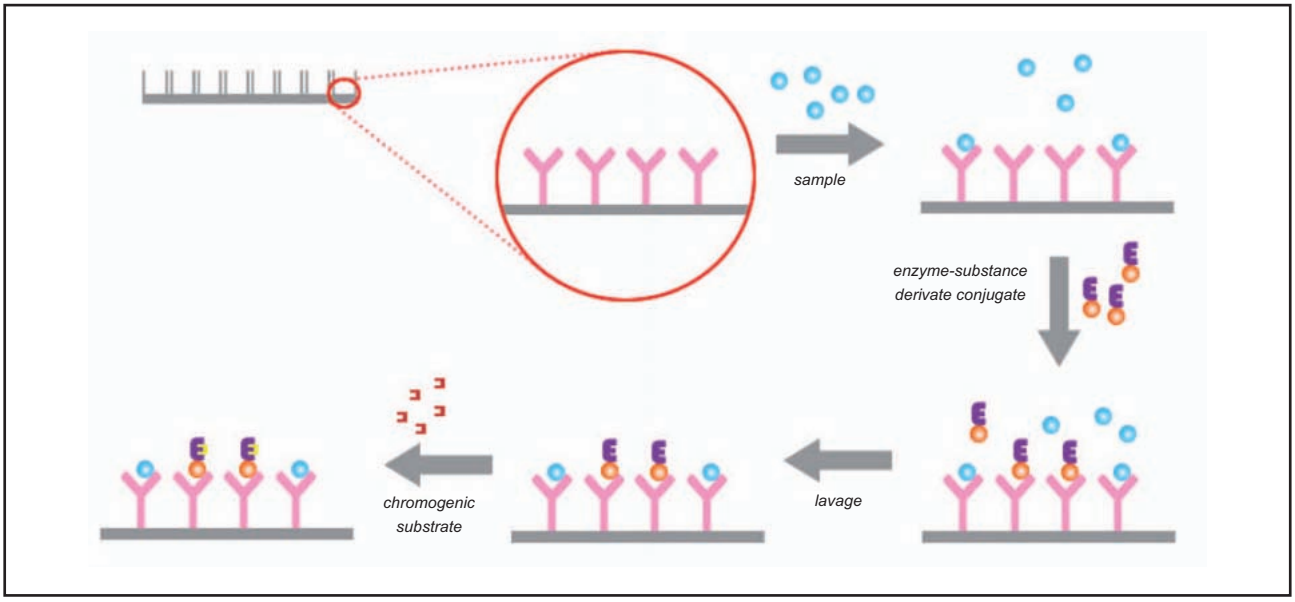
Among the alternatives available for the screening steps, the most widely employed have been immunoassays, characterized by being simple and practical, easy to prepare the sample and requiring little time between sampling and providing the result. They can be applied in loco (quick immunochromatographic tests - on site drug testing devices) or by means of automated methods in the laboratory, where hundreds of analyses can be carried out per day. These techniques are based on the principle of interaction between antigen (target molecules) and antibodies which are specific for each drug or class of drugs to be analyzed, for the purpose of generating a measurable signal (Moffat, 2004). They render the results in a few minutes, at the site of the approach, by visually reading the device in the presence or absence of color. They may be found in the market in versions dedicated to the detection of a single drug or many drugs simultaneously. However, it is important to consider the subjective nature of visual reading, expressed by the presence or absence of a colored stripe. This visualization is impaired in assays where the concentration of the analytes is close to the cut-off values (borderline), which points to the need for adequate training before routine tests are implemented (Costa S, 2005). Another important factor to be considered is the ethical issue of applying these tests, since the result of the test is generated in the presence of the driver, a relevant aspect if we consider the probability of false results, since the specificity of this technique is questionable.

An automated immunoenzymatic technique that has proven most promising for the analysis of PAS in oral fluid is ELISA (Enzyme Linked Immuno Sorbent Assay), due to its high sensitivity. This test consists in an immunoassay which contains a known amount of antibodies bound to a solid support, and a fixed concentration of enzymatic conjugates. The reaction occurs by the competition between the drug of interest present in the sample and the enzymatically labeled drug. (Figure 1). The photometric determination of enzymatic activity by absorption is related to the concentration of the drug through a concentration-response curve (or dose-response curve). The more intense the binding of the antigen present in the sample to the antibodies, the less the enzymatic activity, generating a less intense color. In spite of being practical, some major limitations such as the use of imported kits, low specificity and the possibility of cross-reactivity with other chemically similar substances must be considered. Due to the low specificity, the results provided by these screening tests may be easily questionable, justifying the referral of the positive samples and 5% of the negative ones (to check the screening efficacy) to confirmation by more specific analytical procedures which should be at least as sensitive as the screening tests and based on a different analytical principle, in order not to be subject to the same confounders (Soft/Aafs, 2006; Walsh et al., 2008).

The confirmatory analyses should identify the presence of a specific substance with a high level of certainty. The techniques considered "gold standard" are gas-liquid chromatography coupled to mass or mass/mass spectroscopy (GC-MS, GC-MS(-MS) or LC-MS(-MS)). Among those, the GC technique has a lower overall cost, but it is applicable only to thermally stable volatile (or volatilizable) analytes, whereas HPLC may be considered more versatile and sensitive, encompassing a larger number of substances that may be analyzed simultaneously; but it has a much higher added cost compared to CG.

Generally speaking, mass spectroscopy receives the effluent of the chromatographic unit, and its principle is the formation of fragments which are characteristic for each drug, considered their "fingerprints". They enable

Figure 1. The basics of the competitive ELISA method (Credits: Eloisa Comiran).



the identification and simultaneous quantification of many substances, in many matrices and applications, with high sensitivity and proven reliability, enhancing certainty in identification of compounds of interest, due to the selective fragmentation of their ions (precursor ion) and monitoring of the respective ions produced (product ion) from its fragmentation, significantly increasing analysis selectivity. Methods using GC-MS and HPLC-MS(-MS) have been constantly reported and widely used (Maurer, 2007), and are currently the most widespread techniques among the many areas of analytical chemistry, especially forensic toxicological analysis. Among the acceptance criteria recommended for confirmatory analysis, we may emphasize the use of MS in SIM mode (selective ion monitoring) for the identification of a specific drug, either as part of a quantitative procedure or not, by means of the use of at least one qualifying ion (diagnostic) for each analyte and internal pattern, besides a primary ion (precursor) for each one. For a sample to be considered positive, all the principal and diagnostic ions present in the spectrum of the standard chemical must be present in the analyte, at a rate of up to ± 20% in relation to the proportion of the standard chemical to GC-MS and of up to ± 25% or 30% for HPLC-MS(-MS). The monitoring of adult ions or isotopes as qualifier ions for the identification is not recommended (Soft/Aafs, 2006; Walsh et al., 2008).

The retention time should also be part of the acceptance criteria for chromatographic assays; a variation of up to 1 –2% for the CG technique in relation to the standard chemical is recommended or a slightly larger variation when the HPLC technique is used, especially in the gradient system. The confirmation of the results in extracts or matrices different from the one used in the first test is also recommended to rule out the possibility of sample contamination, as well as the performance of replicated analysis, in the same matrix, with appropriate positive and negative controls (Soft/ Aafs, 2006; Walsh et al., 2008). Following these guidelines the high level of reliability of the analysis allows the unambiguous identification of the PAS, and they are accepted as techniques of reference both in scientific as well as in legal terms, nationally and internationally.

Reliability and applicability of the methods employed for the analysis of psychoactive substances

The selection of the most appropriate method for analysis is a challenge for the analyst, in the face of the range of alternatives available. Regardless of the methodology applied, demonstrating reliability and applicability is crucial and consist in evaluating a method to guarantee that it performs adequately for that particular analysis. Several laboratory quality systems may be applied to the Forensic Toxicological Laboratories such as the Good Laboratory Practices, ISO Guide-25, and those specifically used in Forensic Toxicology Laboratories(E.g.: NIDA, SOFT/AAFS, WADA, SAMSHA).

In this context, the validation of analytical methodologies is a fundamental component which must be followed in any analytical laboratory. According to national and international guidelines, validation may be defined as "The confirmation through analysis and demonstration of objective evidence that the requirement for a specific use were met". Table 1 depicts the most important parameters which should be assessed, according to the International Conference on Harmonization (Ich, 2005), which also defines each expression. Those requirements and definitions were incorporated by the Brazilian National Sanitary Surveillance Agency - ANVISA (Brazil, 2003).

Guidelines such as ISO (Iso, 1992), ICH (Ich, 2005), BRASIL (Brazil, 2003), depict the need for analytical methods meeting the requirements to look for PAS in oral fluid of drivers, including some with a more practical focus, suggesting acceptable limits. Choosing the parameters and acceptable ranges appropriately depends on the proposed method and its application (Green, 1996). In the absence of a specific regulatory guideline, the analyst must define whether the minimum requirements found in the current legislation are enough to guarantee reliable data. In this stage, some problems of terminology may be encountered (Iso, 1992; Ich, 2005), although the one adopted by the international regulatory agencies, such as the ICH, is the most widely accepted. It does not include the definition of stability, which is an important parameter in bioanalytical methods, and the ICH definition for selectivity does not consider the interferents which may be present in bioanalysis, such as the products of biotransformation (Iso, 1992). Considering this reality, the current alternative for forensic toxicologists in Brazil is to look for solutions in international guidelines to fill in the blanks of current national legislation (Soft/Aafs, 2006) which is most frequently used.

Cut-off values and interpretation of analytical results

It is common practice in toxicological analysis to establish concentration limits to classify the results as indicative or not of the use of PAS. Those reference values (named cut-off) are values established for one drug or class of drugs and their biotransformation products and they are utilized to define whether the results of an analysis were positive (analytical values equal or above the cut-off value) or negative. In Table 2 the maximum cut-off values are depicted, as recommended by WALSH (Walsh et al., 2008). Those values vary according to the biological matrix and the detection limit of the analytical

Table 1: Most important parameters assessed in validating analytical methods.

Type of assay	Identification	Impurity Assay		Dosage
		Quantitative	Cut-off	
Accuracy	-	+	-	+
Precision				
Repeatability	-	+	-	+
Intermediate precision	-	+ (1)	-	+ (1)
Specificity	+	+	+	+
Limit of detection	-	-	+	-
Limit of quantification	-	+	-	-
Linearity	-	+	-	+
Concentration zone	-	+	-	+

(-): normally does not have to be assessed; (+): normally assessed; (1):if repeatability assessed, not necessary; (2): the absence of specificity may be compensated by other analytical procedures; (3):may be necessary in some cases.

methods employed, and should be below the therapeutic window, in such a way as to detect usual doses after 24 hours of use (Costa S, 2005).

The term "trace" can be used, but with parsimony, since if a drug was detected in one sample but in concentrations below the cut-off value, from the analytical standpoint, the result is negative, always taking into consideration that methods with low sensitivity or specificity do not reflect the casuistics (Soft/Aafs, 2006).

Analyses performed in the project

Between January 2008 and September 2009, 3,251 samples of oral fluid were collected and analyzed in 26 Brazilian state capitals and in the Federal District, detailed in chapter VII.

The sampling was done using the Quantisal® Device (Immunalysis Corporation). Storage and analysis of the samples followed strictly what is recommended by the manufacturer. After obtaining the samples were placed in portable refrigerators and forwarded to the laboratory for the toxicological analyses which were done in cooperation with the Laboratory of Toxicology of the School of Pharmacy of the Federal University of Rio Grande do Sul, under the responsibility of the main author of this chapter.

The analyses were done by screening followed by confirmatory tests, as recommended by WALSH (Walsh et al., 2008). ELISA (Enzyme Linked Immuno Sorbent Assay) was used for screening through kits which were specific for each analyte (amphetamine, cocaine/benzoylecgonine, tetrahydrocannabinol (THC) and benzodiazepines) purchased

Tablel 2: Maximum cut-off values, in ng.mL-1, recommended by Walsh et al. (2008).

Analytes	Oral Fluid	Whole Blood
Cocaine	10	10
Benzoylecgonine	10	50
Cocaethylene / Ecgonine Methyl Ester	20	10
Amphetamine compounds	20	20
Delta-9-tetrahydrocannabinol	2	1
11-nor-9-carboxy-tetrahydrocannabinol	nd	5
11-hidroxy-tetrahydrocannabinol	nd	1
Diazepam	nd	20
Oxazepam	nd	50
Alprazolam	nd	10
Clonazepam	nd	10
Lorazepam	nd	10
Midazolam	nd	20

**nd: not determined yet*

from Immunalysis Corporation (Pomona, CA, USA). The method was revalidated in loco by means of specific training with technicians who were the manufacturer's representative before the beginning of the analysis.

The samples that were positive in this step were sent for confirmatory analysis, done by HPLC-MS(-MS) (Waters 2695 Micromass® QuattroMicro™ API) using the adapted method of OIESTAD ET al (Oiestad E.L, 2007) and validated by the group, to monitor the presence of drugs containing benzodiazepines (diazepam, clonazepam, alprazolam, bromazepam, cloxazolam, chlordiazepoxide); amphetamine compounds (amphetamine, anfepramon, femproporex, methylphenidate); cocaine and delta-9-THC. For this purpose, optimization of the conditions was performed in ionization module Eletrospray positive, utilizing the standard solution at 200 ng.mL-1 diluted in methanol, varying ionization and collision energy, therefore obtaining the transition of two fragments for each analyte, according to SOFT/AAFS recommendations (Soft/Aafs, 2006). This information plus the respective retention time in the chromatographic system, were used to identify the compound present in the oral fluid samples. For the chromatographic method, column HPLC Luna C18(2) (150 x 2.0mm; 5μ; 100Å; Phenomenex®) was employed, preceded by pre column; mobile phase composed by acetonitrile gradient with 0.1% formic acid as solvent A and ammonium acetate 5 mmol at a pH of 5.0 by adding acetic acid as solvent B. The chromatographic analysis lasted 15 minutes.

By analyzing the results obtained during screening, we could observe a low rate of positive results for the amphetamine compounds, attributed to the lack of specificity of the kits used for the medications sold in Brazil containing anfepramon and femproporex as active principle. This is a matter of concern, since such products (commonly called "rebite") are largely used by professionals drivers, which is a discrepancy with the low rates found, pointing to the need of developing alternative analysis for the screening of such substances or directly analyzing by GC- MS or HPLC-MS(-MS). According to WALSH (Walsh et al., 2008), for the purpose of investigation, there is no need for a previous immuno assay as a screening test if HPLC-MS(-MS) is used in a full-scan method (ion scavenging) to simultaneously identify and quantify the analytes of interest.

Conclusions

The clinical and social effects of the use of alcohol and other drugs in traffic are currently considered one of the most important problems of public safety. The feasibility of the analysis for the use of PAS is fundamental for the control and prevention of use, and it is an area which requires emergency attention at a national level. However, numerous factors should be considered and overcome in order that monitoring approaches can be considered routine in Brazil, such as standardization of analytical techniques, availability of equipment and standard chemicals, assigning credentials and accrediting reference laboratories, and the prospection of qualified professionals.

It is also worth highlighting the need to define, organize and review national regulatory guidelines, especially concerning parameters for forensic bioanalytical analysis, as well as specific standards which facilitate the flow of control-samples and analytical patterns, essential for the accreditation demands of the accredited laboratories. These aspects are crucial to ensure the reliability of the analytical results and depend on the implementation of a national culture of valuing laboratory findings.

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Scenes of data collection on federal highways – an overview of field work

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This chapter describes important decisions that were taken by a team of research professionals to collect data on federal highways of 27 Brazilian state capitals. The detailed description of the specific study is beyond the scope of this chapter, and is done in chapter VII. Our objective here is to provide a practical and operational outline of the difficulties and solutions encountered in implementing the project, aiming to facilitate the future work of data collecting teams in a similar situation.

How logistics of data collection were organized

This study aimed at collecting data on about 3,400 drivers in 27 state capitals during a period of more than one year, with constant trips of trained teams. In addition, the multidisciplinary work of previous data collection foresaw the coordination of a team of professionals from very different backgrounds - Highway Patrol Officers, Federal Police Officers and distinctly trained collectors. Given the ambition and novelty of the research project, we were faced with challenges different from the ones anticipated for the execution of the research project's activities. They will be briefly discussed below.

Regional, climate and calendar factors

These are specific to each of the regions involved. They correlate directly to the decisions on administrative and operational steps to be conducted by the professionals involved, and are the basis for its organization. One of them which may impact strongly on data collection - is weather. It is well known that rainfall and temperature depend on relief and latitude in Brazil. Most of the country lies at an altitude ranging from 200 to 1,000 meters, and the data collection teams were submitted to adverse climatic conditions. Therefore, it was essential for project implementation to assess the typical characteristics of the seasons in the regions where the study was conducted, prior to the field trips, since the definition of the dates for data collection in each state was based on a previous draw which defined the chronology for each region; some climatic circumstances had to be overcome:, for instance, in Belém – state of Pará, where it was necessary to respect the period between noon and 2pm, and delay the beginning of data collecting due to the heavy rains which regularly fall in that region, and made our presence in the roads impossible. This is an example that shows how, inevitably, in a large research project the method must be adapted to the reality of data collection.

Data collection began in August 2008, in the city of Porto Alegre-state of Rio Grande do Sul, where the climate was mainly rainy and cold. In the following week we collected data in the city of Florianópolis-state of Santa Catarina, where we also faced rain and temperatures of 5ºC. In the following data collection in João Pessoa/state of Paraiba, temperatures were high during the activity. The cities and their climatic characteristics alternated in a completely random way, and this method generated continuous, meticulous care in supporting food supplies, accessories and methodologies applied according to the typical weather of each region.

The study in each state consisted in data collection done over the weekends (one weekend for each state except for São Paulo, where two weekends were used because of the large number of cases.) It should be emphasized that the working hours in each place were quite intense. The collecting teams had to travel before each data collection, since their base was mostly in Rio Grande do Sul and they had to travel to the other states, while another team went from Brasilia to the same destination. Details that improve comfort are essential for the team to keep focused, concentrating entirely on the activity that requires great alertness. Above all we can mention the availability of inconspicuous Federal Police transport. Table 1 shows the minimum configuration of a data collection team for one working weekend.

Table 1. Basic configuration of a field data collection team

Data collection personnel (from the research center)
1 Federal Police Officer, 1 Highway Patrol Officer, 03 collectors
Local support personnel
2 Federal Police Officers, 2 Highway Patrol Officers
Equipment
2 breath testing devices, 4 PDAs*, 2 cases with gifts – 100/150 gifts (bags, caps, t-shirts, cd-cases), raincoats, flashlights, 1 cooler to transport saliva tests

**PDA – Personal Digital Assistant – digital cell phones to feed data.*

Time zones and holidays

There is a huge area covered longitudinally by Brazil, with four time zones which vary from minus 2 to minus 5 hours Greenwich Mean Time (GMT). The official time is the one of Brasilia, 3 hours earlier than GMT. From October to February daylight-saving time is adopted, aiming at energy saving. The time zones interfered directly in our activities and therefore must be observed.

As with time, planning also had to take into account the local and national holidays, since data collection would not be conducted on those days, because of method definition – since that modifies the routine profile of the drivers who drive on the roads and that situation might bias the sample. Furthermore, it also impacts public services. In the case of certain departments such as safety and health, the number of personnel is increased during holidays; in the case of the Highway Patrol, there is more demand for officers in road monitoring. The same is true for the Federal Police at airports. This phenomenon had all sort of impacts on planning -, for instance, team travel, housing or obtaining the airplane tickets in advance, because they are more expensive during the high season, and so is accommodation.

Regional diseases and endemic outbreaks

The professionals who worked in the field worked directly and face to face with people, in places strategic to obtain the subjects to be researched: roads monitored by the Highway Patrol stations. In that scenario there is a deliberate and expected diversity of drivers, with a mix of locals and out-of-staters, who bring with them a potential exposure to all kinds of infectious contamination – even more so when physiological saliva samples are obtained, as in this study.

For this reason, every immunization available for the diseases endemic to each region was previously administered to the team members. Nevertheless, it is well known that not every infectious disease can be prevented. Another important example was the data collection done in Rio de Janeiro amid an outbreak of dengue fever. It is relevant because there is no immunization for this disease, and during the year when data were collected more than 250,000 new cases of the disease were recorded in the state. Therefore the team was counseled to wear sneakers, jeans and repellent on the arms, to avoid possible contamination. In Rondônia, on the day we arrived, the newspapers headlines warned of an outbreak of yellow fever, dengue and malaria. On that day we worked at a station 40 km away from the city, almost inside the native forest and with daily rain, an environment that favors vectors of those diseases. In other states such as Acre, Amazonas, Pará, Roraima, Tocantins, Goiás, DF, those diseases are constant, varying in severity according to the moment. Therefore, it is extremely important to have all vaccination updated, use repellents, and be careful with food and housing. In Fortaleza one of the data collectors was stung in the foot by an insect and had an allergic reaction that needed medical care.

Planning food, breaks and rest periods

This item is directly correlated with the health of the professionals involved. Water support is something to be observed, especially during the data collector working hours. Enough water was purchased in advance to supply the collectors who worked for up to 12 hours straight, as well as research participants, since it was offered to the latter to render their participation as comfortable as possible, besides making saliva data collection easier (see study method, in chapter VII). Food should also be the subject of planning and attention. It was crucial for the group to eat food which was adequate to the working conditions and in a healthy environment, since during the data collection period on the road adequate places for a good meal or time to eat it are not always available. During one of the periods of data collections a police officer had food poisoning and had to be treated. Therefore, the meals were always planned and taken as a group to optimize time: there were usually nine people (table 1) in three cars. This prevented unnecessary travel and dispersion, since time was scarce. If it proved necessary, the data collection was shortened, or even canceled, in the case, for instance, of accidents on the road. The schedule for the data collection in the Police Station was of 12 working hours, reaching a large spectrum of drivers and hours. For this reason, it was necessary to have the hours of rest before work. Therefore, comfortable and safe housing was crucial for the success of the action, since a collector who is well rested obtainss data in greater detail from the subjects researched. Even being careful with food, the country's food diversity is paramount in such a huge project.

Data Collection Logistics

The fact that we used the facilities of a governmental body – in this case a Federal Police Station – as headquarters for the operation during data collection does not necessarily mean we will find all the infrastructure necessary for the job. Therefore, physical environment and general characteristics of the place must be previously evaluated by the group so that later data collection can be guided and scheduled. Verification should be performed permanently and prior to each data collection event.

Data collection was done by means of a questionnaire, the answers being typed into PDAs (see chapter VII) and sent to the headquarters in Porto Alegre by means of a telephone company; this led to the need to perform a prior analysis of the local telephone system coverage. In Manaus, for instance, data collection was conducted at a station where the mobile phones did not work; the answers were saved in the palmtops and sent to the headquarters as soon as we had an adequate phone signal. When online routing was impossible, the questionnaire was completed on paper so that the information could be forwarded later on. An essential item was to increase the number of police officers during our actions. At the Police Station, the officers on duty have their

well-established and regulated work routine, and cannot engage in research as a priority. Officers on duty answer the phone, radio, receive drivers, provide information, monitor, write out fines and respond to accidents and events. For this purpose, in the cooperation agreement signed between the Department of Highway Patrol and the Department of Federal Police, we tried to have extra men allocated in such a way that the research would be autonomous, without a negative impact on the safety infrastructure necessary for the action. As to the organization of the action itself, the operation began with the prior purchase of a water supply that was taken to the Highway Patrol Station and cooled in the refrigerator. The Highway Patrol provided restroom and kitchen facilities, lighting for the interview and evening data collection, as well as chairs and tables to receive the drivers, and also traffic cones to organize the lanes and vehicle parking lot.

On arriving at the station, before beginning each data collection, a short meeting was held to introduce the team and the local officers, in order to inform the stages to be followed during data collection and also to answer questions.

Road scenarios

When one decides to work on a Federal highway we must, first of all, be prepared and careful to deal with safety and traffic issues. Therefore, the collecting team, comprising medical students and psychologists was provided training. The Highway Patrol Officers informed, educated and instructed the team on facts and behaviors that are appropriate to deal well with the road environment during data collection. Simple actions such as never turning their backs ton the road, always wearing signaling vests, looking at the driver and never crossing the highway without being instructed to do so by an trained officer.

Each police station, due to its geographical location on the road, has peculiar characteristics. There are those on double-lane roads, where the average speed is usually higher. Some are on straight roads, which allows for a better view of the circulating vehicles. Others are uphill or downhill, which compromises distant visibility both for drivers and police officers. We minimized the problem signaling with traffic cones and signs, vehicles and flashlights in the evening. The stop approaches began with four drivers. Only during those first moments of data collection, four vehicles were parked (they could be buses, trucks, cars or motorcycles). Details of the approach sequencing are in chapter VII.

Events on the road during data collection

Brazilian roads vary a lot, and this was expressed in our data collection. The same road may have different aspects besides a different mix of driver flow. States such as Mato Grosso, Mato Grosso do Sul and Minas Gerais, for instance, have a larger concentration of trucks. In the other states they are more dispersed. Such features will determine adaptations on data collection. In the single-lane segments that cross towns, such as in the data collection in Alagoas, where the road penetrates urban areas, there are more accidents and the team had to be even more careful.

During the periods when we stayed at the Highway Patrol stations, there were interruptions in data collection, due to events on the roads which were a priority at such times. The ideal number of police officers was not always present. Occasionally there was more than one event to take care of, therefore the officers allocated to the study would go and help the other teams. In this way we had "in loco" the clear perception of the importance of personnel and equipment infrastructure that should be available on a road. In Teresina/PI, for instance, data collection was interrupted due to a call involving an accident on the road between a motorcycle and a bicycle. There were not enough officers at the stations and those from the data collection team had to help with that accident. Also, In Florianópolis/SC, the beginning of the data collection was delayed by two hours due to a traffic jam encountered by the team when going to the police station, because a truck had overturned and the road was blocked.

Vehicle flow and lighting conditions

We know that the intensity of this phenomenon varies according to region and time of day. Nevertheless, knowing is not enough -, we have to react to it. Therefore, in the field, the team had to consult with the professionals who work there daily. There were certain periods of time, for instance, when we had to accept the road flow as a definer for the data collection, due to traffic jams and slowness. We had to understand that the drivers were under more stress at those times and an approach under such conditions would not be well accepted by the driver, therefore it would be stressful for the data collector. Data collection took place continuously from noon to midnight, and lighting was not always good. In Salvador we had to collect in the evening, by the roadside, using an ambulance parked with the headlights on for that purpose. Hence the importance of using reflective clothing, as well as traffic cones, with conspicuous vehicles strategically placed during daytime and light signs in the evening, using signaling flashlights. It is important for the data collection teams to assess the precise lighting and safety conditions in such cases.

Atypical circumstances related to local crime

The crime profile and the way criminals act and their impact on our areas of work had to be identified.

Such information should be acquired at the right time, beforehand, from the local authorities. A typical episode that can be mentioned happened during data collection on a road in the Northeast when we were informed that groups of armed criminals were on the highway at that time. This information made both the Federal Police and the Highway Patrol to bring officers armed with riffles, bullet-proof vests and appropriate vehicles. This context required special care during the approach. For instance, motorcycle drivers were signaled at, approached and told not to get off the motorcycle and to keep their hands on the handlebar. The rider was to keep his/her hands on the driver's shoulder until documents were checked. A personal search was done on both, mainly of the waistline and chest. This action was carried out under heavy police supervision. They were only allowed to get off after this procedure. Both personal and vehicle documents were then looked at and the driver was invited to participate in the research. Then, the officer would first check the documents and vehicle as to guarantee the safety of the collectors, checking to see whether there were no drugs or any legal problems involving the driver. It should be highlighted that the data collecting team was installed in a place chosen by the police officers according to safety rules, avoiding exposure to risky situations, in accordance with the training previously mentioned.

Infrastructure provided by governmental bodies

Planning for local infra structure was mandatory, which made technical cooperation between the research project and other bodies necessary, whether they were public or not, belonging to any of the three administrative spheres. It is important to know the particular responsibility of each group with which one wants to cooperate. In our case, we looked for partnership with the Highway Patrol Department, as well as the Federal Police Department. We received great support from them, and professionals from the special operations groups from the State were always present. We always used new vehicles, in excellent state, from the Highway Patrol Department, as well as the Federal Police Department. This structure was provided due to the understanding of the Heads of these Departments, who allowed this support, through the technical cooperation signed between SENAD x DPRF e DPF, throughout Brazil.

USE OF ALCOHOL AND OTHER DRUGS ON BRAZILIAN ROADS

AND OTHER STUDIES

Section B

Alcohol and drug use among private and professional drivers in Brazil

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Introduction

Brazil is the world leader in traffic accidents on roads, according to 2008 data from the HIghway Patrol Department (Brasil, 2009), and in the last decade, in spite of different efforts by the police authorities and preventive measures taken at a national level, there was no reduction in the number of such accidents. From 1999 to 2006, 172,000 deaths due to traffic accidents were recorded at the site of the accidents alone (Brasil, 2009). This epidemic aspect – demonstrated by the numeric impact of the number of deaths per year in Brazil – justifies treating the subject as an important public health issue. In Italy the rate of deaths per thousand kilometers of road is 10, in the US, 6.56, and in Canada 3.3, while in Brazil it is 106 deaths/1,000 km. As a result of this impressive number, Brazil, when compared to more developed countries, is at the top of the ranking on expenditures with traffic accidents in the Emergency Units, in individual and macroeconomic terms, as stated by Walsh (2004)

Since the implementation of the Brazilian Traffic Code in 1997, there was insignificant reduction in drinking and driving behavior (Leyton, Ponce, Andreuccetti, 2009). According to Rozestraten (1988), Fleischfresser (2005) and Soares (2007), 80% of all accidents are caused by human factors. The assumption in Brazil is that the most common causes of accidents are driving under the effect of alcohol and other drugs and excessive speed, the two seeming to be strongly associated. For instance, a pioneering study conducted by the Center for the Study of Drug Abuse of the Federal University of Bahia in 1995 with 865 participants, correlated the use of alcohol in leisure situations in bars and by the seafront of the city of Salvador with traffic accidents, finding that approximately 38% of the participants who suffered accidents driving a vehicle had drunk alcoholic beverages that day (Nery-Filho, Miranda, Medina, 1995). Another national study conducted in emergency services and medical examiner offices in 1997 by the Brazilian Association of Traffic Departments in the cities of Brasília, Curitiba, Recife and Salvador, assessed 831 participants – 27.2% of whom had blood alcohol levels higher than 0.6 g/l, now considered a crime by current law.

A more recent study by Moura et al. (Moura et al., 2009) using the VIGITEL system for risk factors and protection for chronic diseases, from the Federal Health Department, analyzed phone interviews with 54,000 people older than 18 years of age. Approximately 1.5% of those interviewed reported having drunk and driven on at least one occasion under the effect of alcohol binges (five or more doses for men, four or more doses for women). Besides this single piece of data, the study tried to observe whether there was a shift in the prevalence reported for use before and after the so-called "dry law"[1]. According to the study, there was no permanent change in the report on those episodes, although there was a reported reduction in the months that immediately followed the enactment of the law.

Driving under the effect of alcohol and other psychoactive substances is a risky behavior, since these substances alter the interpretation of daily situations as well as the perception of what happens in the surroundings of the driver (De Boni, 2007; Thielen, Hartmann; Soares, 2008). De Boni (2007), quoting Hingson (2003) demonstrates that driving under the effect of alcohol may increase four-fold the risk of a person being involved in a traffic accident when blood alcohol ranges from 0.05 to 0.09 mg/dl, besides a higher probability of getting involved in lethal accidents (Hingson, 2003). The road system – especially roads and highways - is the backbone of mass transportation, being intrinsically connected to people's daily lives. Those substances affect brain functions and mental processes necessary for safe driving, as the literature has shown since the 50's. It has also been demonstrated that those substances affect driving capacity not only when they are used, but also produce residual effects, such as alcohol hangovers, which depresses the driver's reflexes, or the rebound effects of amphetamine, such as depression, sleepiness or fatigue, besides the degeneration of the neurons responsible for serotonin production (Ponce and Leyton, 2008; Rozestraten, 1988).

So far, little is known about the use of alcoholic beverages on Brazilian federal highways, which account for 74.3% of the total paved roads of the national road network, corresponding to 57,933 kilometers (BRASIL, 2005). Those roads are important main routes to carry goods produced besides representing a major connection between state

[1] *Law 11.705 (Brasil, 2008)*

capitals. Moreover, they represent the traffic between the main Brazilian population centers.

The present chapter describes the first effort at a national level towards understanding the use of alcohol and psychoactive substances by drivers who travel on federal roads that cross the metropolitan regions of the 26 state capitals, as well as the Federal District. We intended to establish a methodology capable of obtaining preliminary, yet robust data, on what occurs in the road environment during conventional hours and with the four most common types of target drivers: motorcyclists, truck drivers, bus drivers and private car drivers.

Method

Design and sampling

A cross sectional study was conducted using as data collection sites Highway Patrol Stations that are within the metropolitan regions of the 26 state capitals and the Federal District. The data collection sites per metropolitan region were initially mapped, and the possible sites chosen at a distance of up to 50 kilometers from the geographical center of the city of origin.

The sampling size was estimated considering the budget available and the prevalence of the use of amphetamines, that we supposed to be smaller than the use of alcohol (therefore, to detect it, a larger number of subjects would be necessary). According to a previous study conducted in the country (Silva et al, 2003), the estimated prevalence of amphetamine use was 6%, with a 2% margin of error, and a confidence level of 95%. For that, 542 drivers should be included in each stratum. To maintain the proportion of drivers of the different types of vehicles 3,388 drivers would be necessary, which would allow for an estimate of alcohol use of 30%, with a margin of error smaller than 1.5%.

Table 1 – Proportion of vehicles collected in the national sample (columns in boldface represent the final figures after rounding out for data collection)

State	Number of drivers	% concerning Brazil	n	% Bus and truck drivers	% Car drivers	% Motorcycles	% Bus and truck drivers	% Car drivers	% Motorcyclists
AP	107.202	0,2	100	17,89	47,9	34,21	**18**	**48**	**35**
RR	122.079	0,23	100	12,39	44,21	43,4	**13**	**45**	**44**
AC	142.228	0,27	100	15,23	42,64	42,13	**16**	**43**	**43**
SE	296.768	0,56	100	17,68	53,3	26,02	**18**	**54**	**27**
TO	312.602	0,58	100	16,91	43,9	39,19	**17**	**44**	**40**
AL	324.677	0,61	100	19,79	56,33	23,88	**20**	**57**	**24**
AM	355.258	0,66	100	18,24	60,39	21,37	**19**	**61**	**22**
MA	387.205	0,72	100	21,72	52,46	25,82	**22**	**53**	**26**
PI	384.676	0,72	100	19,09	46,01	34,91	**20**	**47**	**35**
RN	443.078	0,83	100	20,89	37,6	41,41	**21**	**38**	**42**
PB	562.340	1,05	100	16,95	53,68	29,37	**17**	**54**	**30**
RO	627.024	1,17	100	13,57	31,53	54,9	**14**	**32**	**55**
PA	734.182	1,37	100	18,3	52,07	29,63	**19**	**53**	**30**
MS	899.465	1,68	100	18,13	47,01	34,85	**19**	**48**	**35**
MT	982.489	1,84	100	20,39	41,85	37,76	**21**	**42**	**38**
CE	1.041.816	1,95	100	12,35	58,38	29,27	**13**	**59**	**30**
DF	1.119.771	2,09	100	14,63	70,78	14,59	**15**	**71**	**15**
ES	1.384.073	2,59	100	13,77	40,92	45,3	**14**	**41**	**46**
PE	1.476.528	2,76	100	14,99	56,13	28,88	**15**	**57**	**29**
BA	1.643.374	3,07	100	18,27	59,86	21,86	**19**	**60**	**22**
GO	1.802.032	3,37	100	16,48	50,7	32,82	**17**	**51**	**33**
SC	3.189.203	5,96	100	15	50,79	34,22	**15**	**51**	**35**
PR	3.989.295	7,46	138	21,78	52,81	25,42	**30**	**73**	**35**
RS	4.084.483	7,64	138	16,3	58,76	24,94	**23**	**81**	**35**
RJ	4.088.018	7,65	138	20,43	66,61	12,96	**29**	**92**	**18**
MG	5.140.830	9,61	138	14,39	52,95	32,66	**20**	**73**	**45**
SP	17.830.290	33,35	550	20,51	55,98	23,47	**113**	**308**	**130**

The sample in each capital was selected in blocks, proportional to the number of drivers in the specific state and stratified by type of vehicle (car, motorcycle, truck or bus). In a first moment, the data available at the National Traffic Department (DENATRAN) (Brasil, 2008) was evaluated on the number of driving licenses granted by each state of the Federation and updated to the year of 2006, with a total of approximately 53 million drivers. Those were crossmatched with the fleets of the states, also from the data available at DENATRAN; the analysis between the density of drivers and vehicles demonstrated a strong and positive overall correlation between them, with a correlation coefficient = 0.94 ($P<0.001$). Therefore, the 3,388 drivers would be allocated proportionally in the different states. Nevertheless, the result of this first division demonstrated that there was an excess of capitals where the final number of interviews to be performed would be smaller than 25 (in some states with low densities of drivers - even smaller than 10), which would render data collection not only unfeasible concerning cost-benefit, but also of little epidemiologic value for the stratification by type of driver. For this reason it was decided to fix a minimum number of drivers per state (blocks). The states with estimated $n<100$ or those whose n was very close to 100 were consolidated, with a total of 21 states ($n=100$ x 21= 2,100 cases). According to the previous calculation, a total of 1,288 (3.388-2,100) subjects would be left to be divided among the other states with an estimated $n>100$. The total of drivers of the states with $n>100$, was added up, with a result of 38,322,119 drivers, and the proportions for each state were recalculated based on this figure. Finally, the number of drivers to be approached in each state was estimated for this total of subjects that were a surplus in each state, maintaining an intermediate tercile ($n=138$), and one single state was responsible for the last third of the sample (SP, $n=550$). In some situations, a few more cases were collected for the sake of proportion. This calculation is shown in Table 1, and is the final sampling calculation used in this study. The vehicles were randomly selected, proportionally to the number of vehicles in each stratum, according to random number lists generated prior to the data collection during the 12 hours established, (from noon to midnight), on Fridays and Saturdays. There was no data collection during holidays, so as to avoid moments when it is known that the number of deaths in traffic increase. The interviews were conducted from August 8th 2008 to September 26th 2009.

Inclusion and exclusion criteria

Professional and private drivers of the following automotive vehicles were included in the study: buses (as well as vans and similar vehicles), trucks or trailers, motorcycles, and family automobiles, male or female drivers, older than 18, driving on the chosen road in the direction to where the data collection was taking place during the selected time period and who accepted to participate in the study upon understanding of an Informed Consent[2]. Drivers under 18 years of age were excluded from the study, as well as those who refused to participate. Overall, there were exclusions and refusals in a total of 94 cases, distributed without significant differences among the 27 areas of data collection.

Team

The data collection team consisted of seven collectors and one federal police officer specifically trained for the role of establishing an interface with the local teams and managing the logistic structure of the data collection. Besides this federal police officer, senior members of the Highway Patrol followed and structured all data collection at the 27 locations. Teams of at least 3 collectors followed a pre-established travel plan. All collectors (04 psychologists and 03 medical students) were extensively trained by the principal investigators before the beginning of data collection, including pilot studies and field tests of road blocks. All the training of the data collection teams was done in Porto Alegre, utilizing an adaptation of the data collection methods developed by the Pacific Institute for Research and Evaluation (Lacey , 2007), which, in 2007, conducted a pilot study on roadside surveys. Training was as follows:

- Acquaintance with the data collection instrument in its many adaptations, including the use of Personal Digital Assistants (PDAs) specifically programmed for the questionnaire to be used;
- Theoretical education on alcohol metabolism and use of the breathalyzer, and practical training on sample data collection and storage, given by a professional with certification on handling and using the specific digital breathalyzer that was used in the present study;
- Theoretical information on data collection, storage and transportation of saliva utilizing ice boxes, as well as practical training on sample data collection and storage, given by certified professionals;
- Role-playing of typical and atypical approaches in roadside data collection supplied by the police officers and overseen by the principal investigators;
- Pilot study with data collection conducted on a federal highway close to the city of Porto Alegre. The data

[2] *Available at www.obid.senad.gov.br*

of this pilot study were not considered as part of the sampling of the metropolitan region, but as a training activity in the data collection technique, which led to changes in methodology and equipment adaptations;

- Training in notions of bioethics given by members of the Laboratory on Bioethics of HCPA. A procedure guide[3] was written to guide the interviewers in the different phases of the interview and data collection.

Instruments – interview, data collection and storage of physiologic samples

The interview for data collection based in american pilot study was adapted for use in Brazil after field trials. The wholeinterview was inserted into PDAs specially programmed. These wouldsend the individual data sets of the different capitals via internet for a secure webpage[4]. In summary, interview section were:

- Sociodemographic characteristics of the driver;
- Vehicle characteristics (type of automobile), number of passengers, use of seat belts by driver and passengers;
- Typical driving characteristics and geographical distance from the data collection site to the home of the person interviewed;
- Recent use of alcohol and other psychoactive substances, including medications with a psychoactive effect;
- Behavior and risk factors associated with drinking and driving[5].

The measurement of blood alcohol was done utilizing digital Alco-Sensor IV breathalyzers (Intoximeters, Inc), certified by the Brazilian Institute for Metrics (Inmetro), using standard procedures to store this type of data. Samples collected and stored by the Highway Patrol Officers were later entered into the records of the above mentioned interview. Swabs used and recommended in international literature (Pil and Verstraete, 2008; Walsh et al., 2008) for the data collection of saliva (Quantisal, Inc) were used to obtain the other measures for the use of psychoactive substances. Subjects were asked to accumulate saliva on the swab for approximately 1 minute; to stimulate saliva production, the interviewers provided the drivers with water. After obtaining the saliva, the swab was stored in an appropriate, refrigerated box at 4ºC, and brought to the laboratory to be analyzed by the method previously described in chapter V. Besides being trained in the use of the breathalyzer – although breath was obtained by Highway Patrol officers, the collectors also learned the values corresponding to the effects of alcohol in the body and the conversion tables of the values of the breath test equipment for blood alcohol. This material can be found on the web site www.obid.senad.gov.br.

Data Collection Logistics

The members of the data collection team traveled at least one day in advance to the point where the data collection zone was to be set up. Local highway patrol officers would be waiting there to give logistic support and detail the road signaling tasks, as well as the sequence of data collections established by the interviewers.

At the data collection station, the officer was instructed to signal for a vehicle to stop at the appropriate place, far from the main section of the road. Initially the officer would approach the selected vehicle with educational material on the prevention of accidents associated with drinking and driving[6]. Then the driver was invited to participate in the study, and was referred to the data collection area. The driver was informed that the study was anonymous and private, with members of a data collection team from UFRGS. In case of refusal, the driver would be allowed to leave if the officer did not identify any signs that justified his/her stay in the police station. In case of acceptance, driver documents were reviewed by a highway patrol officer (according to police routine) followed by the interviewer applying the questionnaire. At the end of the data collection process, the interviewer would send the driver back to the officer responsible for the documents. The officer would then invite the driver to undergo a breath test. If the officer would find anything that made him/her suspect of the use of alcohol or drugs by the driver, he/she would follow the standard police procedures. After the appropriate procedures, the driver would be released to the road.

The interviews lasted between seven and ten minutes. At the end of the interview, caps or T-shirts with NEPTA and SENAD logos printed were offered as gifts to all the

[3] *Available at www.obid.senad.gov.br*

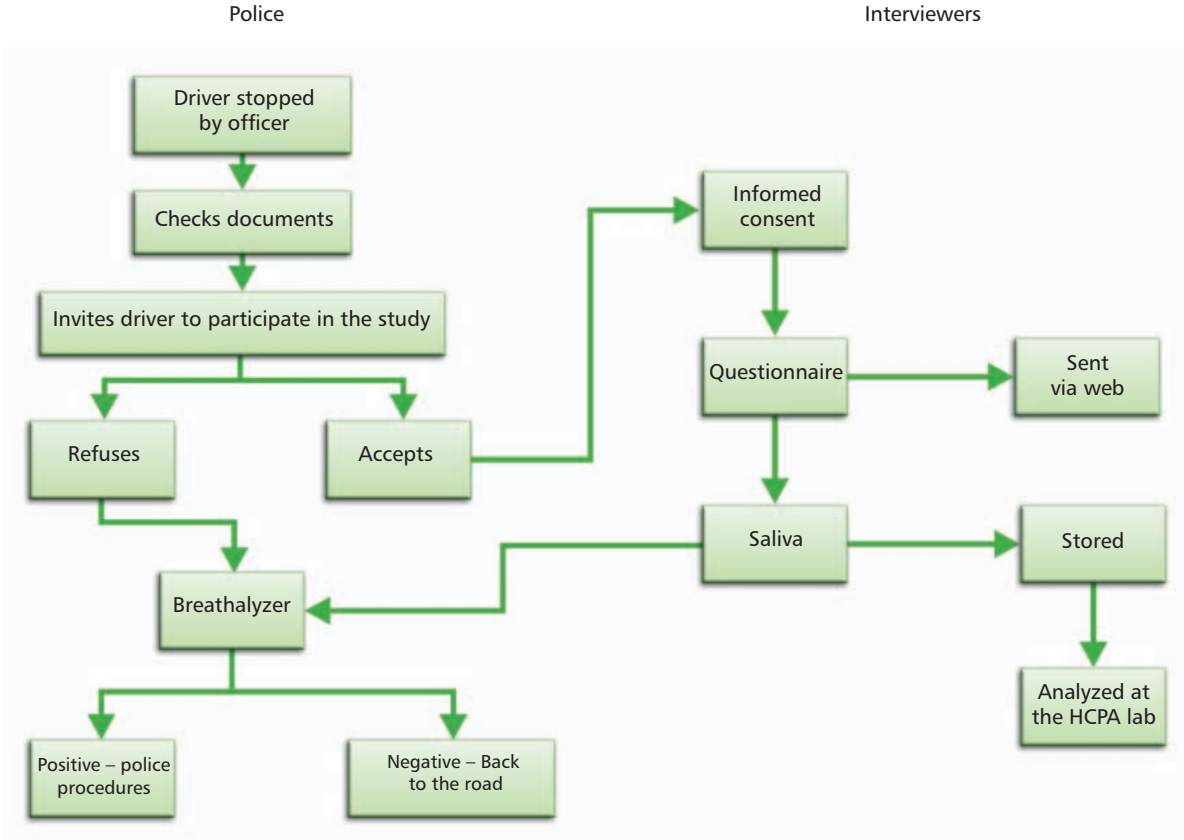
[4] *Those interested in detailed information on the programming, data entry, data collection spreadsheet modification and data transmission should contact the authors directly.*

[5] *For this chapter, only the main analyses will be presented.*

[6] *Available at www.obid.senad.gov.br*

participants, who were not previously aware that they would receive gifts. Figure 1 illustrates the activities of the officers and of the collectors in the data collection process.

Figure 1. Actions of police officers and of interviewers in data collection



Results

Of a total of 3,492 contacts, we had 94 losses and refusals (97.4% accepted to participate), generating a database of 3,398 drivers. Among those, most were males (n=3,206, 94.3%), with a mean age of 37.3 years. Female participants had a mean age of 36.3 years. There was no significant difference in refusals per capital. With regard to the types of drivers, the refusal rates were concentrated (85%) in private drivers (cars and motorcycles).

As to types of vehicles, we had the following proportions: 51% (n=1,735) were family vehicles (cars, SUVs and mini-trucks); 10% (n=344) buses or similar; 9.9% (n=337) trucks and 28.9% (n=982) motorcycles.

Of the total amount of the interviews, 31.2% (n=1,058) of the drivers had studied until at least the 8th grade, and 41.1% (n=1,395) of these had studied until the first year of High School or part of High School or were unemployed, disabled, housewives or students. The median individual income was R$ 1,500.00 and family income R$ 2,200.00. Table 1 shows the income proportions and educational level of the sample according to the type of vehicle approached.

The interviewees' reasons for travelling were: 52.5% (n=1783) work, 39.2% (n=1333) leisure, and 8.5% (n=281) other. Drivers were mainly coming (42.2%, n=1.435) or going (62.9%, n=2.135) from home or from some acquaintances (34.8%, n=1.183) or going (22.5%, n=766) to work. The other answers, such as coming or going to a restaurant, school, church or hotel, all together predominated in 22.8% (n=779) and 14.6 % (n=495) respectively. Figure 2 illustrates the site of origin of the drivers approached and its relation to the alcohol intake on the day of the data collection.

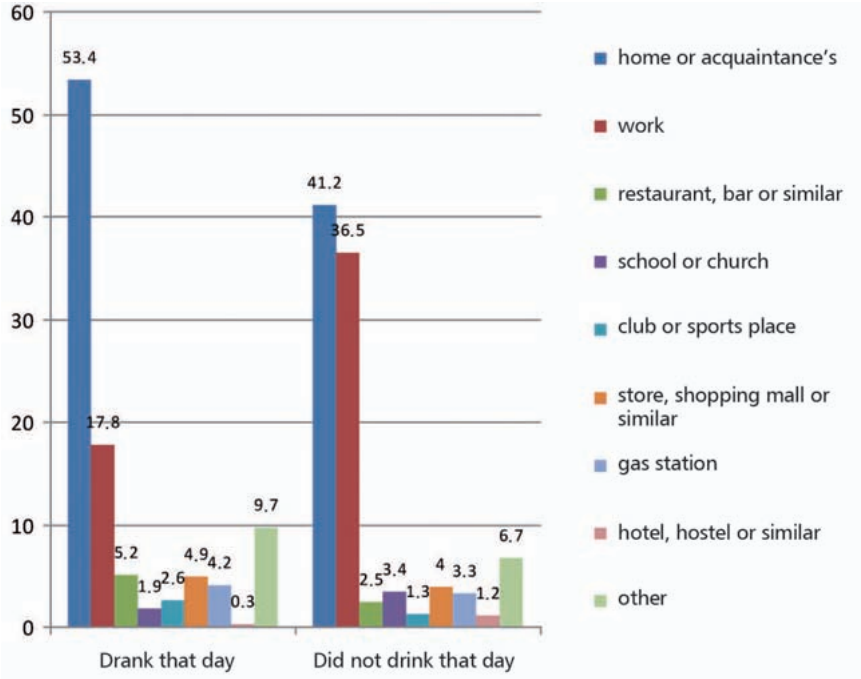
Of the total participants, 71.1% (n=2,412) reported the use of alcoholic beverages in the 12 months preceding data collection. Only bus drivers differed in this proportion (61.1%). The typical frequency of ingestion by the four main types of drivers is Figures 3 and 4.

On abuse in the last twelve months (binge drinking, i.e., five doses or more for males and four or more for females),

Table 1: Income and education per type of vehicle

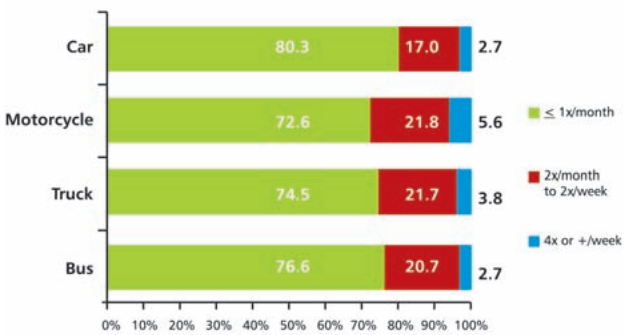
Variable Grade completed	Cars, SUVs or mini-trucks	Bus or van	truck, articulated truck, trailer (cargo transport)	Motorcycle, motor scooters, moped scooters, motor trycicles.
Until 8th grade	361 (20,8)	184 (53,6)	202 (59,9)	309 (31,5)
1st grade of High School until completed Hgh School	609 (35,1)	146 (42,6)	126 (37,4)	515 (52,5)
Incomplete college, complete or technical school	764 (44,1)	13 (3,8)	9 (2,7)	157 (16,0)
Individual median income (em Reais)	2.000	1.200	1.500	1.000

Figure 2. Site of origin of the drivers approached and intake on the day of sampling



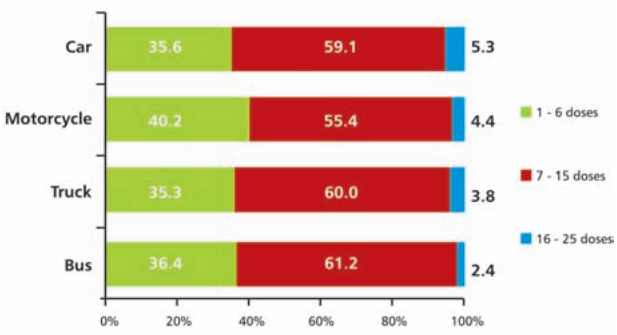
the study shows that this happened to 73% of the total of car drivers, 79% of the motorcycle drivers, 71% of the truck drivers, and 61% of the bus drivers. The main frequency (for binge drinking)was less than once a month (73.1% for the total of drivers), while 25.3% of the drivers reported binge episodes between two to eight times a month.

Figure 3. Frequency of ingestion (%)



n=2412

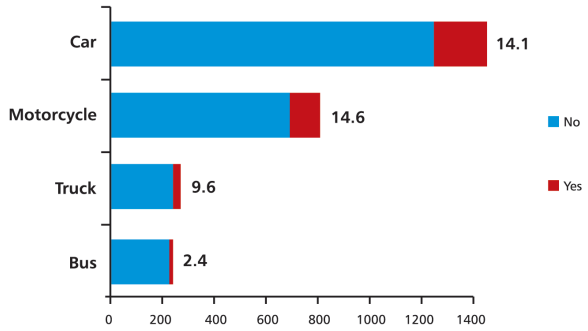
Figure 4. Typical alcohol doses in a normal day of ingestion (%)



n=2412

During the interview, 309 drivers (12.8%) reported having drunk alcoholic beverages on that day, and its distribution is shown in Figure 5.

Figure 5. Drank on the day of data collection (%)

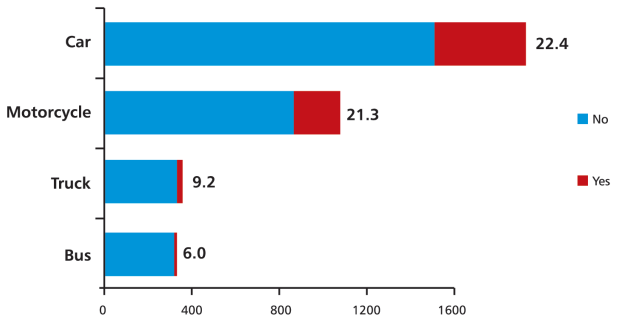


n=309

Most of those who reported having drunk on that day did it at home or at an acquaintance (54.7%) or in bars or restaurants (21%), the other responses being divided in small proportions between work, club or sports place, store or similar, and gas stations. An interesting aspect is that out of the 309 subjects who reported having drunk on the day of the data collection, only 18 (6%) considered that their driving ability was not affected by the intake alcohol.

Also, 60.2% of the drivers (n=2,040) reported having been passengers of drivers who had drunk before driving, the positive proportions being higher for private drivers (approximately 62%) when compared to professional drivers (approximately 50.5%). Although reports of suffering an accident after 3 or more doses of alcohol were rare in the sample (4% for cars, 6.5% for motorcycles, 0.9% for trucks, and 2% for buses), the report of having driven after drinking so much that it would have been legally inappropriate was not infrequent, as seen in Figure 6. Again professional drivers were more conservative than private drivers.

Figure 6. Have you driven after having drunk so much that it would have been legally improper? (%)



n=3391

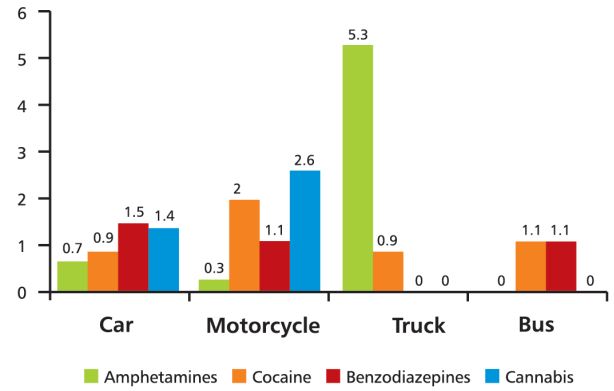
During data collection, drivers were asked how many times they had been in the same situation and whether they knew the legal limits on drinking and driving. Again, private drivers reported that it happened rarely (9.2% for cars, 8.3% for motorcycles). Professional drivers had been breathalyzed more often, but also in low proportions (20% for trucks and 20.9% for bus drivers). Paradoxically, car drivers and motorcyclists claimed to know the legal limit for drinking and driving more often (38% and 33.6%, respectively) when compared to professional drivers (23.6% for trucks and 31.1% for buses). Nevertheless, since the proportions of schooling and income were distributed very differently in the sample studied, it is possible that this information was mediated by schooling. Moreover, reports not yet fully analyzed from our interviewers suggest that most of the knowledge described by those drivers was of little value, that is, the information provided demonstrated that in practice they were not aware of the legal limits or the relations between doses and their impact on driving.

Of a total of 309 drivers who reported having drunk on the day the data collection was done, the largest figures were for cars (14.1%) and motorcycles (14.6%). A smaller number of truck and bus drivers reported the same (9.6% and 2.4%, respectively). Concerning the finding of positive blood alcohol, according to the breath analyses, the rate of any volume above zero was of 4.8%, in similar figures for cars, motorcycles and trucks (4.5, 4.8 and 4.9%, respectively), and lower for buses (1.2%). There was some correlation between the reports of having drunk on that day and the test, which somehow respected the proportions identified in the drivers' reports. The overall proportion of blood alcohol was more frequent after 8pm (7.3%) when compared to the data collected before 8pm (3.3%). After having informed that they had drunk, drivers would answer whether they thought their driving ability was affected by alcohol. One hundred per cent of the bus and truck drivers who reported drinking said that their ability was affected on the day of the data collection, while 81% of the motorcycle as well as car drivers claimed that their ability to drive was affected.

Since the drivers in the study were not questioned directly about the use of substances besides alcohol, we can only have an estimate from the saliva tests. It should be highlighted that from the methodological standpoint, saliva analyses presented in this chapter do not have the confirmatory characteristics of analyzes performed by mass spectrometry (see chapter V) that were being conducted as this chapter was being written (see Discussion). A total of 150 (4.6%) drivers presented some positivity for other drugs in the saliva, distributed as: cocaine: 2.05% (n=67), cannabis: 1.5% (n=49) and benzodiazepines: 1.04% (n=34). For the amphetamine compounds, 1,158 of the 3,251 samples were analyzed, due to the lack of specificity of the kits for the derivates sold in Brazil (amphepramone and phemproporex). Out of the 1,158 samples, 14 were positive, corresponding

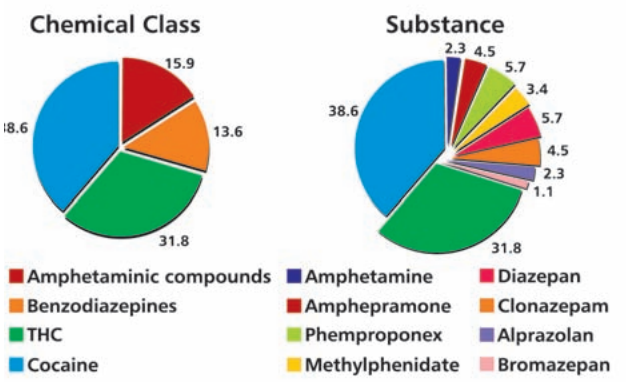
to 1.2%, a number that is rather conservative, considering the use that we know is indiscriminate. The distribution of substances per type of driver is shown in Figure 7.

Figure 7. Distribution of substance per type of driver



The confirmatory analyses were able to identify the different types of substances utilized by the total of drivers approached. Figure 8 depicts the chemical class and type of substance identified.

Figure 8. Confirmatory analyses of the positive salivas (%)



Discussion

This is the first nationwide study conducted to identify the prevalence of alcohol and other drugs by drivers who drive on Brazilian federal highways. In spite of the inherent limitations of the method, it was possible to identify some patterns in the behavior of those drivers. The analyses of those patterns may facilitate the refinement of the policies aimed at prevention, enforcement and reeducation of drivers who drive on the roads under the influence of substances.

The first aspect we consider important to highlight is the feasibility of the method– the insertion of a research project nested inside a standard police procedure. According to data from studies on perception of coercion in research described in chapter III, it was possible to identify that the drivers did not feel more coerced to participate in this study than in other studies that also involved data collection. Moreover, the fact that not all of them accepted (there was a small percentage of refusals) allows us to assume that even in the atypical circumstance of an invitation extended by a police officer to participate in a scientific study there were subjects who preferred – for different reasons – not to participate. Further, the fact that the highway patrol officers were responsible for the drivers' breath test allowed for the legal procedures that might prove necessary (penalties, document apprehension, fines, custody) to be performed in an environment different from the research scenario, since those would eventually happen as a consequence of the origin of the action (police action on highway/road). The reports inherent to the facts parallel to this process of data collection are in chapter VI.

What we found on this first nationwide data collection was that the drivers approached are not very different from the well-known drinking pattern of Brazilian adults: a significant and non differentiated proportion of drivers use alcohol on a regular basis (generally around 22%) and on regular days will ingest significant amounts of alcohol (approximately 60% mention 7 to 15 doses). There seems to be some parsimony in regard to having drunk on the day of the survey, especially in relation to professional drivers – who theoretically would be circulating on the roads for a longer time and, as a consequence, would be more exposed to the risk of the association with alcohol. This phenomenon is repeated in the response on having driven after drinking, showing a difference in awareness between the professional and the common driver, as depicted in figure 6. Nevertheless, it is important to stress that, even if there are differences, these figures demonstrate that the relation between drinking and driving is not infrequent in the drivers approached.

As to the use of other substances, the sample studied demonstrated that private drivers had a larger range of options of substance use, even with small proportion of use, when compared to professional drivers. It is worth highlighting that the findings on amphetamines, much more frequent in truck drivers – as already identified in other findings in the literature (Leyton et al. 2002; 2009; Yonamine, 2004) – are underestimated. As mentioned in the section on methods in this chapter, the final analyses of amphetamines and other psychoactive substances had not been completed when this chapter was closed. Confirmatory exams by mass spectrometry will probably demonstrate an increase in the levels of amphetamine found in the drivers, since the kits for saliva analysis used in the samples are North American, and as a consequence do not accurately measure the amphetamines most often used abusively in Brazil - ampheprамone and phemproporex, less frequently abused in the US. Further analysis will be made public in scientific papers.

Generally speaking, the sample of drivers analyzed somehow reflects the intuitive impression we had about drivers on Brazilian federal roads: there is a clear difference in schooling and income between professional (buses and trucks)

and private drivers, which in a way appeared in many of the study findings. At the same time, due to their professional activity, bus and truck drivers had some responses with more conservative behaviors concerning alcohol intake or even on drinking and driving or on being passengers of drunk drivers. Nevertheless, there is only a downward difference in the prevalence of these findings. Among professional drivers a significant number of individuals still drink alcoholic beverages on the day they will be driving – even in lesser proportions than the private drivers. This may be due to the fact that professional drivers are more controlled by the employing company concerning alcohol use (including breath tests before they take the wheel). Such differences in proportion also appear in regard to having driven with an amount of alcohol that would characterize illegal use. Again private drivers are more abusive from this perspective than professional drivers.

An information that needs to be highlighted is how frequent is alcohol intake in the daily lives of drivers, both on the specific days when they are driving and on other days. As it is possible to see in Figure 2, most of those drivers told that they were coming or going home or from an acquaintance's, or work. Nevertheless, regardless of the association between drinking and driving on the specific date that data collection took place, the high frequency of use associated with high doses - besides the amazing frequency of binge drinking among those drivers - suggests that very often they are under the acute effects or post- effects of alcohol use, which we know affects driving capacity, even under apparently small doses or with no evidence of blood alcohol on the breath test (Liu and Fu, 2007); moreover, drivers in risk conditions, such as professional drivers with few hours of sleep, and the active use of amphetamines, increase their risk when they use alcohol, as demonstrated in the literature (Banks et al., 2003; 2004; Barrett; Horne; Reyner, 2005). We also know that due to the characteristics of the data collection, (only Fridays and Saturdays, from noon to midnight, not on holidays), our sample probably has conservative prevalence data. Even so, since the objective of the study was not to identify the obvious findings but what is usually identified on a road, we believe that the information is useful to guide prevention policies on alcohol use in regard to specific drivers. Furthermore, future analysis of the data collected – not reported in this chapter for the sake of conciseness – may enhance our understanding of those phenomena.

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Psychopathology and Risk Behavior of Private and Professional Drivers in Brazil

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Introduction

The influence of alcohol and other psychoactive substances on driving, associated with the high prevalence of psychiatric disorders, such as Mood Disorders, Post-Traumatic Stress Disorder (PTSD) and Antisocial Personality Disorder is reported in several studies as a determining factor for increased risk of Traffic Accidents (TAs)) (Mcmillen, Pang et al., 1991; Sutton, 1994; Lapham, Smith et al.,2001; Lapham, C'de Baca et al., 2006; Mcmillan, Timken et al., 2008). According to the National Comorbidity Survey – NCS, performed in 2001 (Lapham, Smith et al., 2001), 91% of offenders drivers presented alcohol-related disorders at least once in lifetime, against 44% of the general population of the United States (Kessler, Mcgonagle et al., 1994). Among these drivers, 50% of the women and 33% of the men were diagnosed as having at least one psychiatric comorbidity besides drug abuse or dependency, most often Major Depressive Disorder and PTSD.

In order to estimate the prevalence of psychiatric disorders during lifetime, and in the last 12 months, in a sample of drivers with repeated infractions due to drinking and driving, interviews were performed between 2001 and 2003 with 385 men and 74 women in Oregon, USA. These drivers were participating in a three-year program, with monitoring and supervision of the infractors, and treatment for alcohol abuse focusing on change of behavior and abstinence. The results indicated that 65% of the men and 79.7% of the women had at least one psychiatric comorbidiby with alcohol abuse or dependence during their lifetime. Again, the most prevalent disorder not related to substance use was Major Depressive Disorder (30.9%), followed by PTSD (15.3%). Two hundred and thirty-three of the study participants were screened for psychiatric disorders and it was found that 97.2% of the cases of drug use and 100% of the cases of Obsessive Compulsive Disorder (OCD) were not adequately diagnosed during treatment, which means a great loss of opportunity to increase the results of intervention (Mcmillan, Timken et al., 2008).

Thus, most of the studies published ratify the possibility that personal characteristics and psychiatric pathologies influence and are influenced by TAs and the consumption of PAS. Therefore, a psychiatric diagnosis or the identification of risk markers for such morbidities may determine the interventions and post-treatment plan for drivers who are infractors, in order to reduce recurrences, consumption and ,consequently, traffic violations (Palmer et al., 2007). Knowing the importance of psychiatric follow up, in several countries the individuals infractors who drove under the influence of substances are referred for treatment. However, studies have shown that these patients are underdiagnosed as regards these disorders, even though it is known that, besides the use of alcohol and PAS, comorbidities also help increase the risk of TA (Mcmillan, Timken et al., 2008; McMillan, 2008).

As to risk behaviors in traffic, to some degree all drivers are susceptible to committing errors and violations. Both errors and violations are inadequate forms of conduct, i.e., infractions (Aberg and Rimmö, 1998; Kontogiannis, Kossiavelou et al., 2002). According to Reason (Reason, Manstead et al., 1990), the two terms have different psychological origins, and, therefore, require different ways to understand and, consequently, to intervene. Error can be defined as "the failure of planned actions to achieve given desired results without the intervention of chance or an unforeseeable factor", and violation as "a deliberate infraction of some regulated or socially accepted code of behavior." (Parker, West et al., 1995). Thus, error means an involuntary act related to the individual's cognitive processing, whereas violation involves intentionality, and is related to motivational and social factors. Anyhow, it is believed that driving under the influence of alcohol or other drugs increases the probability that both types of infraction may occur.

In order to make studies more accessible for researchers and interviewees, increasingly, telephone interviews have been used in health surveys. The first studies in this field to use this modality of survey were performed in the USA in the mid-1970s. Since then this method has been used in many populations and countries, because it has an adequate cost/benefit ratio, since it is cheaper than face to face interviews, besides being more reliable (Greenfield, Midanik et al., 2000).

However few psychiatric studies so far have used telephone interviews as a way to obtain data. In one of them, the reliability and validity of telephone interviews to evaluate alcoholism was examined by Slutske (Slutske, True et al., 1998) in a study of 8,000 Vietnam veterans. A subsample of 146 men was interviewed by telephone using the same structured interview The test-retest reliability to diagnose alcohol abuse and dependence was adequate (presenting kappa coefficients of 0.74 and 0.61, respectively), and 96% of the individuals identified as having a diagnosis of dependence were correctly evaluated by that method. Some studies about alcohol and traffic used telephone interviews to evaluate drinking and driving behavior among young people and in drivers who have committed infractions by drunkenness (Rothe e Elgert, 2005). Interviews performed with 400 young adults aged 19 to 25

years aiming to examine attitudes, practices and sensitivity to the law about the topic of "drinking and driving" (Stutts e Wilkins, 2003), found that 34% of the respondents said that they had been drinking before driving and 17% admitted that they had drunk much more than the amount considered safe. These results are similar to those found in interviews performed face to face abroad and in Brazil (Rosman e Sawyer, 1988; Rosman, Ferrante et al., 2001). Recently, in Brazil, the VIGITEL Report – already mentioned in Chapter VII – was published with a total of 2000 participants, to verify risk factors and morbidity and mortality related to non-transmissible chronic diseases, including smoking and alcoholism, it is an example of a study with a well- structured method of telephone interviews.

The information presented so far demonstrates that driving under the influence of substances is a serious public health problem in Brazil. There are very few studies to evaluate characteristics and elements involved in this practice in the country, due to financial and geographical difficulties. In Brazil there are no studies estimating the degree of this association, making it difficult to elaborate programs which cover the driver's needs. Considering that interviews to evaluate drivers who drive under the influence of alcohol and other PAS on highways require a quick approach, complement the data collection through later telephone contacts for psychiatric and behavioral evaluation it is an alternative to be considered. Therefore, the main purpose of the study in this chapter was to verify the association between psychiatric disorders and risk behaviors in traffic in drivers who had a positive blood alcohol level and previous use of other substances, comparing them to those without the use of alcohol and substances. Besides, we consider that the description of the method used will be very useful to other investigators who want to use it in an adapted form.

Method

Design and Sampling

This study used a cross-sectional design. The candidates to participate were recruited in the moment of the data collection of the study mentioned in chapter 07, with drivers using the main Brazilian highways.

Method to Select and Obtain Telephone Contact

At the end of the interview performed in the study of highways, each participant was asked authorize information needed to make a later phone call, like name and telephone. There were attempts to contact all those who authorized it.

Calculation of the Sample Size

The size of the sample in this study was calculated based on data on the prevalence of psychiatric disorders in the general population and among drivers who presented drinking and driving behavior found in the literature (Lapham, Smith et al., 2001). It was calculated to estimate the prevalence of the more rare psychiatric disorders in the study – 3% for bipolar disorder which presents a lower prevalence- and to detect a difference between the group of drivers who had a positive blood alcohol level or prior use of other substances and the group without positive blood alcohol and without the use of other substances. An alpha value of 0.05 and power of 80% were considered, and a minimum of 1900 individuals was obtained to detect a difference among the three groups of drivers.

Inclusion and Exclusion Criteria

FThe study included all drivers who authorized telephone contact after their participation in the stage performed on the highways who, after informed consent, at the time of the telephone call, accepted to answer the telephone interview. Those who were not able to answer the telephone questionnaire, - whether it be because they were intoxicated by drugs, or by incapacity or sensorial incapacity[1]– were excluded from the study, in a total of 0.3% of the cases. These conditions were measured by questions asked at the beginning of data collection.

Factors Studied and Outcomes

The main outcome of this study is the presence of positive blood alcohol (verified using the breathalyzer at the time the sample is recruited), or prior use of other PAS verified by saliva test (procedures already reported and shown in chapters V and VII). Two groups were considered for the analysis of the different variables:

1. Drivers with positive tests for the use of alcohol and other PAS;
2. Drivers who did not have substances in the blood.

The groups were compared for the following factors studied: presence of psychiatric comorbidities, dependence and abuse of alcohol and other PAS, and risk behaviors in traffic.

Logístics

Place and Team

The telephone interviews were performed on VivaVoz, Serviço Nacional de Orientações e Informações sobre a Prevenção do Uso Indevido de Drogas (National Service for Guidance and Information about the Prevention of Improper Drug Use), founded in June 2005 through a cooperation agreement between SENAD and Universidade Federal de Ciências da Saúde de Porto Alegre (UFCSPA). VivaVoz is a call-center type telephone service which provides orientation and free, confidential information about the prevention of

[1] *Auditory deficiency or deafness, since the driver who presents one of these characteristics could not possibly answer the interview by telephone.*

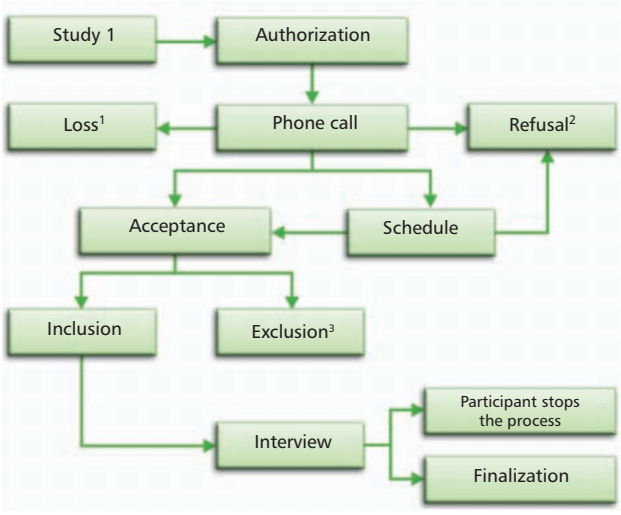
the improper use of drugs, by free calls (0800 calls). Besides disseminating scientific information on drugs, the service is specialized to provide brief intervention for PAS users and support to their families, and also to indicate places for treatment. The physical and technological structure of the VivaVoz call centers has:

1. Attending Positions or Stations (Postos de Atendimento) (APs) comprising a computer equipped with specific softwares for data storage, telephone attached to a headphone and microphone, giving the consultant free hands to write during the time when they are attending - and a telephone line connected to the computer;
2. Audible Response Unit (ARU), which allows identifying how many calls are waiting, receives calls and refers them to the APs without the interference of the person who answered, directing the flow of calls uniformly.

The consultant's conduct is guided by the POPs (SOPs-Standard Operational Procedures) which are scripts prepared with different situations and guidance to use the local structures. This study had a POP developed especially to guide telephone calls to the drivers.

Six consultants who operated the VivaVoz were selected by the study coordinators together with the local coordinators to participate in the collection team. In this study the main researcher was trained to manage the interviewers. The training was performed according to a course that is commonly taught by the service team, with a total of 40 hours of theoretical classes and 20 hours of practical work with software management and applying scales. The consultants were given specific, oriented training with simulations of interviews and different data collection situations. Two VivaVoz supervisors were also trained to help manage the call center and perform interviews. The graphic scheme of collection is shown and detailed in Figure 1.

Figure 1:Graphic scheme of the logistics of data collection



Tacit refusals and impossibility of making contact[1] – Formal refusals[2] – According to exclusion criteria[3]

Organizing Information

Interview Form and Databases

An independent database was developed to store confidential information needed for the telephone calls. Every week, having received the authorizations through the collection team of the highway study, with the names and phone numbers of the people interviewed at the highway police stations, the study coordinator organized the names and telephones of the drivers on an Excel spreadsheet, together with information about the registration number in the study. In this way, individuals were located and contacted but the identification data were not related to the data collected, and the identity of the survey participants was kept confidential.

All the information acquired during each interview was inserted into Word documents and then written on an Excel spreadsheet by the study coordinator and a research assistant.

Telephone Call and Interview

Through the call-center located in VivaVoz, based on information contained in the contact database, the collectors placed calls, contacting the drivers to interview them.Differences in the Brazilian time zones were taken into account, so the interviewers would not disturb the participants when they were resting.

Development of data collection

The first step after establishing the contact by telephone was to read the first part of the consent form to the driver, who was then invited to participate in the study. If he accepted, the next step was to evaluate the inclusion criteria. If the driver asked the collector to perform the interview on another occasion, the interviewer set a day and time, and then would call back as agreed. To perform the interview, the collector had to follow the POPs read previously, and the instructions contained during the interview, whose approximate duration was 30 min.

Throughout the data collection, the study coordinator supervised the telephone interviews at the time of the interview – listening to the calls with authorization and real time monitoring – and through fortnightly meetings to evaluate logistical problems.

Interview

The interview developed to obtain data consisted of questions about sociodemographic information, using the following instruments[2]:

1. Mini International Neuropsychiatric Interview (MINI - CORE) – Brazilian Version, which consists of a brief

standardized diagnostic interview (15-30 minutes) organized by independent diagnostic modules, compatible with the DSM-III-R/IV and CID-10 criteria, for use in clinical practice and in primary care research and psychiatry. It can be used after short training (1 to 3 hours).

2. EVEM- Escala de Violações e Erros de Motoristas (Scale of Driver Violations and Errors), which was based on the "Driver Behaviour Questionnaire (DBQ)" of Reason et cols. (1990), and was adapted to the Brazilian socioeducational context. EVEM consists of questions concerning errors and violations, distributed into 4 domains: 12 questions about error; 7 about violation; 10 about aggressive violation and 11 about interpersonal aggressive violation.

Rate of Responses

Of 2,957 drivers interviewed in the highway study, 2,580 (87.25%) accepted to receive a later phone call (Table 1). Of these, 1,134 agreed to answer the interview and 199 (7.71%) refused to participate at the time of the phone call. Among those who were not interviewed and did not formally refuse to participate, 300 (11.62%) made an appointment for a contact at a later date and did not answer the subsequent calls, and 947 (36.70%) were not found. Thus the rate of acceptance was 43.95%, which is within acceptable limits for this kind of study.

Table 1: Sample response rates

Contact Level	n (%)
Total number of drivers- highway study	2957 (100)
Authorized phone contact	2580 (87.25)
Interviewees	1134 (43.95)
Refusals	199 (7.71)
Interviews scheduled	300 (11.62)
Drivers without a contact	947 (36.70)

Data Processing and Statistical Analysis

The database containing the participants' answers was exported to program SPSS v.16.0 for statistical analysis. The categorical variables were described by absolute frequency and percentage relative frequency; the quantitative variables and standard deviations in symmetrical distributions, and median and interquartile range in asymmetrical distributions. In the secondary analysis of the data, the categorical variables were compared using Chi-square test with a Yates correction.

Ethical Aspects

Authorization for a later phone call, supplied by the participants in the study performed on highways was not considered part of a consent, but rather a resource for possible participants to be contacted. The inclusion of the study participants occurred at the time of this phone call, through a process of informed consent, performed verbally, with tacit acceptance to participate by obtaining answers after the objective and purpose of the project have been duly informed This possibility is foreseen in Brazilian Resolution 196/96 in item IV3.c. The consent, described in greater detail in chapter 3 was obtained by stages (rolling consent), in which the interviewee was informed of each change of section, so he could choose between continuing or ending the interview. Thus, a set of initial information was supplied, and at each change of section the verbal authorization of the participant to continue the phone interview was reiterated. Data identifying the participants were kept confidential, and the names of the participants were not linked to the results obtained.

Results

The sample was comprised mainly by men (95%) with approximately 35 years of age (interquartile interval of 28 to 44). Around 34% of the sample had not finished high school and 51% had an income of up to R$ 1,499.00. Approximately 7%[3] (n=83) of the sample presented positive blood alcohol or use of substances at the time the interviews were performed on the federal highways, indicating that these drivers were driving under the influence of alcohol and other PAS. This second group of drivers presented a higher prevalence of psychiatric diagnoses compared to the group of drivers who had not used alcohol and other drugs (Graph 1). Despite the risk behaviors in traffic (Graph 2), neither group presented statistically significant differences in any of the domains of the EVEM scale.

Conclusions

The preliminary analysis of the data collected showed that there was a strong association between driving under the effect of alcohol and other psychoactive substances, and all the psychiatric disorders evaluated in this sample, especially Depression, PTSD and Substance Abuse/Dependence. What appears to be quite significant concerning these findings is the major difference between the two groups, even compared to the results of other studies previously performed in the USA (Lapham, 2001). A North-American study published in 2008 examined the relationship between depressed mood and the practice of drinking and driving, reporting that the association between these two elements has major implications for traffic safety, since both drinking and driving and depression significantly impair the psychomotor performance in traffic (Stoduto 2008). Individuals with Antisocial Personality

[2] *Available on site www.obid.senad.gov.br*

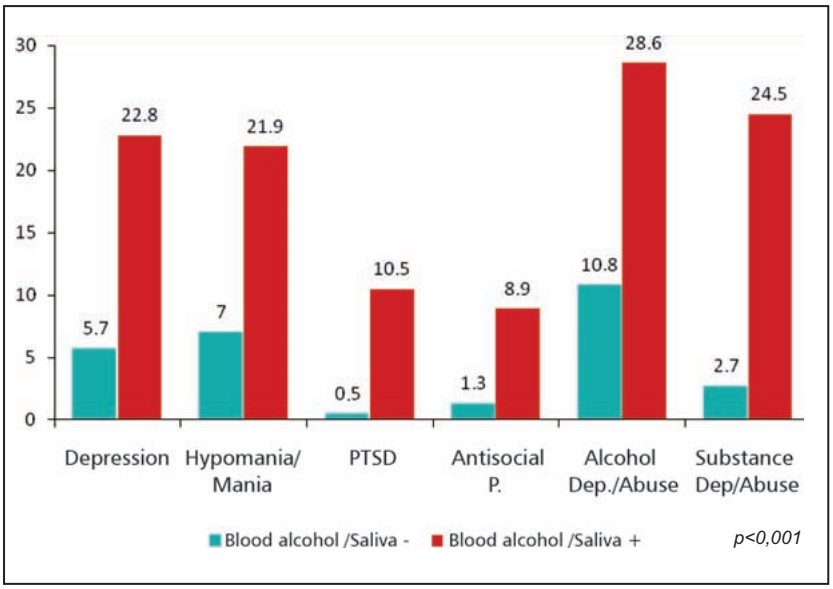
[3] *Editor's note. The proportion of 7% is greater in this specific sample compared to the proportion found in the national study (aproximately 5%) :because here the proportion of respondents is different from the original sample.*

Disorder, which is also quite prevalent in this study sample, can contribute to TAs by means of violation behaviors, since they have a tendency to behave more aggressively. In turn, the anxiety disorders, such as PTSD present biases in processes such as attention and perception, and may make the driver hyperreactive to stimuli such as car horns and sudden maneuvers by other drivers, making it easier for accidents to occur.

As regards risk behaviors for traffic acidents, no statistically significant differences were found between the groups studied. It should, however, be pointed out that the proportion of errors and violations was quite high in the sample studied, which reveals a very relevant problem for public health in this country, independently of the drivers' consumption of alcohol and substances.

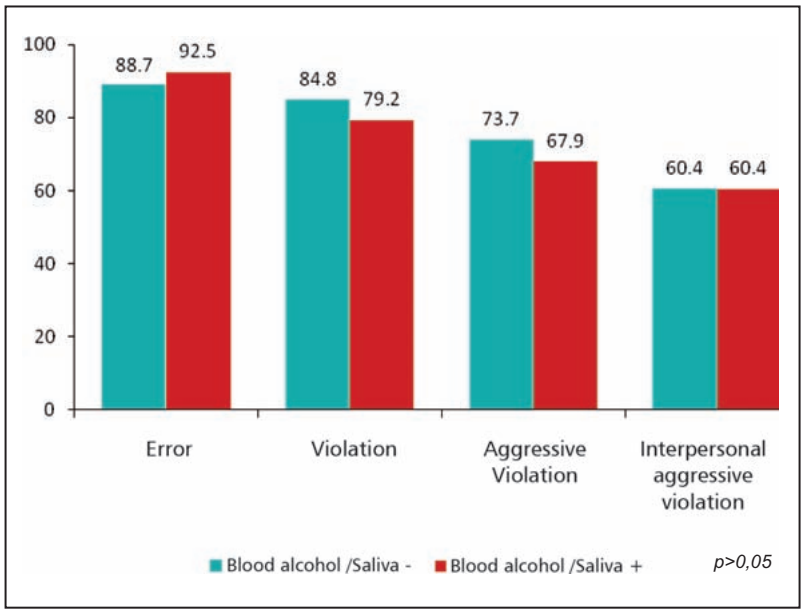
This is the first national study that aims at evaluating psychiatric disorders, positive blood alcohol, use of PAS and risk behavior in traffic among Brazilian drivers, using a telephone interview with rolling consent. Some aspects were essentially important for the success and quality of the study. Among them, the collection of data performed using a call-center structure which allowed improved organization of the calls and the team; real time supervision, which monitored all data collected and clearing up doubts at the time of the interview, increasing the quality of information; and, lastly, the extensive training of the study coordinator, supervisors and interviewers underwent, both to operate the resources and to be able to deal with technical problems that might arise in a call center structure, and also to deal with theoretical issues and issues involved with holding the interview.

Comparing this telephone study to others performed by face-to-face interviews, we present lower rates of response (Lapham, Smith et al., 2001). This may be related to the type of population – mainly professional drivers who spend



Graph 1: Psychiatric disorders – Comparison between prevalences in the two groups of drivers (%)

Graph 2: Behaviors in traffic - Comparison between prevalences in the two groups of drivers (%)



their time travelling the Brazilian highways; drivers who had positive blood alcohol and suffered the penalties of the law – and to the type of interview. Brazil does not yet have a tradition of performing interviews by telephone. It is believed that the refusal to participate may also be related to the negative reaction of the population caused by the increased frequency of extortion and other crimes which are committed by telephone and the proliferation of telemarketing services. On the other hand, the form of consent used keeps the participant from feeling obliged to answer the questions all the way to the end of the interview, minimizing the possibility of embarrassment and attenuating possible discomfort. From a positive standpoint, the telephone interviews made it easier to access drivers from different regions of Brazil, enabling a nationwide study to be performed in a very large country, reducing the time that would be spent on displacement of the team and, consequently, the financial costs of transport, accommodation, food and material. In brief, the method used in the study proved feasible, and the results were significant from the point of view of Brazilian public health.

Considering the evidence presented and discussed above, the risk behaviors in traffic and psychiatric disorders are factors that influence and are influenced by the practice of drinking and driving. Therefore, these drivers need evaluations and specific interventions directed at psychiatric disorders and not only at alcohol-related problems and other PAS. Thus, knowledge of the reality of the Brazilian drivers is the first step to make and plan public policies such as the design of interventions, treatment programs and performing appropriate psychiatric evaluations so that impairment resulting from the problem will be avoided or, at least minimized.

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Alcohol and drug consumption among accident victims attended in emergency rooms in Porto Alegre

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Alcohol and drug use frequently leads to admissions to Emergency or Trauma Centers (CAET-Centros de Atendimento a Emergencia ou Trauma), and it is estimated that problems stemming from this use are responsible for about 15% of all the emergency room treatments in the USA (Global Road Safety Partnership, 2007; Bendtsen P et al, 1999). The main causes of such visits are accidents, overdosing and clinical complications arising from substance use (Global Road Safety Partnership, 2007). The most frequent drugs demanding medical care in emergency rooms are alcohol, cocaine, marijuana and heroin. A study carried out in ERs of 16 countries showed blood alcohol above 0.08 mg/dL as significantly associated with serious injuries, the greater percentage of treatment related to positive blood alcohol being secondary to violence related lesions (Erin Kelly SDJR, 2004). A study was carried out in Brazil on the prevalence of substance use in CAETs (Reis et al, 2006), evaluating patients treated for any traumatic lesion. The use of alcohol was ascertained in 11% of the cases, cannabis in 13% and cocaine in 3.3% of the cases. At the trauma hospital, Hospital de Pronto Socorro (HPS), in Porto Alegre, there are data estimating that the prevalence of cases where acute alcohol intoxication was found varies from 16 to 57%. Among victims of violence, the number reaches 70% of treatments, mostly involving males aged 15 to 35 years, mainly treated at night (Cevenini et al, 1991).

Traffic accidents are also responsible for a large proportion of the treatments at CAETs and are strongly associated with the use of psychoactive substances. At a US trauma hospital, TA victims were tested for the use of alcohol and drugs (who represented about two thirds of the patients treated in the period). Of these, 65.75% screened positively for alcohol or drugs, half of them being positive for other drugs – except alcohol – and a quarter were positive for marijuana. A study of accident victims in Belo Horizonte hospitals confirmed data from the literature showing that most of the drivers surveyed (over 70%) were male and on the average 26 years old. Moreover, 27.7% of the drivers had been drinking alcoholic beverages (Kelly E. et al, 2004). As can be seen, international studies show that alcohol is not the only psychoactive substance that influences traffic related behavior significantly. Amongst the illicit PAS, marijuana has been strongly associated with TAs (Nery Filho A. et al, 1997; Stowell AR, 1998). In 2006, Jones and colleagues showed that the starting age for marijuana and drug dependence was a predictor of driving under the effect of cannabis for women (Valencia-Martín JL, et al, 2008). In France, in a population-based case-control study, drivers arrested in traffic testing positive for marijuana showed a 3 times greater risk of being guilty, with a dose-effect type association being established (Walsh JM et al, 2008).

Two trauma hospitals in the city of Porto Alegre receive more than 90% of the traffic accidents victims: Hospital de Pronto Socorro (HPS) and Hospital Cristo Redentor (HCR). On the average, HPS carries out 600 TA victim treatments per month. Of this total, estimates show that 45% of the victims are motorcyclists and 42% are drivers or passengers of vehicles (MPV). HCR carries out an average of 300 TA victim treatments per month, being the proportions between types of victim similar to those estimated for HPS. However, there are no specific data associating these numbers to alcohol or drug use.

The main objective of this study was to estimate the prevalence of alcohol and other psychoactive substances use in patients who received medical care due to traffic accidents (TA), at the two main CAETs in Porto Alegre and to compare associated factors between individuals detected with and without blood alcohol.

Method

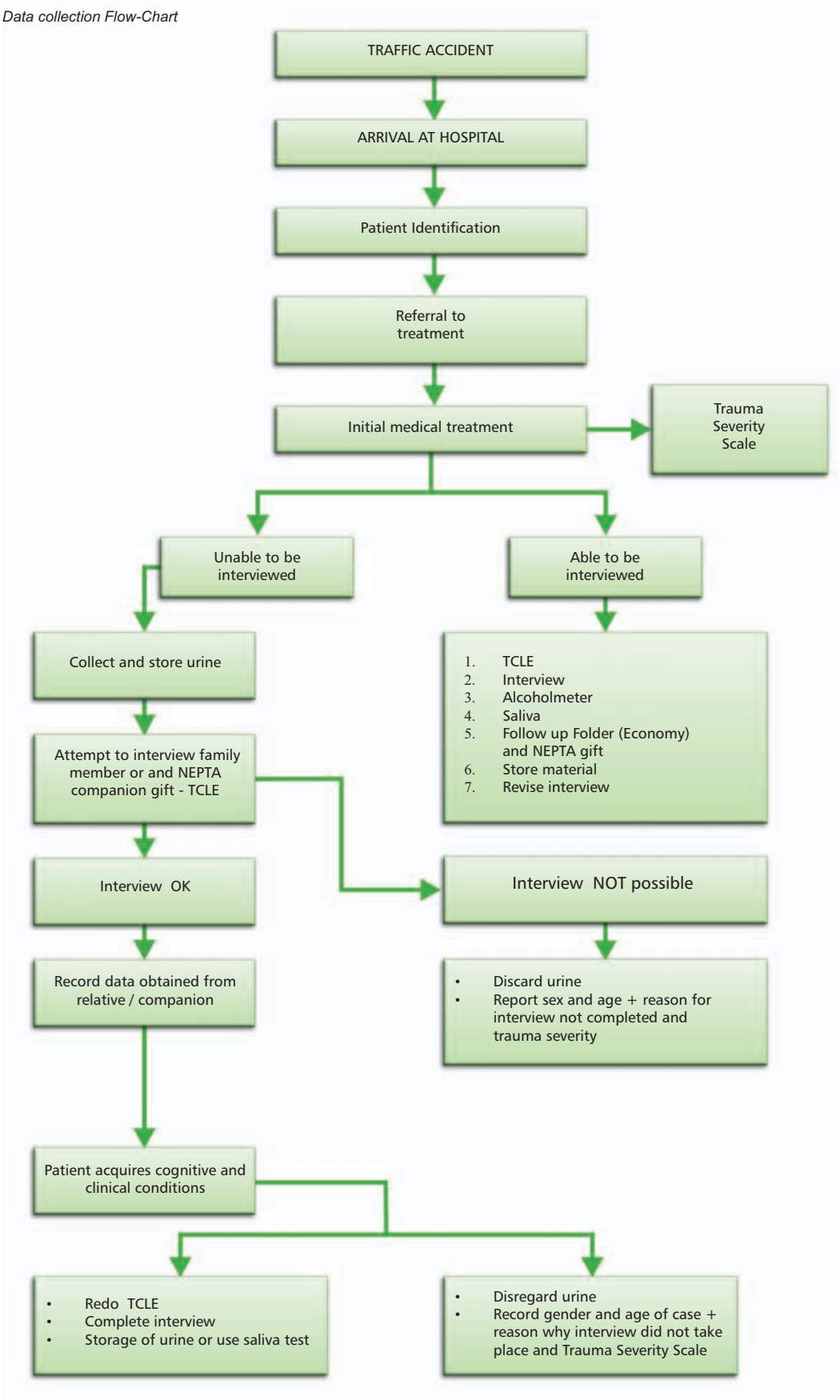
Designing and Sample

A cross sectional study was outlined in order to obtain a consecutive sample of all the patients over 18 years old who have been treated at HPS and HCR due to TAs, both as drivers and passengers or pedestrians. These centers were chosen because they are the main reference centers for trauma treatment in Porto Alegre. Data was collected during 45 days, between October and November 2009. Additional criteria for inclusion in the study were patient´s clinical and cognitive conditions to give informed consent and to answer the interview questions, which always took place after initial medical treatment and patient stabilization. When patients did not show the necessary conditions for the study procedures at the time of interviewers first approach, consent was sought and interview was carried out with family members or another person accompanying the patient, urine samples being collected to measure toxicology. As soon as the patient reached the required condition, ratification of the consent was requested, without which the collected urine and the information collected previously were discarded. Figure 1 shows a schematic of data collection.

Measurements

The main outcome was the presence of alcohol found in saliva, urine or through direct measurement of alveolar air by breathalyzer. This, as other variables of interest (income, age, schooling, use of other substances, site of accident, time of accident, situation of victim, passenger, driver or pedestrian, type of vehicle and diagnosis of abuse and dependence, are described in this chapter.

Figure 1 – Data collection Flow-Chart



Team, logistics and data collection.

Fifty-one interviewers, either students or health professionals, were selected. They all were trained in the treatment of victims of TAs at emergency services, way of approaching patients and family members for survey purposes, interviewing techniques, post-information consent, urine and saliva data collection, use of an ethylometer and insertion of the interview answers and further information in PDAs, in a form similar to the data collection and insertion of sample data on federal highways (Chapter VII). Training included the discussion of the data collection instrument (questionnaire)[1] and simulations of all the procedures.

As a first step towards project presentation, personal contact took place between those in charge of the study and the directors of both Emergency Treatment or Trauma Centers that had been selected. Before beginning the pilot study, the coordinators contacted the section chefs who were identified as facilitators for the survey at both hospitals. This approach enabled the adaptation of the data collection procedures to the treatment routine at each hospital. Before beginning the interviews, as part of the strategy to make the interviewing team work easier, the manager of each hospital sent a communication to every sector involved informing the starting date for data collection and a list with the names of the interviewers.

Four-hour shifts were established for data collection. Each shift comprised a data collection manager and two to four interviewers (whatever the estimated prevalence of accidents during the shift) . The manager would complete a form with interview data such as the time and the age of each interviewee, total of interviews carried out during the shift, cases of patients who were not in clinical condition to be interviewed and must be interviewed by the next shift, besides relevant observations, names and signatures of the collectors present. At HPS, the manager identified the entry of any traffic accident victim for treatment by consulting a hospital computer, managing the interviews with the collectors. At the end of each interview, the manager checked the material and arranged for the complements and corrections that might be required. At HCR, without access to the computerized records, the manager would go though the halls and emergency rooms to identify patients who were traffic victims according to the study criteria. The remaining procedures were similar. At the end of the interviews, flyers[2] were distributed with information on the impact of alcohol use in traffic, also containing aspects of Brazilian law and gifts were given (e.g., caps and T-shirts) to all the participants. The forms for informed consent used in this study are available to interested parties[3].

Results

According to the treatment records of the institutions, 92.6% of the eligible individuals were approached and the final sample was composed of 609 persons, average age being 32.8 years (sd=13.2), 72% males. Most victims were the drivers (60%) and 80% of these were driving motorcycles. The drivers, as compared to passengers and pedestrians, were mainly younger men with binge episodes of heavy alcohol consumption ($p<0.05$).

The prevalence of positive blood alcohol was 8.3% though 28.5% of the individuals referred alcohol consumption in the 24 hours before the TA. The average of refusals was 11.2% in both data collection environments, 70% of the cases being obtained at the HPS and 30% at HCR, in accordance to the proportion of emergency treatments in the city of Porto Alegre.

Table 1 shows the prevalence of the presence of alcohol and of the other psychoactive substances surveyed, considering the total valid cases for each substance. Therefore, cases where use of the breathalyzer, saliva or urine test use was refused were not included, nor those cases where, for other reasons, the information was unavailable.

Table 1 – Presence of alcohol and other psychoactive substances in traffic accident victims treated at hospitals in Porto Alegre between October and November of 2009.

Type of PAS	Positive		Negative	
	N	%	N	%
Alcohol (n=529)	44	8,3	485	91,7
Marijuana (n=440)	32	9,5	398	90,5
Benzodiazepines (n=394)	17	4,3	377	95,7
Amphetamines (n=436)	6	1,4	4304	98,6
Cocaine (n=433)	29	6,7	404	93,3

There were no differences in the association between blood alcohol and the main socio-demographic characteristics of the accident victims (gender, age, schooling, income) The analyses of the association between blood alcohol and characteristics of the traffic accidents that resulted in the studied medical treatments are presented below.

Most of the victims (76%) referred having suffered the TA within the city limits of Porto Alegre or some other city. It was not possible to identify significant differences, although none of orother kinds of vehicle such as, for instance, buses or trucks. In the latter case, no instance of blood alcohol was identified in any of the patients treated. (Table 2).

Table 2– Association between blood alcohol and place of accident (N=527)

Place	Positive Blood alcohol		Negative blood alcohol	
	N	%	N	%
Porto Alegre urban road (N=458)	39	8,5	419	91,5
Another city urban road (N=48)	4	8,3	44	91,7
Federal Highway BR (N=9)	0	0,0	9	100,0
State Highway RS (N=12)	1	8,3	11	91,7

P <0,001

[1, 2 e 3] *Available at site www.obid.senad.gov.br*

More than a quarter of the TA patients treated between midnight and 6 a.m. showed positive blood alcohol in a significantly more elevated proportion than at other times of day, as shown in Table 3.

Table 3 – Association between blood alcohol and time of accident (N=507)

Time	Positive Blood alcohol		Negative blood alcohol	
	N	%	N	%
0 to 6 am (N=49)	13	26,5	36	73,5
6 am to 12 am (N=148)	6	4,1	142	90,8
12 am to 6 pm (N=168)	9	5,4	159	94,6
6 pm to 12 pm (N=142)	11	7,7	131	92,3

P <0,001

No significant difference between the proportion of pedestrians, passengers and drivers with positive blood alcohol was perceived during treatment (Table 4).

Table 4 – Association between blood alcohol and situation of the victim during accident (N=529)

Situation	Positive Alcoholemia		Negative Alcoholemia	
	N	%	N	%
Pedestrian (N=88)	8	9,1	80	90,9
Passenger (N=120)	11	9,2	109	90,8
Driver (N=321)	25	7,8	296	92,2

P = 0,300

A greater proportion of victims –drivers or passengers – in cars had a positive blood alcohol compared with those riding motorbicycles or other kinds of vehicle such as, for instance, buses or trucks. In the latter case, no instance of blood alcohol was identified in any of the patients treated. (Table 5).

Table 5 – Association between blood alcohol and the type of vehicle involved in accident (N=438)

Tipo de Veículo	Alcoolemia Positiva		Alcoolemia Negativa	
	N	%	N	%
Motorcycle (N=308)	23	7,5	285	92,5
Car (N=79)	12	15,2	67	84,8
Other (N=51)	0	0,0	51	100,0

P = 0,006

The use of seat belts at the time of the accident, where pertinent, was not associated with blood alcohol as shown in Table 6.

Table 6 – Association between blood alcohol and the use of seat belts at the time of the accident (N=105)

Use of Seat Belt	Positive Alcoholemia		Negative Alcoholemia	
	N	%	N	%
Yes (N=64)	9	14,1	55	85,9
No (N=41)	4	9,8	37	90,2

P = 0,726

Table 7 shows the result of the analysis of the association between the presence of blood alcohol (positive blood alcohol) during hospital treatment and diagnostics of alcohol abuse or dependence in TA victims. In both cases, a greater proportion of individuals with positive blood alcohol are observed among those who meet the diagnostic criteria for the disorders studied, though the pre-stipulated statistic significance was not achieved.

Table 7– Association between blood alcohol, alcohol dependence and abuse (N=524)

Diagnosis	Positive Alcoholemia		Negative Alcoholemia	
	N	%	N	%
Alcohol abuse (p = 0,089) (N=30)	5	16,7	25	83,3
Alcohol dependence (p = 0,084) (N=21)	4	19,0	17	81,0

Comments

First, it is important to stress the feasibility of carrying out studies on such a relevant subject within the context of emergency medical treatment of traffic accident victims. Taking into account the medical priorities and with a duly trained team, it is possible to obtain interviews on delicate matters involving behavior that may even be illegal. In the same way, most patients give permission for the concentration of illegal substances in their body to be measured.

The data presented here show a high prevalence of alcohol consumption. Though the high prevalence of blood alcohol, verified using breathalyzers, was 8.3%, 28.5% of the individuals mentioned alcohol consumption in the 24 hours before the TA. This crucial difference can be explained by the time elapsed between the accident, treatment and survey procedures. In itself, the finding that a not insignificant proportion of accident victims treated at reference hospitals is under the effect of psychoactive substances (PAS) – that alter our behavior – is in itself alarming, even though prior knowledge on the matter already gave us an idea of this.

It must be stressed that there was no statistically significant difference in the prevalence of positive blood alcohol among drivers, passengers and pedestrians. In fact, even though this hypothesis has not yet been tested in our study, it is reasonable to assume that the possibility of a passenger under the influence of a PAS being driven by a driver who used such substances is high. Therefore, the results show that preventive strategies as to alcohol consumption must aim at the three potential groups of victims.

Within the typical clinical features of these behavioral disorders, amongst the results analyzed up to this point, the tendency is that an individual diagnosed with alcohol abuse or dependence will be under the influence of these PAS at the

time of the accident, since the tests of these associations show marginal statistical significance ($p<0,09$). Therefore, the solid evidence showing the ill effects of various psychoactive drugs on the capacity to drive motor vehicles or to cross streets on foot, together with the high frequency of drug usage in these situations, point to the urgent need to plan and implement efficient actions with a view to controlling the problem.

The evidence showing that most victims treated at the two biggest trauma hospitals of Rio Grande do Sul come from the urban perimeter and that most accident victims with blood alcohol were treated between midnight and 6 a.m. brings up the matter of alcohol consumption at parties, bars and social meetings, which once again shows the need for adequate preventive strategies. Even after Law 11,705, altering the Brazilian Traffic Code, was enacted, there seem to be few changes of habit among the citizens of Porto Alegre , which may mirror Brazilian reality. Strategies to alter the permissive culture involving the use of alcohol and other PAS are indispensable besides police enforcement.

Finally it must be emphasized that the number of motorcyclists treated was quite high (78.4% of the drivers), considering that only 11% of the licensed vehicles in Porto Alegre are motorcycles. This is a relevant finding that may represent an emerging public health problem that requires peculiar and specific prevention and control strategies.

Becoming aware of these characteristics, as well as others that will be studied in future analyses, should contribute to building public policies based on scientific knowledge, intensifying and focusing on actions with a view to efficiency in preventing traffic accidents and their negative consequences for society.

Acknowledgment

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Traffic accidents with fatal victims autopsied at the Porto Alegre Medical Examiner's Office

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Introduction

The purpose of this chapter is to identify the profile and measure the prevalence of alcohol and psychoactive substances in fatal traffic accident victims autopsied at the Medical Examiner's Office in Porto Alegre, in a one-year period.

There have been many studies of accidents with fatal victims under the effect of alcohol and drugs, to identify data that will characterize a profile of the accident and the victims, supplying the tools needed to suggest public policies aiming at reducing these accidents. As to accidents with fatal victims and their correlation with the use of psychoactive substances,(Campos, Salgado et al., 2008), they mention the likelihood that an individual under the effect of alcohol will become a victim of a fatal accident is seven times greater than if the person is sober.

Recent international studies on toxicology analyses of traffic accident fatalities show a considerable increase of positive results for illicit substances compared to similar studies of a decade ago. A study performed in Sweden over a 2-year period followed non–fatal and fatal victims of traffic accidents. Of the fatally injured, 38% were positive for alcohol and 9% for illicit substances (Ahlm, Björnstig et al., 2009). Also in Sweden, between 2000 and 2002, toxicology tests were performed on 855 drivers who were victims of fatal accidents. Comparing these two periods, an increase of positive results from 38.9% in 2000 to 45.9% in 2002 was found, and alcohol was the most common substance detected ((Holmgren et al., 2005). Alcohol continues to be the great risk at any age, and young drivers who take alcohol and marijuana are a priority target for prevention (Cheng, Chan et al., 2005).

Method

The study was performed using data obtained in the electronic records of fatal traffic accident victims autopsied at the Medical Examiner's Office (DML- Departamento Médico Legal) in Porto Alegre, capital of the state of Rio Grande do Sul, between July 1, 2008 and June 30, 2009. The data were collected manually and recorded on paper forms. The data were accessed by one of the authors (HHS), a physician specialized in legal medicine, and collaborator in the project, because of the confidentiality of the institution and to preserve the identity of the subjects.

Examinations by the coroner are performed in RS by the DML – which is a department of the Instituto Geral de Perícias (IGP) – (General Institute for Forensic Examinations) at 36 units distributed throughout the state and the unit in the capital. That is where forensic examinations are performed. They are sent to the unit by the Civil Police, the Military Police and the Judiciary, according to their areas of competence, coming from the cities around Porto Alegre, in cases of violent death. Autopsies of cases that occur in other cities but sent to Porto Alegre hospitals due to the severity of their condition which ended in death are also performed.

In order to perform the medico-legal expert examination (autopsy) it is necessary that the appropriate authority request it. This is done after it is appropriately recorded at the civil police stations. Only then is the DML called to pick up the body for examination. It should be mentioned that sometimes it is necessary to wait for the site to be examined forensically, which is done by the Department of Criminalistics, and by request of authorities, and only then can the body be removed. .

The accidents are recorded at the originating police stations, i.e, at the police stations of the district to which the address of the accident belongs, or stations that cover emergencies. The result is an accident report, with data identifying the person and what has happened. The forensic report is sent to the appropriate police station which is often is the same as the one where the case originates. This information is provided in the accident report pertaining to the case.

When accidents are recorded at the police stations of Porto Alegre and surrounding area, the DML is called in, after the police stations inform the Centro Integrado de Operações da Segurança Pública (CIOSP- Integrated Center of Security Operations), which calls it in by radio to the DML Removal Team. However, in accidents that are recorded in other cities, the DML is called by the funeral homes that pick up the body. These businesses are affiliated to the Sindicato dos Estabelecimentos de Prestação de Serviços Funerários do Estado do Rio Grande do Sul – SESF/RS, (Union of Establishments of Funeral Services of the State of Rio Grande do Sul), which has an agreement with IGP and the information is called in by telephone. All bodies are identified at the time they are picked up.

When they arrive at the DML, the data contained in the accident report are included in the electronic registration

system with the protocol number of the DML and the bodies are taken to the autopsy room. The pick-up is done daily and the examinations are performed between 8 am and midnight, obeying the legal rule of 6 hours after death before the autopsy begins.

The forensic examination consists of an external examination of the body and internal examination of the cranial, thoracic and abdominal cavities, systematically describing the injuries found and collecting biological material. The blood is collected for the quantitative research of alcohol level. Preferably, urine is collected for a qualitative research of psychotropic substances and , if there are none, a fragment of the liver. For this study, the following substances were looked at: cannabinoids, amphetamines, cocaine, benzondiazepines and barbiturates, These materials are sent to the Laboratório de Pericias (Forensic Laboratory) for analysis. After examination the body is released to the family and the death certificate is issued. The bodies of people unknown or who are identified but not claimed within 30 days are buried by the DML. The medical examiner then writes the medico-legal report and awaits the results of the tests for psychoactive drugs to complete the report. The results of the examinations are included in the electronic record system by the employees of the Laboratório de Perícias,, and they will be accessed by the DML employee who will add them to the waiting report and send them to the medical examiner in charge of the case for the final conclusion. Copies of the finished report are sent to the DML archive and made available to the final police stations. It should be mentioned that, from the legal standpoint, the presence of any drug is enough to confirm the report., and therefore not all drugs are routinely measured. In this study, all psychoactive substances described were measured in each test.

The characteristics of the accidents and of the victims obtained in the DML system included the following variables in the data collection instrument: sex, age, color, place of birth, city of residence, marital status, schooling, profession, the original police station for the event,, police station to which the report is to be sent, date of death, date of accident, time of accident, site of the traffic accident (identifying the region – urban or rural, state or federal highway), from where the victim was taken to the DML (directly from the site of the accident, Hospital de Pronto Socorro, Hospital Cristo Redentor or some other hospital) day and time collected, type of biological material collected (blood, urine or liver) and quantitative result for blood alcohol testing and qualitative for psychotropic drugs (cannabinoids, amphetamine, benzodiazepines and barbiturates).

After the questionnaire was completed[1], the cases were inserted into a data base created in Excel and analyzed in an SPSS (version 10) program. Thus it was possible to create a profile of fatal victims and estimate the prevalence of blood alcohol and other psychoactive substances in them.

The criterion chosen to select the cases was deaths that entered the DML during the period from July 1, 2008 to June 31, 2009, recorded as caused by a traffic accident. Considering this criterion, the date of death is not always the same as the date of the traffic accident, since there are cases where the victim was treated in hospital, but ultimately died all the same. The identities of the victims were kept confidential, and the criterion of age 18 years and older was used.

Results

Out of a total of 370 accident victims, the data base was concluded at 348, and 22 cases of minors were excluded. Details follow of the main results of the analysis. This study considered the cases of cases of people who died in traffic accidents and were autopsied at the DML. They came from the cities of Porto Alegre, Alvorada, Eldorado do Sul, Gravataí, Guaíba, Viamão and Camaquã. Cases from other cities (that were seen in Porto Alegre hospitals and died) and were autopsied were also counted. The cities with the highest rates of traffic accidents, after Porto Alegre were Gravataí and Viamão, with a prevalence of approximately 10 and 5%, respectively.

As to the accident site, considering that this information could only be obtained in 40% of the cases, it is believed that 42.9% occurred on urban streets in Porto Alegre, 25% on federal highways, 13.6% on state highways. Among the federal highways, BR290 had the highest incidence (73.5%), BR116 had 17.5% of the cases, and BR 386, 8.8%.

Among the general characteristics of the victims,, 76.7% were male, most of them white (83.7%), single (61.5%) and a mean age of 43.1 years, the mode – most common value – being 20 years, indicating that the age group of 18-35 years, the youngest in this sample, represents the highest percentage (40.4%) of fatal traffic accident victims. When age is analyzed versus sex, it is found that the proportion of male victims is higher in the 18 to 34 age group than in the other age groups, while the proportion of female victims is greater in the 50 years or over age group.

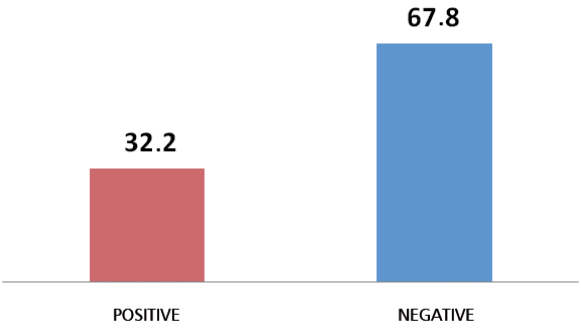
Although there is no information about the level of schooling, a proxy could be obtained through the profession. Although information could be obtained about only 51% of the cases, it was diagnosed that most of the victims have some remunerated activity (82%). The other victims are students, retired and "housewives".

[1] *Available at site www.obid.senad.gov.br*

During the period of analysis, it was found that the months of April 2009 and October 2008 had the highest incidence of deaths due to traffic accidents, with 11.5 and 10.3% respectively. The weekdays with the highest incidence were Friday and Saturday, although there is not much variation between them. The study showed that, among the victims autopsied at the DML, 38.9% were from the place where the accident occurred, 19.3% from Hospital de Pronto Socorro, 21.7% from Hospital Cristo Redentor and 20.2% from other hospitals, which may be either in Porto Alegre and in another city.

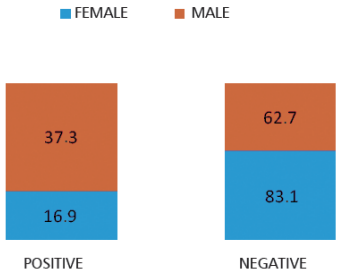
As to blood alcohol (Figure 1), considering the cases in which the examination was performed (337 cases), we had a prevalence of 32.1%. The percentage of loss of information concerning this variable was 31.9% (111 cases). Among the reasons for not performing the test are: analysis impaired because of coagulated or unsatisfactory material (9.9%), organ donor (6.3%), hospitalization (where the maximum time to perform the test should be 24h (38.7%), and test not requested (0.9%).

Figure 1: Prevalence of blood alcohol (%)



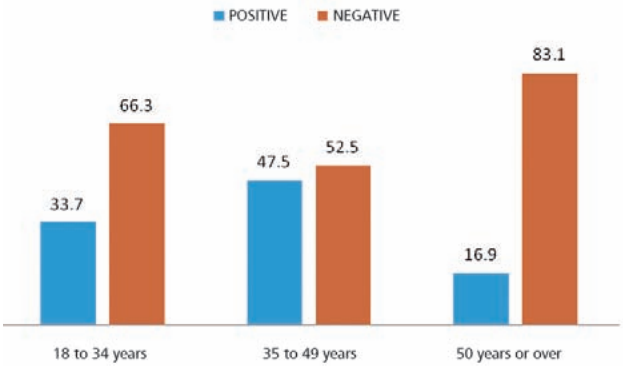
In the analysis of blood alcohol per sex (Figure 2), it is found that blood alcohol prevalence in men is practically double that of women. When age groups are considered, it is found that for the age between 35 and 50 years, the prevalence is higher, reaching 47.5% , and also, that for the age group of 50 years or over the prevalence is lower compared to the analysis of all ages together.

Figure 2: Prevalence of blood alcohol per sex (%)



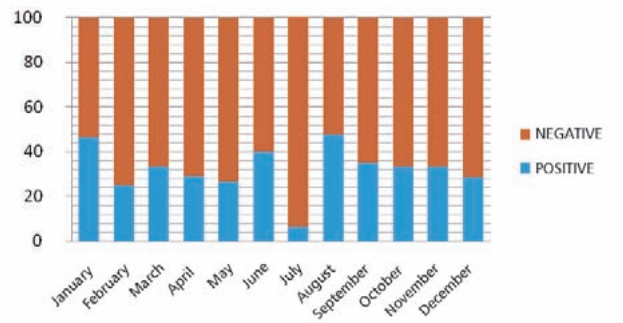
Although the age group of 18 to 34 years was the one with the greatest number of fatal victims, it was second in terms of blood alcohol prevalence, according to Figure 3.

Figure 3:Blood alcohol per age group (%)



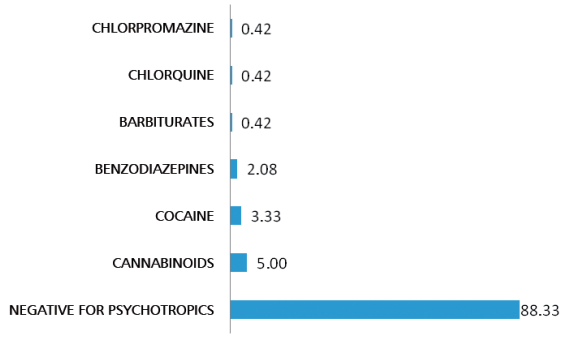
Mean blood alcohol considering all the cases in which the test was performed, was 5.036 dg/l. When the monthly prevalence is analyzed, it is found that the months of August, January and July have the highest prevalence, according to Figure 4.

Figure 4: Prevalence of blood alcohol according to month of death (%)



Of the total sample, toxicology tests were performed for other psychoactive substances in 231 of the victims (loss of 33.6%) Among them, the prevalence of other psychoactive substances was 11.03%. Marijuana was the most frequently found substance (5%), followed by cocaine and 2.08% of the cases respectively.) Positive results were also found for barbiturates, Chloroquine (used to treat malaria and osteoarthrosis), and Chlorpromazine (antipsychotic), according to Figure 5.

Figure 5: Prevalence of positive toxicology (%)



There was a higher prevalence of other psychoactive substances in the age group of 18 to 24 years. This result is different from blood alcohol, since for blood alcohol the age group with the highest incidence was 35 to 49 years, according to Table 1.

Table 1: Number of exams and prevalence of positive toxicology, stratified by age group.

	18 to 34 years	35 to 49 years	50 or more years
NEGATIVE FOR PSYCHOTROPICS	88 (88.9%)	55 (90.2%)	66 (93%)
CANNABINOIDS	6 (6.1%)	1 (1.6%)	1 (1.4%)
COCAINE	3 (3%)	1 (1.6%)	0 (0%)
BENZODIAZEPINES	0 (0%)	2 (3.4%)	3 (4,2%)
BARBITURATES	0 (0%)	1 (1,6%)	0 (0%)
CHLOROQUINE	0 (0%)	0 (0%)	1 (1. 4%)
CHLORPROMAZINE	1 (1%)	0 (0%)	0 (0%)
CANABINNOIDS AND COCAINE	1(1%)	1 (1.6%)	0 (0%)
PPOSITIVE FOR PSYCHOTROPICS	11 (11.1%)	6 (9.8%)	5 (7%)
TOTAL NUMBER OF CASES(NEG.+POS.)	99 (100%)	61 (100%)	71 (100%)

Discussion

This study began by consulting the DPTRAN (Traffic Department) enquiries in Porto Alegre. Routine information found there was analyzed, and a data collection instrument was created. However, it was found that the time since they had been filed would be a problem to obtain current data, so that it would be necessary to think about an alternative form of obtaining the information available in the police enquiries. The mean time in which most of the cases have been closed is around 6 months, since many took over a year to be closed, which prevented creating a current database. For instance, data for 2007 were still being collected in February 2009.

Since the result of testing for alcohol and other psychoactive substances was essential to measure the prevalence of these substances, it was found that there was a relationship between the enquiries and the DML, which sent these results. An alternative was then considered, which was to seek the information in the enquiries of the DML system – which was a partner in performing the study. The data collection instrument used was the questionnaire made based on information that existed in the police enquiries of DPTRAN. However, it was found that not all information that can be obtained in the police enquiries is part of the DML system, and an incompatibility was found between the systems used by DML and by the police. This is a factor that could make it easier to process the cases, besides both public agencies having access to the same information, enabling decisions to be taken more efficiently.

Due to the lack of complete records in the DML information system, for instance, type of accident, situation of the victim – if driver, passenger or pedestrian – date and time of accident, an alternative access to the data system of DPTRAN which also participated in the study was sought. Despite the support from both institutions, they systems do not talk with each other, and it was difficult to identify the cases of the DML at DPTRAN, since, for each DML case there is a source police stations and a destination police station. Given the difficulties, it was chosen to work in this study only with the DML database. However, it is intended to finish collecting all DML cases in the DPTRAN system, and to propose making these systems compatible with each other, based on the logic of each one regarding how they function.

Some variables were not included in the results because they presented a high percentage of loss (greater than 50%). One of the variables that is not taken into account due to lack of records is level of schooling. However, special attention should be given to this variable, because it is important for socioeconomic analyses, since with this variable it is possible to infer incomes, helping calculate loss of productivity and, consequently, economic costs.

One of the advantages of working with the DML data system was the possibility of having access to all the data on victims coming to the DML from other cities, not only the Porto Alegre cases. This is an advantage because in the Porto Alegre enquiries one would only have access to the cases in the city (cases that have already been closed, and it would be necessary to travel to other police stations to obtain data from inquiries in other cities. The difference in profile observed between the cases from Porto Alegre and those of the other cities, considering death at the place of the accident or in hospitals, may be related, in the other places to the need to pick up the cadaver at the site of the accident , and then perform the documentation procedures and thus, reduce the exposure of the body, which, placed in hospitals awaits transport to the morgue in Porto Alegre. Another aspect to be considered involves the lesser immediate severity of the injuries, allowing longer survival for the victim. However, records of these aspects are not accurate.

In this study it was said that young people – victims between 18 and 34 years – represent a higher percentage of fatal traffic accident victims. National literature indicates that the chance of traffic accidents with young fatal victims is 55 times higher than for an individual aged 65 years, due to possible factors such as driver, impulsiveness, habit of driving

very fast, and the less frequent use of a safety belt (Campos, Salgado et al., 2008). International literature also indicates that deaths from traffic accidents worldwide usually affect male youths aged 18 to 35 years. This age group indicates that the victims are of a productive age, and that therefore they generate an economic problem related to loss of productivity (WHO, 2004).

It was found that as to sex of the accident victims, men are notoriously predominant (77%) even when sex is analyzed by age group. This result agrees with national studies that have already been performed, where men expose themselves to physical risks under the effect of alcohol three times more than women (Carlini Ea, 2007). It also agrees with international studies.

The prevalence of blood alcohol found was 32.2%. This result is greater than that found in studies performed by the Associação Brasileira de Departamentos de Trânsito (Brazilian Association of Traffic Departments) in which 27% of the traffic accident victims had positive blood alcohol (Galduróz and Caetano, 2004), however, in the latter study both fatal and non-fatal victims are taken into account, differently from the study performed here, which analyzes only data on fatal victims. This result is interesting, since it shows that blood alcohol in fatal victims tends to be higher when all types of victims are considered – fatal and non-fatal. Analysis of psychoactive substances – without taking blood alcohol into account – presented a prevalence of 11.02%, and the prevalence was higher among the young. This result surpasses some results found in international literature, since the prevalence found was 9% in Switzerland (Borkenstein Rf, 1974), 9.3% in Canada (Mercer and Jeffery, 1995 apud Del Rio and Alvarez,2000), 2.5% in Spain (Del Rio and Alvares, 2000, apud Ponce and Leyton (2008). Marijuana was the most prevalent substance in this study – ignoring alcohol – representing 5% of this total. This result agrees with the finding by Ponce and Leyton (2008), according to which marijuana is the illicit drug most commonly used by drivers worldwide. When all psychoactive substances are looked at together, including alcohol, the presence of some psychoactive substance increases to 37.1%.

Political analysts have proposed a variety of ways in which the incidence of people who drive while drunk can be reduced, ranging from educational programs to the Zero Tolerance Law. In the United States, a study performed with young people aged 18 to 21 years as a control group (Carpenter, 2004), indicates that the Zero Tolerance Law reduced blood alcohol by 13% among men under the age of 21 years who drink 5 or more drinks on a single occasion, i.e., it had a positive impact on reducing risk behavior involving abusive alcohol consumption and driving. The change in the Brazilian Traffic Law (law of zero tolerance to alcohol) which came into force on June 20, 2008 aims at reducing the number of traffic accidents caused by the influence of alcohol and its adverse consequences for society: number of deaths, expenditures on hospital, calling ambulances, loss of productivity, costs of vehicle insurance, costs of life and health insurance, etc. It is observed that in the month of July 2008, after the law, the prevalence of positive blood alcohol in the fatal victims was the lowest of the entire period analyzed (6.3%). Moreover, the month of August 2008 was the one with the lowest incidence of deaths from traffic accidents. These results may be due to the new traffic law, but it is noted that these rates are not maintained, and may be the consequence of a perception, among the population, concerning the lack of enforcement of the law.

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Geoprocessing and the study of the relationship between traffic accidents and bars in Porto Alegre

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Introduction

Geoprocessing is defined as the "set of technologies used to process and handle geographic data using computer programs" (Carvalho, Pina et al., 2000), and the computer systems that perform these tasks are called Geographic Information Systems(GIS). GIS adds variables referring to the "spatial location" (for instance, geographical coordinates referring to latitude and longitude) to different kinds of data of a proper geographic nature (for instance, a mountain range relief or the course of a river) or not (for instance the population of a given city or the incidence of a given disease), thus defining an interface that can generate thematic maps and make it easier to present and process information (Câmara e Queiroz, 2001).

GIS applications can be basically descriptive (producing cartograms or thematic maps) or analytic, using computational and/or statistical analysis methods, as in the so-called spatial statistical analysis. Although in a descriptive form exclusively, cartograms are powerful, simple strategies to view data, as in the famous series of cartograms about the contemporary world, which has become a very successful book called "The Atlas of the Real World" (Dorling, Newman et al., 2008).

The tools of what we now call GIS began to be used already in the 1950s, when they were developed for military purposes, especially as a result of the Cold War (WHO, 2008). Until recently, their use in health was very limited, because of the costs and complexity of the software used, which made it difficult and laborious to extract relevant information for the field of public health (WHO, 2008). This situation changed in the last few decades, and GIS has been used increasingly often to perform the geographical determination of disease distribution (Kistemann, Munzinger et al., 2002), spatial and temporal analysis of trends (Wu, Guo et al., 2009), mapping populations at risk (Murray, Marais et al., 2009), evaluation of resources, planning and monitoring interventions over time (Geanuracos, Cunningham et al., 2007), including work done in Brazil (Carvalho, Pina et al., 2000). One of the first observations when we began to study traffic accidents (TA) in Porto Alegre, in 2006, was that there are several sources of information about them, from different agencies and institutions. However, despite the data available, it is difficult to integrate them in a way that allows the analysis of the relationship of TA with the use of alcohol or with other associated factors, such as seasonality, highway conditions or vehicle flow. In general, databases are not interlinked, and there are not necessarily common fields with complete, consistent information which will allow for their easy, fast linkage. Because of these difficulties analysis is hard, long, expensive and sometimes requires the use of refined methods such as probabilistic linkage. (Malta, Bastos et al., 2009). In this sense, if the difficulties mentioned are overcome, the tools used in geoprocessing are useful not only to understand the phenomenon itself (alcohol-associated traffic accidents) and the main associated variables , but also allows linkage and integrated processing of data of different bases for purposes of analysis, formulation, monitoring and evaluation of public policies (Thomas, 1992). International studies use it to analyze and prevent TA, and some of them observed that the places where people drink alcoholic beverages can be considered as an indicator of chances for drinking and driving – suggesting that the density of points where beverages are sold is directly proportional to the number of alcohol-related traffic accidents (Treno, Johnson et al., 2007).

This chapter discusses subsidies for the use of geoprocessing instruments as a tool to study the occurrence and spatial distribution of TA associated with alcohol consumption. A study performed in Porto Alegre was used for this purpose. It comprised the integration of various data sources and the determination of areas in the municipality of Porto Alegre, with the greatest concentration of TA with its casualties, related or not to alcohol consumption, and the areas with the highest density of establishments where alcoholic beverages are consumed.

Method

An exploratory study was performed using secondary data from different sources listed below. Initially the name of the streets was standardized, between the table of attributes of the axis map of streets and the tables with the addresses of the accidents and the bars. Since each database stored the street names differently, this standardization was essential to enable locating the data by geocoding the respective addresses. The whole process was performed manually and took a lot of time. Then the following data were obtained:

1. EPTC -Empresa Pública de Transportes e Circulação (Public Company of Transport and Circulation): the EPTC made the database of traffic accidents for 2007 available. This database comprises the location (address) of the TA, and covers the following variables: presence of fatalities,

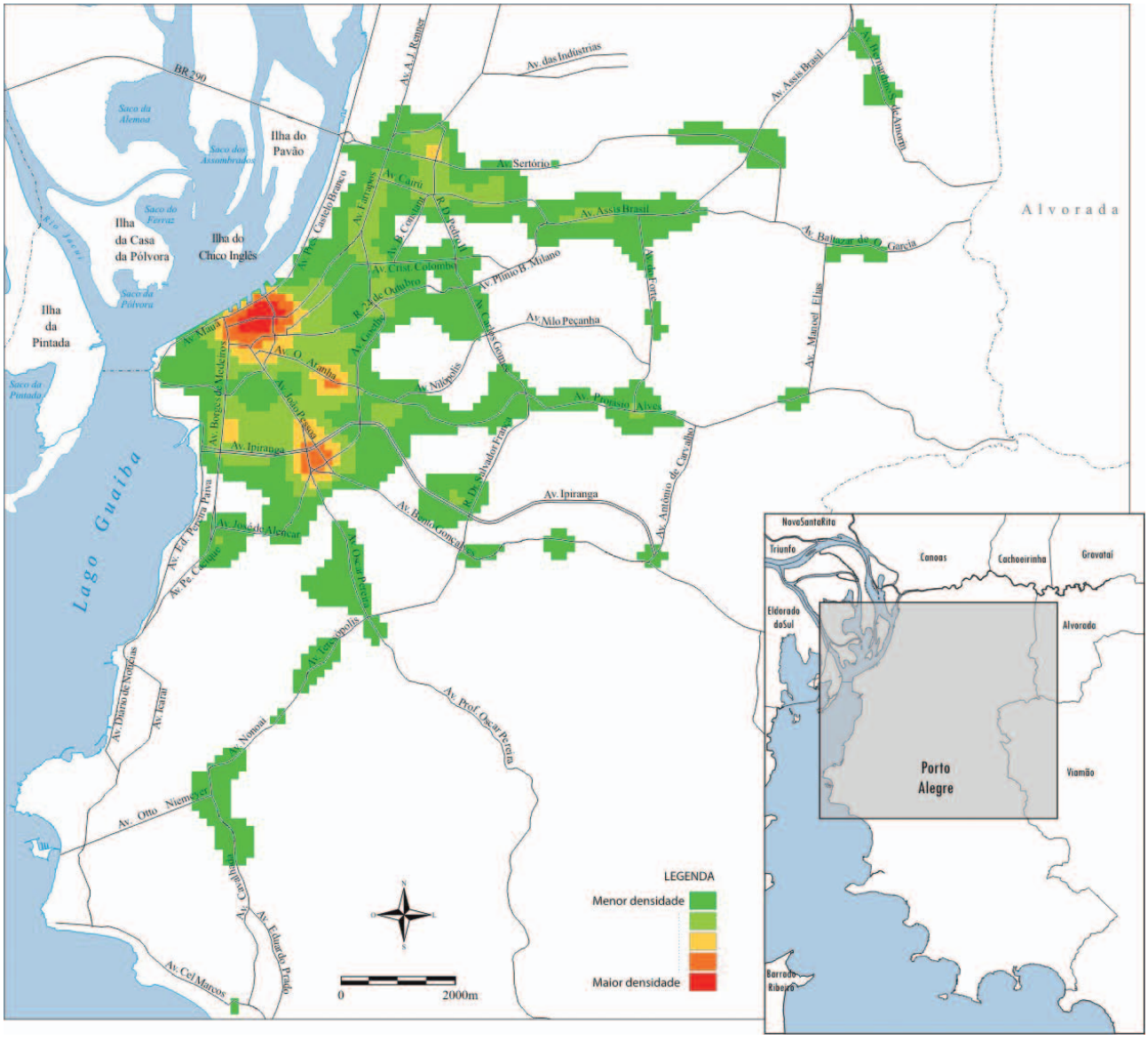
weather conditions, date, time, type of accident (rear-ending, running over, collision, overturning, crash and fall and fall), type of vehicle (truck, motorcycle, bus, passenger van, car, bicycle).

2. SMIC- Secretaria de Indústria e Comércio de Porto Alegre (Porto Alegre Department of Trade and Industry)): SMIC provided the addresses records for licensed establishments classified as bars- beer bar, coffee bar, places where bowling or pool are played,night clubs and convenience stores. These establishments were chosen because they were considered places where people usually drink alcoholic beverages.

The two sets of data from EPTC and SMIC, and the streets axis of the municipality of Porto Alegre, were imported and processed using Terraview program (Inpe et al., 2009) . The thematic maps were made and exploratory analysis was performed seeking to identify agglomerations of accidents and bars. For this purpose a Kernel estimate was used – "interpolation technique which generates a density surface for the visual identification of "hot spots" (…), a hot spot being a concentration of events that indicates somehow an agglomeration in a spatial distribution." (Barcellos, 2007). In brief, the Kernel maps result from a grid division of the area where the number of events can be counted by cell, when density estimates are sought.

Then, density estimates are calculated for the neighboring areas using Kernel functions, which supplies a "softening" surface of the hot spots. To perform a Kernel mapping, two parameters are essential: bandwidth (or radius) – which will supply the softening gradient – and the type of calculation to be performed. This study used density calculation and several bandwidths were tested, including the adaptive one. However, to obtain some form of comparison between the different events (accidents and bars), in this chapter Kernel

Figure 1: Density surface of traffic accidents unrelated to alcohol in Porto Alegre, obtained using the Kernel technique, with data from EPTC (2007)



maps that used radius = 0.6 km will be presented.

Results

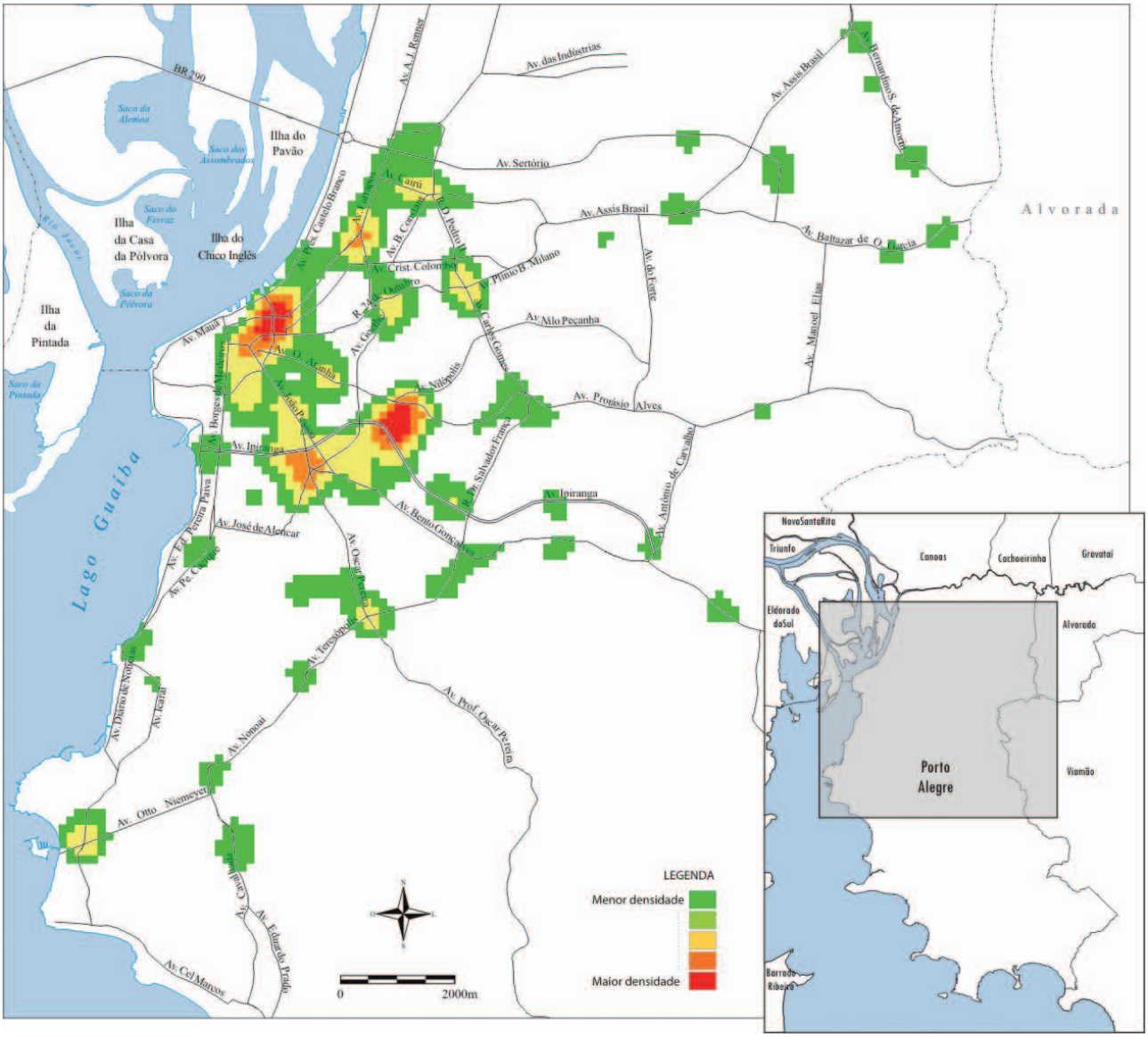
The EPTC database presented a total of 23,333 accidents recorded in 2007. Among these, those involving drivers of cars and/or motocycles as casualties were selected (4,580 TA). These data were then geocoded based on the address, and 4,235 TA were successfully identified (loss of 7.5% of the available records). Of the total number of accidents with casualties, 976 (21.3%) were considered basically related to alcohol consumption – i.e., despite the absence of data on blood alcohol of the drivers, they took place at night (between 8 pm and 4 am). Accidents with these characteristics are considered in international studies as indicating the influence of alcohol use (Voas, Romano et al., 2009), thus utilizing a proxy of accidents associated with alcohol in ecological studies.

The SMIC establishment database had 2,027 entries, of which 513 entries were excluded because they were duplicated. Of the valid entries, 1,498 establishments were geocoded, which led to a 3% loss.

The areas with high TA concentrations that were not related to alcohol, alcohol-related TA and points of sale for alcoholic beverages, after performing the Kernel technique, can be seen in Figures 1, 2 and 3, respectively.

According to the conclusion of the study by Joyce (2009), evaluating the perception of geoprocessing use by health care managers, the use of GIS allows for the establishment of a common language among the different subjects involved in the formulation and evaluation of public policies. However, there is still the difficulty that map interpretation is potentially subject to biases from various fields of action and/or knowledge/formation. Bearing this in mind, the author suggests that when using and interpreting analysis findings that use geoprocessing, it is essential for teams to work in a

Figure 2: Density surface of alcohol-related traffic accidents in Porto Alegre, obtained using the Kernel technique with data from EPTC (2007).



collaborative context – not only for the appropriate use of the analyses, but also to interpret the results and make it possible to use the tools (Joyce, 2009).

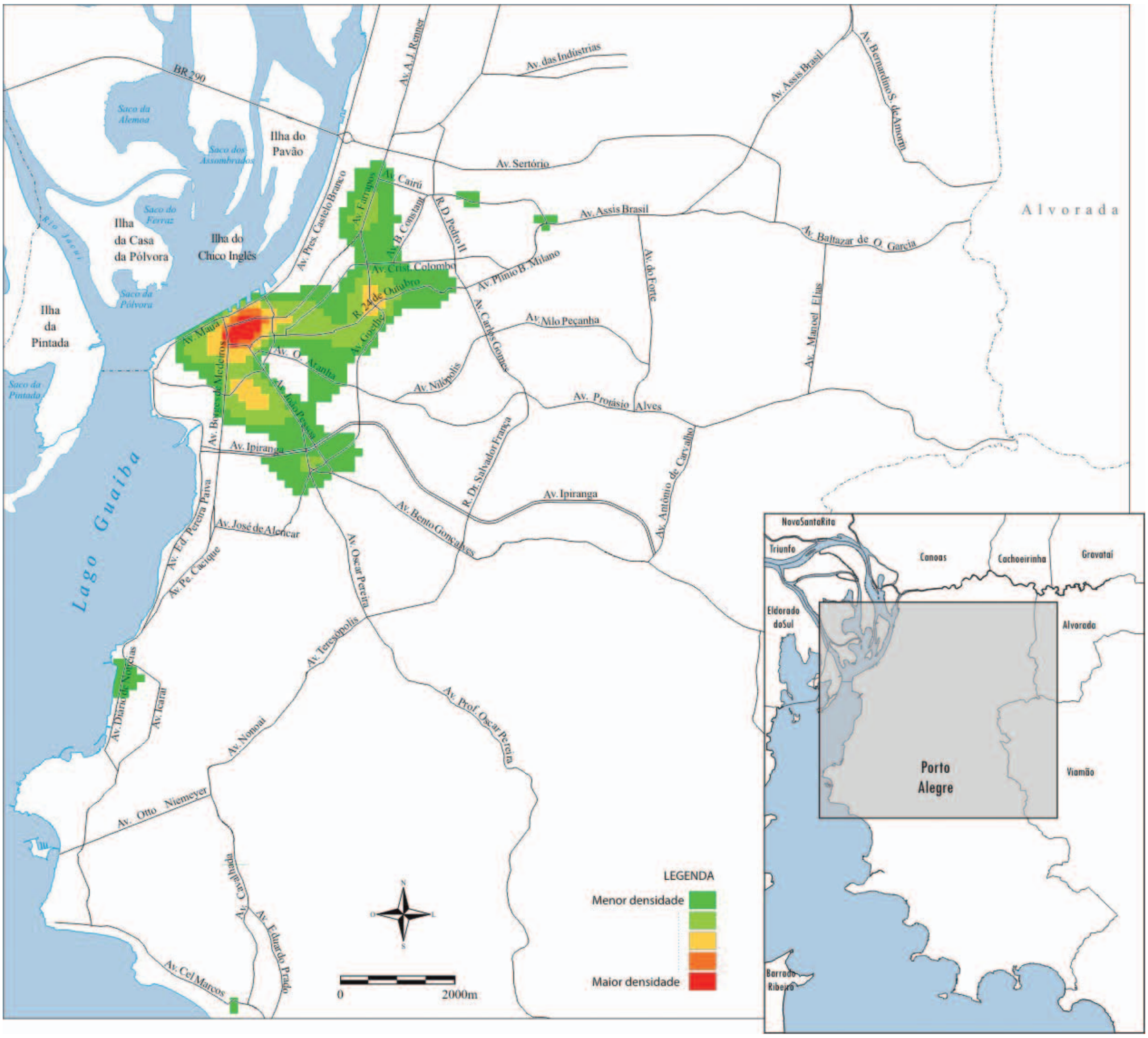
A very practical, simple example of this productive interaction between geoprocessing professionals (such as geographers and cartographers), health care managers and professionals took place in the Health District of Pau da Lima, Salvador, Bahia, where setting up an easily operated GIS substantially contributed to the planning, management and daily operation of local health care units, with clear benefits to managers, health care professionals and the local population (Kadt and Tasca, 1993).

Looking at the maps, the highest concentration of events (traffic accidents) is noticed in the red areas. Areas with a high concentration of accidents, related or not to alcohol consumption, coincide with densely populated areas and include avenues with intensive vehicle flow.

In this stage of the study (exploratory), the variance in accident distribution was not evaluated statistically among the areas of TA concentration related and not related to alcohol, although visually there is a great similarity among the points of highest incidence of both accidents. The visualization of areas with the highest concentration is actually very useful to raise research hypotheses and issues to be studied further using analytic methods.

For instance, what would the characteristics of these areas be, and what are the differences compared to areas with a low density of TA? Very possibly, some plausible explanations could be related to vehicle flow, to population density and to the density of commercial areas in the regions. Another issue to be investigated is its association with the areas where there is a high density of bars, since they mostly coincide, especially the "hot spots " of bars and those of TA related to alcohol consumption.

Figure 3:Density surface of establishments where alcoholic beverages are consumed in the city and municipality of Porto Alegre, obtained using the Kernel technique with data SMIC (2007).



Even so, it is important to point out that the results supply major information for planning preventive interventions. The careful observation of maps allows to estimate that a large part of the TA- related or not to alcohol consumption – takes place in a specific city area that could be delimited by a radius circumference of approximately 2 km In this way, preventive actions such as police barriers to perform breathalyzer tests (blood alcohol level) must consider these areas a priority

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Drinking and driving in a sample of drivers who frequent Porto Alegre bars

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International literature indicates that consuming alcoholic beverages at places like bars and restaurants increases the chances that individuals will drive while intoxicated (Gruenewald, Mitchell et al., 1996), but it is not completely clear as to what extent the geographic location and availability of points of sale for alcoholic beverages is associated with individual consumption patterns and the risks to these individuals (Livingston, Chikritzhs et al., 2007). The importance of studying these associations consists in the fact that the availability of points of sale may be modified by public policies, comprising actions such as restriction of the number of points of sale and restrictions as to days and selling hours (Holder, Gruenewald et al., 2000). There are several ways to infer hypotheses that allow for exploring and analyzing these associations, such as that presented in Chapter XI; however, one of the problems encountered in ecological studies is how to determine the ways in which individual characteristics may be integrated into the geography of places where alcohol is purchased and consumed, as well as the way in which variables concerning the level of individuals and the contexts of which they are part are interrelated. Simply put, it is necessary to investigate to what extent individuals who leave home and go to bars and restaurants usually drive after drinking, and also to describe the characteristics that predispose these individuals to such behavior (Voas, Romano et al., 2006).

There are substantial difficulties in obtaining this information. First of all, bars are located in very different areas of the cities, and often it is difficult to obtain updated records with their addresses, because this kind of establishment may open and close very quickly. After locating the bars, it is necessary to find the individuals who drink alcoholic beverages there, and who may possibly drive after drinking. Many of these individuals move from bar to bar, at different times of day, at different days of the week and even times of the year, and as such are a floating population for which there is no a priori information about where and when its members can be found – a crucial information to design of a conventional probabilistic sample. In this sense, locating and approaching individuals whose behavior could be sanctioned criminally, such as to drink and drive, or stigmatized behaviors such as the use/abuse of illicit drugs, is a challenge for investigators worldwide. Often, because these individuals are involved in illegal behaviors, they try to keep their behavior secret, and avoid sharing this kind of information.

Because of these difficulties, different techniques have been created in order to recruit and analyze hidden populations, based mainly on information supplied by the social networks of individuals with behaviors we aim to study – such as the techniques of Snowballing (Goodman, 1961; Kalton e Anderson, 1986) and Respondent Driven Sampling (Heckathorn, 1997) – or in combinations between these methods and possible space-time location of individuals in a given context, such as the method called Time Location Sampling, used for instance in the analysis of data on truck drivers in Brazil (Ferreira, De Oliveira et al., 2008). The reader can consult the excellent data collection of reviews organized by the European Monitoring Centre for Drugs and Drug Addiction, 2001, which summarizes all the methods and techniques available in the period it was published, although, due to the time lag, it does not include the above mentioned Respondent Driven Sampling, Time Location Sampling methods, neither, a very recent method, the Scale-Up methodology (Salganik e Feehan, 2009), yet to be fully implemented in Brazil.

There is also the progressive refinement of classical ethnographies, now a rich combination of participating observation, mapping as in the traditional ethnographic sense, but also mapping in the contemporary sense, with the intensive use of resources such as the portable GPS (Global Positioning System) and geographic information systems. An interesting example of this multidisciplinary work is given by the group that originally worked in the city of New Haven, USA (Singer, Stopka et al.,2000), based on Yale University, which, (through anthropologist Merrill Singer) coined the concept of syndemics for the complex superposition of different risk factors and adverse social, health, and economic conditions, such as large scale violence and drug or alcohol abuse. However, the use of these strategies presents two major difficulties – namely, obtaining samples that can represent the population under study (Thompson and Collins, 2002) and knowledge of their magnitude or size, important elements to quantify the proportions of risk behaviors among such vulnerable populations, which are the relevant estimates for planning and intervention in public health.

Therefore, in this chapter it was attempted to show the strategies used to investigate behaviors associated with alcohol and drug use in a probabilistic sample of drivers who drink alcoholic beverages in bars and convenience stores in the municipality of Porto Alegre. Later, we present

relevant findings so the reader may become acquainted with the characteristics of the group under analysis as well as descriptive statistics on the prevalence of drinking and driving.

Method

A cross-sectional study was performed with individuals who were potentially at risk for alcohol-related traffic accidents (leaving bars, defined as the places where individual drink alcoholic beverages, which includes nightclubs and convenience stores, and excludes the places where beverages are only sold, such as supermarkets and small grocery stores).

The survey population comprised individuals aged 18 years or more, who lived in Porto Alegre, who had not yet been interview, had driven in the last 12 months, had drunk alcoholic beverages at the place of data collection, and who accepted to participate in the study. In order to study this floating population, a stratified probabilistic sample was designed, with three stages of selection. In the first stage census enumeration areas (CEA) were selected. In the second stage combinations of bars and time shifts (defined by the week day and a time period) were selected, and on the third stage, individuals of the study population were selected and interviewed using the techinique of inverse sampling (Haldane, 1945)

Before their selection, CEA were stratified into two strata of bar concentration. It was decided not to stratify CEA according to the their number of bars, but rather according to geographic areas with high and low concentration of bars, as described in chapter XI. In each stratum, the CEA were selected with probability proportional to their respective number of bars, counted on the frame of licenses, for the year of 2008, supplied by the Municipal Department of Industry and Trade (SMIC) of Porto Alegre. As usual in selections done with probability proportional to size, some CEA were included in the sample with certainty (inclusion probability =1), due to their number of bars. In this case, these CEA are selection strata and the primary sampling unit is the combination of bar and time shift. Thus, two bar concentration strata were defined: (1) high concentration of bars, with 23 selected CEA, and (2) low concentration of bars, with 25 selected CEA. To define the sample size in each stage and foreseen selection frame impossibilities, we began with a very high number of 806 interviews (506 for the stratum with the high concentration of bars), with 22 and 12 interviews per CEA in the strata with high and low concentration of bars, respectively.

Next, the data collection team performed a survey of the 48 selected CEA, to verify the data of the SMIC frame and to obtain the opening hours of the bars, per day of the week, in order to make it possible to create the frame used in the second stage of selection. In this frame for each bar were defined the time shifts according to the day of the week and time of day. Basically, for each day of the week (1- Sunday to 7 – Saturday), we defined four time shifts: (1) from 03:00 to 09:00; (2) from 09:00 to 15:00; (3) from 15:00 to 21:00; and (4) from 21:00 to 03:00 of the next day. For the definition of these shifts, we used a previous study conducted in trauma and emergency rooms in the city of Porto Alegre, described in chapter IX, whose traffic accident (TA) data with positive blood alcohol concentration (BAC) were tabulated in three hour periods, to identify the peaks of higher incidence of TA.

These data (Table 1) allow us to define the stratification of shifts (a combination of day of the week and opening hour) in three strata of TA incidence: low, medium and high.

Table 1: Number of traffic accidents with BAC in trauma and emergency rooms in the city of Porto Alegre, by time shift

Day of the week	Time shifts			
	03:00:01 to 09:00:00	09:00:01 to 15:00:00	15:00:01 to 21:00:00	21:00:01 to 03:00:00 (+d1)
Sunday	2	5	7	3
Monday	2	1	5	3
Tuesday	0	0	3	3
Wednesday	1	0	2	2
Thursday	1	1	0	2
Friday	1	1	0	4
Saturday	4	0	2	8

Legend — *TA incidence strata*

Low number of accidents (0 or 1)

Medium number of accidents (2 or 3)

High number of accidents (4 or more)

Within each selected CEA and within each TA incidence stratum, the combinations of bar and shift (CBS) were selected with a probability proportional to the duration of the shifts. Thus, 324 combinations of bar and shift were selected, where interviews should be performed.

In order to determine the size of the CBS sample in each TA incidence stratum of each selected CEA, the numbers of CBS and individuals to be interviewed in each CBS were established: (1) in the selected CEA of the stratum of high concentration of bars, were established 2 CBS with 2 interviews, 3 CBS with 2 interviews, and 3 CBS with 4 interviews, for the low, medium and high TA incidence strata, respectively, and (2) in the selected CEA of the stratum of low concentration of bars 2 CBS with 2 interviews each were used for the three strata of TA incidence.

In the third stage, the individuals were selected using the inverse sampling technique. Inverse sampling, initially described by Haldane (1945), is a sequential sampling method in which the number of interviews is established a priori, and the sample size (n) becomes a random variable. Thus, the main idea of inverse sampling is to count how many units (n) must to be observed to obtain k interviews (where k is the given number of interviews performed).

With the number of interviews to be performed by CBS, as previously indicated, all people who left the bar during the selected shift were approached to find out whether they fulfilled the study criteria (i.e., a screening operation was performed). At this time, data on each person who left the bar were recorded on a data collection sheet (DC), specifically designed for the study. In the DC, the answers to the key questions of the eligibility criteria were recorded, as well as the time the interviews ended and the results of each attempt to interview people, in order to determine the number of people approached (n), the number of people who were eligible, the number of people actually interviewed, as well as the duration of the screening, which are essential data to calculate the sampling weights.

In this sample design, the time when the screening in CBS began was randomly selected. The persons who left the bars were approached by two data collectors until the number of interviews was obtained, or the time of the shift printed on the DC was reached. This data collection work was performed between April and December 2009.

The main outcome evaluated in this study was the presence of positive Blood Alcohol Concentration (BAC) couple with the intention of driving during the first hour after the interview. Some of the other variables studied and their respective measurement criteria are summarized in Table 2.

All interviews were collected using PDAs connected to a Web Server so that they were sent in real time to the database. The data collection team comprised seven two-person teams of interviewers, selected among students in the field of biomedical sciences or psychology, and trained by the study team to use the breathalyzer and the saliva tests, as well as to apply the interviews.

Ethical Aspects

The study was approved by the Institutional Review Board of the Hospital de Clínicas de Porto Alegre, and tacit consent was used as shown in Chapter III. For individuals who were drunk and said they were going to drive, it was suggested that another person who was sober should drive; if this was not possible, a taxicab was offered, with a pre-determined value paid to the taxi driver by the interviewer.

In order to ensure the safety of the data collection team, in 55 bars/shift considered to be dangerous, mainly because of the high rate of crime and drug trafficking in the neighborhood, officers of the Porto Alegre Police accompanied the interviewers from afar.

Results

Overall, 3,118 individuals who were leaving bars were approached to obtain 683 interviews. The data collection flowchart with the number of individuals approached, until the final sample was obtained can be seen in Figure 1. The prevalence of drinking and driving, per day of the week and per shift can be seen in figures 2 and 3.

As to the sample of individuals interviewed, it consisted mostly of males (74.4%), with a mean age of 37.7 years ((+/-12.3 years), higher education or more (54.9%), a and median family income of R$ 3,000.00 per month. Among the 683 interviewees, 6.7% refused to undergo the breathalyzer test.

Median BAC was 0.29 mg/L of alveolar air and 52% of the individuals mentioned binge drinking (i.e., five or more doses

Summary table 2.Variables of interest and respective measurement criteria

Variable	Method of Measurement
1. Blood alcohol level	Conventional breathalyzer (ALCO-SENSOR, Intoximeters, Inc)
2. Intention to drive	Question: "Do you intend to drive in the next hour?"
3. Demographic variables (age, schooling and income)	Structured interview
4. Opinion concerning the Law 11,705/08	Questions: "Are you in favor or against the law that forbids any alcohol consumption before driving?", and, "Have you changed your behavior after the law was implemented?"

Figure 1: Flowchart of data collection and inclusion criteria (screening)

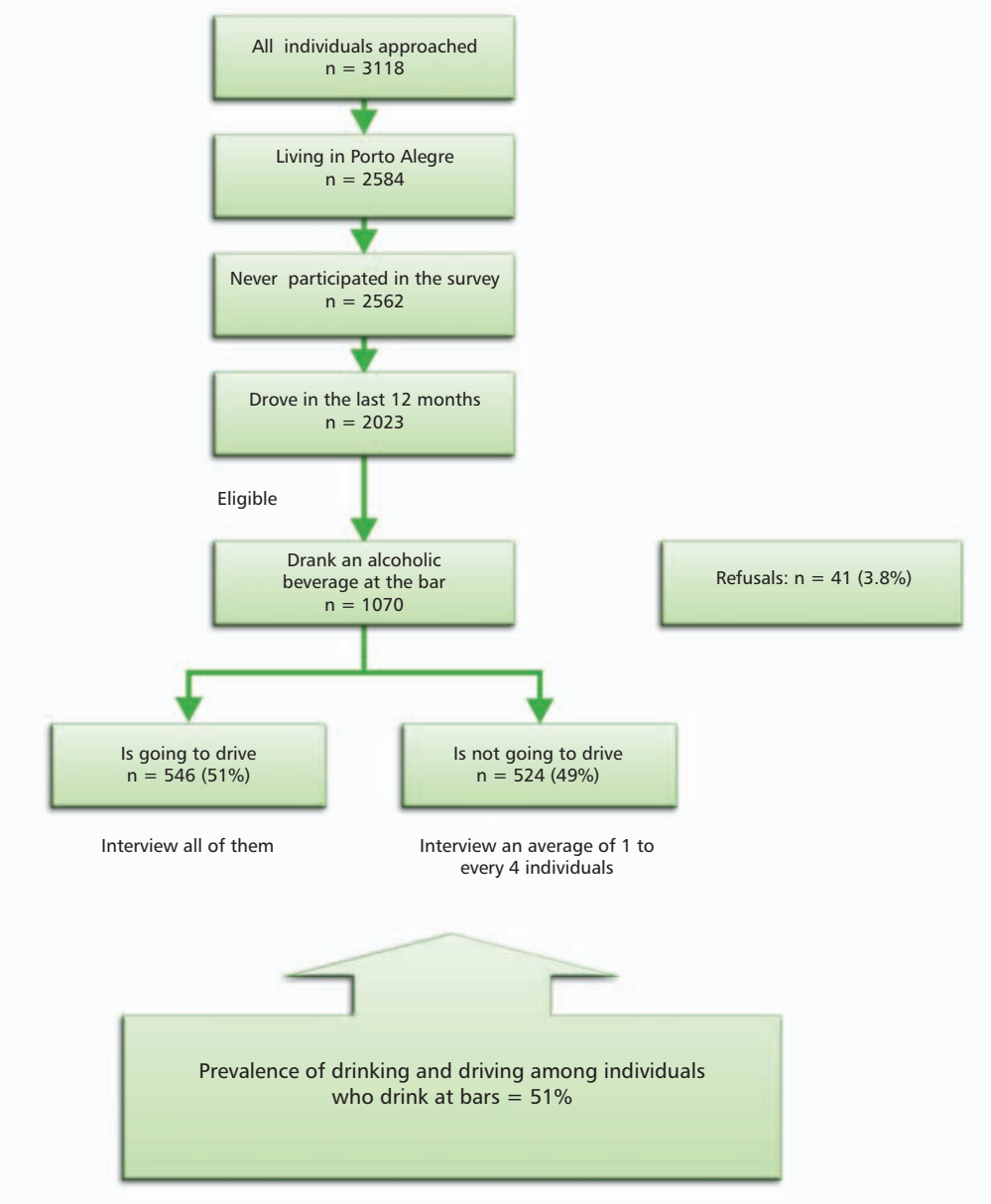


Figure 2: Prevalences of alcohol consumption and drinking and driving per day of the week.

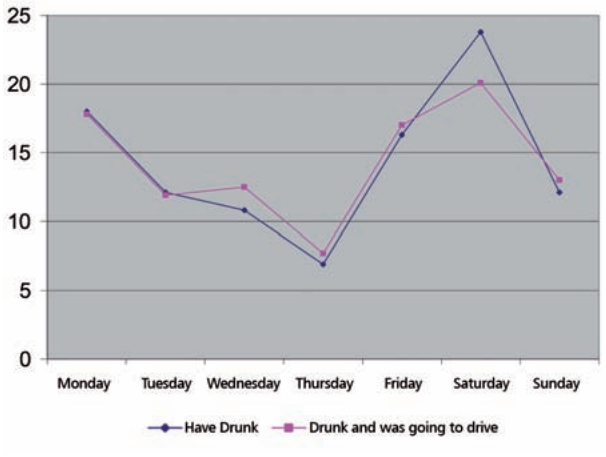
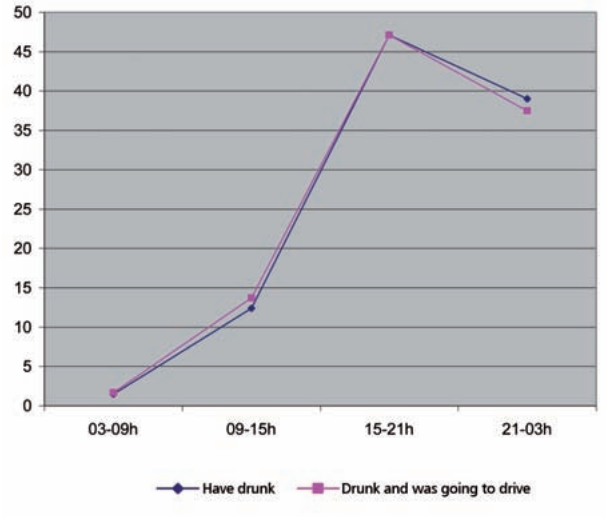
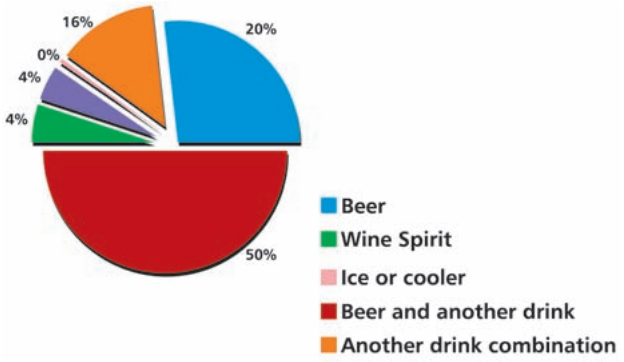


Figure 3: Prevalences of alcohol consumption and drinking and driving per shift.



on a single occasion for men, and four or more doses for women), at least once a month. As shown in Figure 4, most the subjects (75.9%) had drunk beer, combined or not with another beverage at the bar.

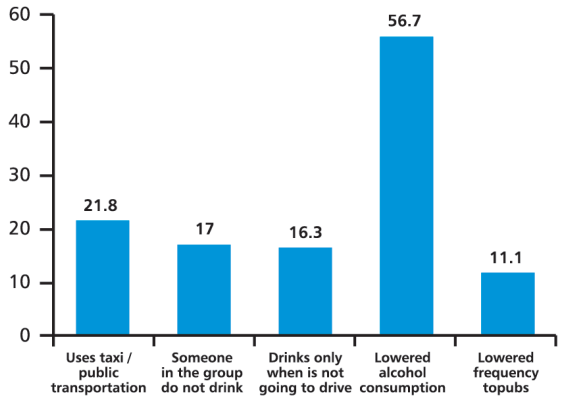
Figure 4: Type of beverage consumed.



Although 85.9% of the individuals mentioned drinking and driving in the last 12 months, only 9.2% mentioned having been stopped in their lifetime to undergo a breathalyzer test.

Most of the sample (63.0%) mentioned that they were in favor of Law 11,705/08, and 43.8% mentioned that they had changed their behavior about drinking and driving after its implmentation. Among those who have changed their behavior, the main changes can be seen in Figure 5.

Figure 5: Changes after the implementation of Law 11.705/08, among the individuals who mentioned having changed some behavior (n=299).



Discussion

This chapter presented a strategy to study a floating population at risk for drinking and driving, which may be considered in planning future studies on a countrywide level. It is noted that, based on the method proposed, valid population estimates can be obtained, with a relatively small number of individuals interviewed (n=683), approximately 1/5 of the total of individuals approached (n=3,118). This is, therefore, a useful strategy in studies to determine public policies for this specific population, firstly due to what was mentioned previously in the introduction, and secondly, because a smaller number of interviews also means saving financial resources to perform interviews.

It is, however, important to take some care in working with complex samples and this must be considered during the process o making inferences about the population. Briefly, it is essential to consider the design of the sample before performing statistical analyses and modeling the data. In this chapter, expansion of the data is not presented, so results are limited to the data of the sample and cannot be generalized. Also, as to the sampling plan, it should be mentioned that the evidence available about drinking and driving in the city of Porto Alegre was useful for the initial specifications: geographical stratification of the bars (obtained by geoprocessing- chapter XI), times when the alcohol-related accidents occurred (obtained in the study of emergencies, chapter IX), and some estimates of the prevalence of drinking and driving among individuals who frequented bars in Porto Alegre. The latter, obtained in a study performed at convenience stores in the city, estimated that approximately 30% of the individuals who drank at convenience stores would be driving in the subsequent hour ((De Boni, Leukefeld et al., 2008), and justified the selection of all the individuals who would be driving, and only one out of every four (selected randomly among the first, second, third and fourth individuals) individuals who would not be driving (which would ensure a minimum number of people with the outcome in the sample that was being analyzed, and assumed prevalence may have diminished when Law 11,705/08 was implemented). This distinction, however, proved unnecessary when a prevalence of 50% of drinking and driving was found, so that basically the data collection process could be simplified in the context of new studies.

The prevalence of drinking and driving among drivers who drink in bars was the highest compared with the samples of drivers presented in this book. This information agrees with the international literature which indicates bars as places where the risk of drinking and driving is increased – although not even international studies report such high numbers. According to two systematic reviews published recently, high densities of bars are associated with heavy alcohol consumption and with the problems resulting from this consumption – ranging from alcoholism to traffic accidents. Both reviews recommend that restrictions should be adopted concerning both the density of bars and their opening times/days, in order to diminish the risk to the population (Campbell, Hahn et al., 2009; Popova, Giesbrecht et al., 2009). The data also confirmed the days and times at which risk behaviors occurred most; at night and on weekends

As to the demographic data, the high level of schooling of the research subjects should be noticed (approximately 55% mentioned having complete or incomplete higher education), which was in contrast to the other samples described in this

book, and much higher than the proportion found in the Southern region of the country as a whole (15.5% of individuals above the age of 25 years with complete/incomplete higher education (IBGE, 2009)). This is possibly related to the fact that only individuals with a driving license were interviewed, that the sampling process took place within the urban area, and that such person should have a socioeconomic status that may permit them to purchase alcoholic beverages in bars. However, schooling does not appear to have an influence, at least in these preliminary analyses, neither on drinking and driving behavior, nor on alcohol consumption itself: most mentioned binge consumption and drinking beer – both classically associated with drinking and driving.

Finally, most individuals approved of Law 11,705/08, popularly known as the Dry Law. However, a smaller proportion (43.8%) mentioned having changed their drinking and driving behavior, and 86% of them mentioned to have been drunk and to have driven, sometime in the previous year. Possibly this discrepancy between the perception of the relevance of the law and actual behavior change can be explained by ineffectual enforcement, since less than 10% mentioned ever having been stopped in a road block to perform a blood alcohol test, although the dissonance between information/perception and consistent adoption of safer behaviors has been observed in practically all fields of public health, as, for instance, in the substantially smaller proportion of people who use condoms consistently when having sexual relations, compared to those who are adequately informed and realize that they are at risk of sexually transmitted diseases, including HIV/AIDS. These data support the importance and need to have effective enforcement and health education strategies.

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"Motoboys" and reckless behavior in traffic. Is there an association with psychiatric disorders?

Anne Sordi, Fernanda Kreische, Breno Matte, Renata Gonçalves, Christian Kieling, Roberta Coelho, Cláudia Maciel Szobot and Luis Augusto Rohde

Introduction

Growing urbanization has led to motorcycles being extensively used in low and medium income countries as a means of transport. The speediness, mobility and low cost of this vehicle have led to exponential growth in the number of circulating motorcycles (Sano K, 2005). This is particularly true for many cities in Southeast Asia, which in some cases show seven times the average number of motorcycles found in other cities around the world, besides having the highest global proportion of road fatalities (Ibrahim Sak, 2006; Lagarde E., 2007; Senbil M, 2007). However, even in developed countries, the risk of dying due to a motorcycle accident per kilometer covered is 20 times greater than for other motor vehicles (Solagberu, 2006). While the number of motorcyclists per inhabitant is still relatively low in Latin American countries compared to these Asian countries there has been a dramatic increase of this fleet in the last 20 years. In Brazil, specifically, the annual production of motorcycles has increased from about 200 thousand in the eighties to 2 million in 2008 (Abraciclo - Associação Brasileira dos Fabricantes de Motocicletas e Motonetas, 2008), and this was accompanied by a 400% increase in motorcycle-related male deaths (Moraes, 2008).

In several developing countries motorcycles are also used to deliver documents and small parcels. In Brazil such delivery men are called "motoboys". Although there are no official statistics , motoboys are generally perceived as being responsible for the increased number of traffic accidents in large Brazilian cities (Silva, 2008). However little is known about the specific factors in this population that may be contributing to this increase in traffic accidents and fines.

Although traffic accidents have a multifactorial etiology their main causes seem to be attributable to human failure (Norris, 2000). In this context two main factors are associated with human failures: substance use and lack of attention, which may be, at least partly attributed to the diagnosis of substance use disorder (SUD) and attention deficit / hyperactivity disorder (ADHD)). It is estimated that 30 to 50% of individuals with SUD (mainly alcohol or cannabis) have a comorbidity with ADHD (Tapert, 2002; Szobot, 2007). Despite the growing number of people working as motoboys in developing countries and the constant growth of traffic accidents with motorcycles, besides the potential link between accidents and ADHD/SUD, surprisingly, very little attention has been given to studying the association between mental health and motoboys.

Since these issues are important, a study was carried out with the following objectives:

1. To describe the various characteristics of a sample of motoboys that circulates in a large urban center;
2. To evaluate the prevalence of psychiatric-disturbances - particularly ADHD and SUD in an adequate sample of motoboys.

Method

Population and Recruitment

The study was carried out in the city of Porto Alegre, which, at the time, had a population of 1,360,000 inhabitants. The participants were recruited at three venues. Hospital Pronto Socorro (HPS), companies that supply motoboys to perform deliveries (identified through the phone list), and the largest motoboy parking lot in this capital. All the individuals treated at HPS following traffic accidents that took place between September 2006 and April 2008, and who stated that they were motoboys were contacted by phone after being discharged and invited to take part in a study, if they were eligible for it. The motoboy companies received a letter briefly describing the project and inviting individuals to take part in the survey. Additionally, flyers1 were distributed to the motoboys that were at the parking lot on different occasions, during three consecutive months. Except for the individuals who were recruited at the HPS and contacted by phone, all other individuals were invited to call the research center to find out if they fitted the inclusion criteria of the study and to, schedule a date for their evaluation.

The study procedures were briefly described by phone and the individuals were invited to appear at the study center for an evaluation. On arrival each received a detailed description of the project and signed an informed consent[2]. Each participant received a monetary compensation of about R$ 13.00 per hour of participation. The study protocol was approved by the Grupo de Pesquisa e Pós Graduação do Hospital de Clínicas de Porto Alegre (Research and Graduate Program Group of Hospital de Clínicas de Porto Alegre).

[1 and 2] *Available at www.obid.senad.gov.br*

Individuals were chosen for the survey if they were presently working as motoboys, were between 19 and 34 years old, lived in the Porto Alegre metropolitan area, and were literate. They were excluded if they had health problems that could interfere with their driving skills (psychosis, sensory or motor difficulties, apnea or epilepsy).

Evaluation of the Participants

After maintaining contact with the research center and having fulfilled all the inclusion criteria the individuals were scheduled for evaluation. They were evaluated one weekday from 6 p.m. to 10 p.m. in groups of two to four motoboys per session. All the evaluations took place in private and individual rooms.

The complete evaluation comprised:

1. A socio-demographic questionnaire as defined by the Associação Brasileira de Empresas de Pesquisa (2003)[3];
2. A personal record of the history of traffic accidents and violations[4];
3. Block designs and vocabulary subtests of the Portuguese version of the Wechsler Adult Intelligent Scale (WAIS - III) (Wechsler 1997), applied by a psychologist;
4. A semi-structured interview through the Mini-International Neuropsychiatric Interview (MINI) (Amorim, 2000), followed by an evaluation of attention deficit disorder and adult hyperactivity through the Adult Self Report Scale (ASRS) (Mattos, 2006), both validated for the Brazilian population and carried out by a psychiatrist;
5. Valuation of externalizing disorders in children, including ADHD, through the Schedule for Affective Disorders and Schizophrenia for School–Age Children, Epidemiological Version (K-SADS-E) (Orvaschel H, 1989), modified to evaluate DSM-IV criteria, Portuguese version (Mercadante Mt et Al., 1995) applied by trained researchers whose reliability among evaluators had been previously tested (kappas of 0.77 to 1.00, $p<0.001$).

The ADHD diagnosis was obtained in three stages:

The first one was an evaluation with a semi-structured K-SADS-E interview and application of the ASRS. Then a review was made of each diagnosis obtained supplied via K-SADS-E by a psychiatrist who is a specialist in child and adolescent psychiatry. Finally, a phone interview was carried with one parent of each individual who presented sub-syndromic ADHD diagnosis ($\geq$ 4 symptoms in any dimension). As to the history of accidents and traffic violations, the individuals were asked to inform as well as possible an estimate of the traffic accidents in their lives and an estimate of the number of traffic fines received. The accidents recorded were then classified as to being with or without victims. Each part of the evaluation was carried out by a different member of the research group, blind to the results of other evaluations.

Statistical Analysis

The comparisons between categorical variables were carried out through chi-square or Fisher's exact test. Continuous variables were compared by the Student's t test or the Mann-Whitney U Test, according to the data distribution. A 5% significance level was accepted in all the analyses.

Results

A total of 101 motoboys took part in the survey, recruitment places contributed withing 75 of the individuals in this sample. The remaining 26 individuals were inserted after calling the research center, having been referred by previous participants of the study. The sample was predominantly male (95%). The socio-demographic characteristics are as in Table 1.

Table 1: Demographic characteristics of the sample

Characteristics	N	%
Age		
19 - 26 years	44	43,6
27 - 34 years	57	56,4
Marital Status		
Single	40	39,6
Married/Stable Union	61	60,4
Ethnics		
European descent	64	63,4
Non-European descent	36	35,6
Schooling		
Secondary School (not finished)	34	33,7
Secondary School (finished)		58,4
University	8	7,9
Social Class		
B	25	24,8
C	62	61,4
D/E	14	13,9

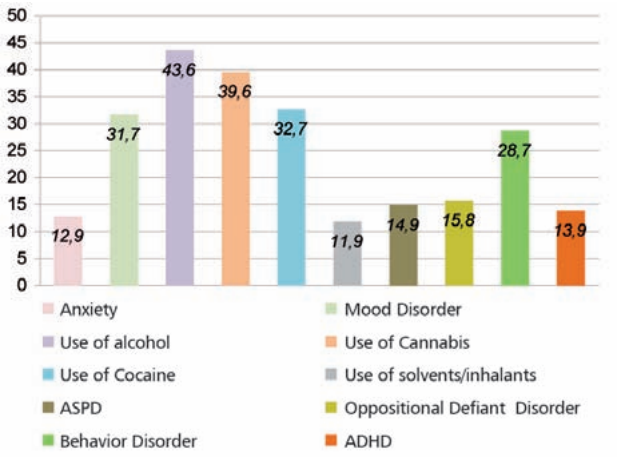
An interesting fact regarding the employment status of the interviewees is that only 37 of the 101 participants declared that they were legally employed. They stated that they had a motormotorcycle bicycle driver's license an average 71.2 months and had been working as motoboys an average 57.5 months. Seventeen had been working as motoboys before obtaining their drivers licenses. Twenty-three individuals stated they worked seven days a week and 37 , six days a week.

As to the lifetime prevalence of psychiatric illness 75% were found to have at least one diagnosis and 54% of the interviewees had two or more diagnoses. The most prevalent

[3 and 4] Available at www.obid.senad.gov.br

lifetime DSM-IV disorders were substance abuse and mood disorders, which only included cases of major depression and disthymia. The number of cases of childhood externalizing disorders was also remarkable as well as anti-social personality disorders (ASPD) (Figure 1).

Figure 1: Lifetime PrevalencLifetime Prevalencee of Psychiatric IllnesssIllness: percentage of cases in sample studied.



Comparing these data with those of a similar age group in the USA, there is a higher prevalence of psychiatric diagnoses except anxiety disorders (Kessler, 2005). The numbers were also substantially higher when compared to a previous study of the lifetime prevalence of mental illness, with age adjustment, carried out in three Brazilian cities where the most prevalent psychiatric disorder rate is , not above 15% (Almeida-Filho, 1997). The distribution of the diagnoses found in this study were similar for both forms of recruitment.

These data are worrying especially concerning the high rates of ASPD amongst motoboys. It is known that ASPD is considerably linked to crime and the motoboy population is particularly subject to suffering or causing accidents, including accidents with victims. Besides, they are people who are in contact with the public, directly in their homes, when delivering goods. The implications as to an increase in traffic accidents, or even urban violence have yet to be made clear. It can also be reasoned that it is precisely the fact that because these people, who present difficulty in following rules and adapting to other kinds of work, are marginalized that they were pushed into this activity. However this study cannot offer more than a causal hypothesis due to the limits of its scope.

It is important to reflect on these findings. Attention deficit disorder and hyperactivity is a mental disorder for which there are available and effective treatments (The MTA Cooperative Group, 1999), that have proven to also be effective in improving behavior in driving vehicles (Verster, 2008). If we consider that the motoboy population could be assisted in the treatment of this pathology, the rates of reckless behavior in traffic and deaths could perhaps be significantly reduced. Besides, knowing that ASPD has a greater prevalence in this population when compared to a prevalence of 13.8% verified in results with a mere 3% of the general population (Vasconcellos, 2004), specific legal measures for this profession could be planned with a view to greater safety.

Motoboys are an omnipresent phenomenon in large cities in many developing countries. In spite of the fact that in the last decade thousands of young men have joined this risk-laden trade, information on their mental health is still scarce. In this context, these results are a first record of a significantly higher prevalence of mental disorders amongst professional motorcyclists than is expected in the general population.

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Cost of traffic accidents with victims associated with alcohol use in Porto Alegre

Tanara Rosângela Vieira Sousa, Esmeralda Correa, Marianne Zwilling Stampe, Sabino da Silva Pôrto Junior, Raquel De Boni

Introduction

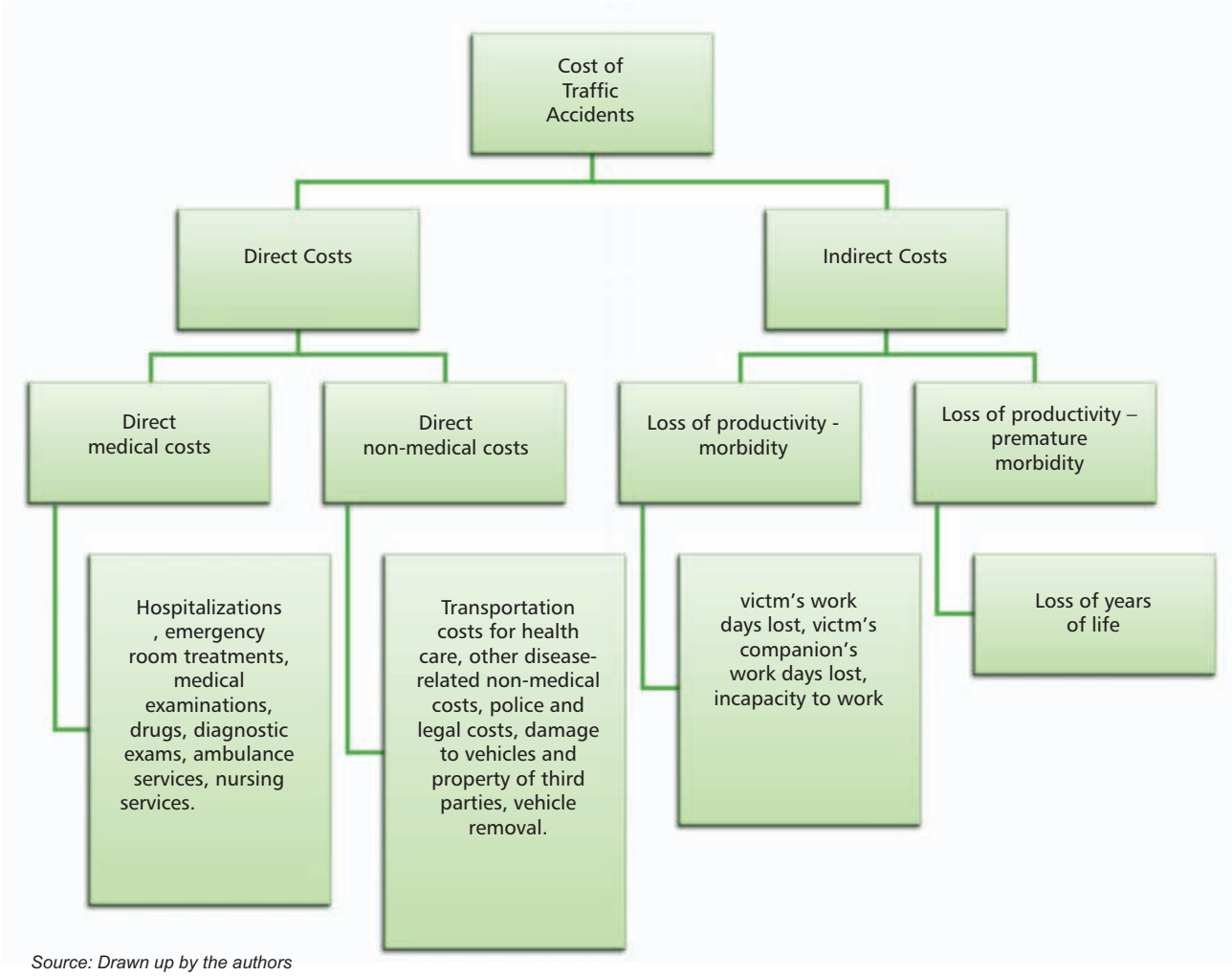
Excess alcohol consumption is a public health problem since it causes strong externalities such as loss of productivity, premature death, crime, family relations problems, low self-esteem, suicide and traffic accidents (Cook and Moore, 2000). The intake of any quantity of alcoholic beverage causes cognitive alterations that hinder driving performance increasing the risk of traffic accidents (Zador et al., 2000; Peden et al., 2004).

Although there is evidence of an association between alcohol use and traffic accidents, the magnitude of these economic costs imposed on society by these events is still not much discussed. However there is an inference that they are important, since they involve rescue costs, medical-hospital costs, victim rehabilitation costs and loss of productivity, and, most of all they are responsible for the loss of life of an economically productive segment of the population. Thus, this chapter contributes to measuring the social and economic costs of traffic accidents with victims, caused by alcohol abuse in the city of Porto Alegre.

Method

For this study, which aimed at showing the economic impact of traffic accidents caused by alcohol abuse, only one aspect of the economic evaluation was considered: the cost component. Therefore using the Cost of Illness or burden of illness methodology,

Figure 1 – Categorization of Traffic Accident Costs



Source: Drawn up by the authors

the cost of traffic accidents due to alcohol consumption was estimated from society's perspective (Drummond et al., 2005; Bouwes, 2006). Therefore Figure 1 shows the cost classification that was adopted and the costs measured1.

The period for the evaluation of traffic accident costs was 2008 for non-fatal victims (injured)[2] and the fatal victims of 2007. For homogeneity purposes the costs were updated to 2008. The data base used consisted of accidents within the urban perimeter of Porto Alegre (RS) that were recorded by the Empresa Pública de Transporte e Circulação (EPTC) and the Departamento Estadual de Polícia Judiciária de Trânsito (DPTRAN).

Considering that this study used different sources of data an organized structure was designed through sub-studies to obtain both primary and secondary data (Figure 2).

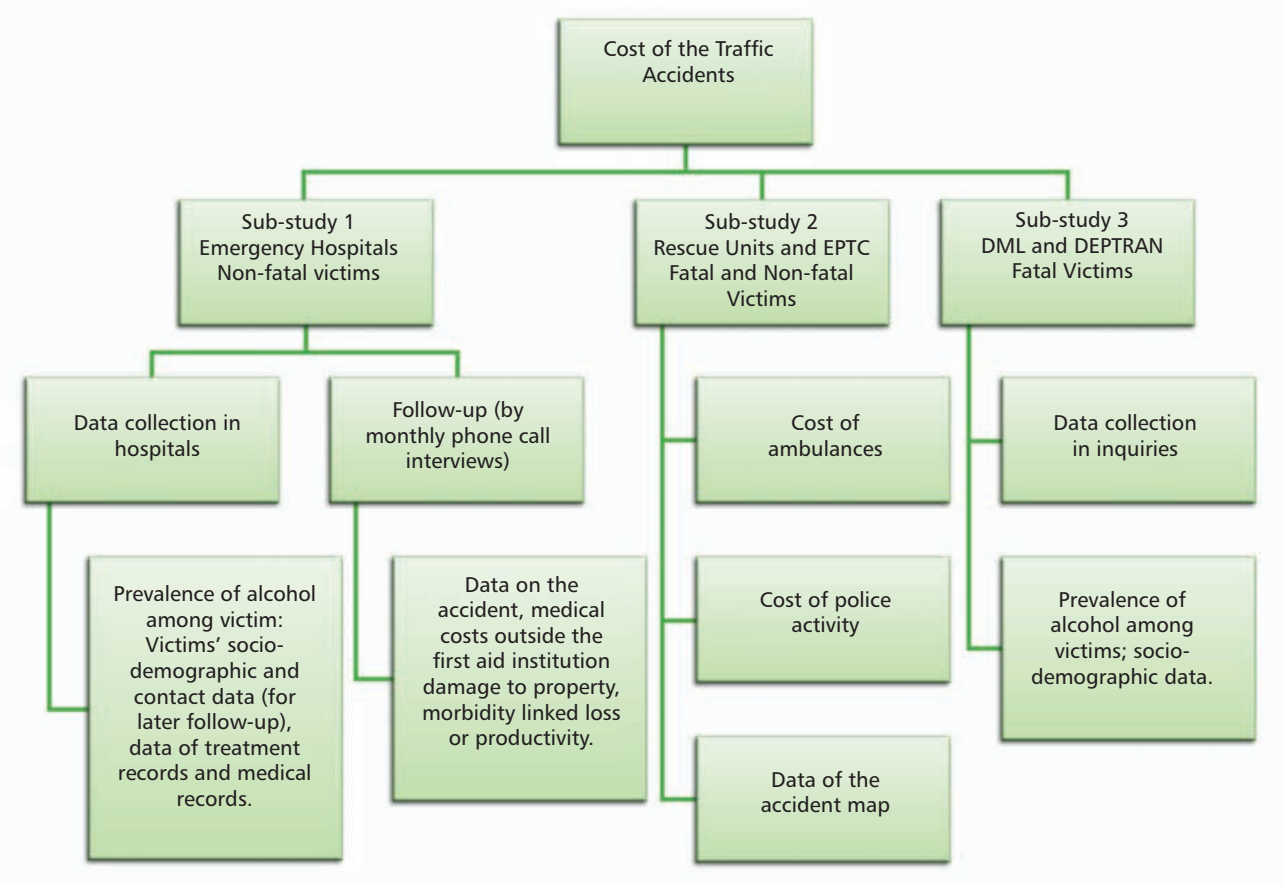
For the monetary values presented in this chapter, the exchange rate for 2008 should be taken into account. This was US$ 1.00 = R$1.834.

Sub-Study 1 – Emergency Hospitals

This sub-study was carried out together with the survey presented in Chapter IX, which consisted of a cross-sectional study in the hospitals that receive the highest proportion of the trauma cases from traffic accidents in Porto Alegre, for a sample of non-fatal traffic accident victims treated in the city hospitals. Data collection took place between October 10 and November 19 of 2008 at Hospital de Pronto Socorro (HPS) and Hospital Cristo Redentor (HCR)[3].

All the traffic accident victims over 18 years old that entered the hospital in the data collection period were invited to take part in the study. A structured questionnaire was used for the approach, considering socio-demographic data on the accident, consumption of alcoholic beverages and

Figure 2- Organization Chart to obtain data



EPTC - Empresa Pública de Transporte e Circulação; DML – Departamento Médico Legal e DPTRAN - Departamento Estadual de Polícia Judiciária de Trânsito.

[1] *The categorization used here follows the traditionally used literature ,however an alternate categorization is proposed by Drummond et al. (2005), subdividing costs into "health care sector costs " and "other sectors" of "patient and family" and "loss of productivity". The choice of one categorization or another should be made so as to achieve the proposed objectives most adequately (Rascati, 2010).*

[2] *Victims not injured at the time of the accident are not considered.*

[3] *According to data obtained from the Mobile Emergency Care Service of Porto Alegre - Serviço de Atendimento Móvel de Urgência de Porto Alegre – SAMU, in 2006 about 66.3% of the victims were sent to HPS, 32.7% to HCR and 1% to several other units.Therefore, based on these data ,collection was planned for the two first . Data collection was not simultaneous in both hospitals for logistical reasons, since data collection took place 24 hours a day.*

other psychoactive substances. The individuals could agree or not to being tested for blood alcohol with breathalyzers as well as undergoing tests for other substances through saliva data collection and, in cases where the individual could not supply this, urine tests were performed. Details on this data collection can be found in Chapter IX.

To obtain the costs and loss of productivity related to the accident the victims were invited to supply their personal identification data such as personal identification and phone number besides authorizing access to the emergency and normal medical records[4], and to participate in a phone contact once a month during the first six month after the accident. A monthly approach was considered adequate to avoid the person forgetting the description of the costs and morbidity caused by the traffic accident and remaining able to describe them more precisely.

Of the total sample 563 victims (81% of the victims approached and invited to take part in the study) authorized their participation in this stage of the survey. In all these cases information was collected from incident reports and medical reports, containing data on the consequence of the accident as well as the cost of the initial treatment of the victims, both in the emergency units and in hospital where necessary. Four cost categories were considered to measure these costs: 1) Medical fees; II) fees and hospital stays; III) Materials and medicine; IV) Diagnosis and therapy (psychotherapy, physiotherapy, etc.)[5].

A structured electronic questionnaire encompassing different data blocks was used for monthly follow up by telephone interviews[6]: I) Identification of the individual and "Informed Consent" that was read and explained to the individual at each phone contact, enabling him to desist from participating if he felt uncomfortable in spite of the initial consent obtained in hospital; besides this all the interviews had a rolling consent, i.e., a consent by stages throughout the interview allowing the interviewee to stop answering questions at any time; II) Registration data with questions to complement information obtained at the initial interview (see Chapter IX) and which were only asked at the first contact; III) Data related to property damage, also only in the first month; IV) Data related to medical-hospital costs used in the contact throughout the six months; V) Data concerning the loss of productivity (lost work days and other activities) collected for 6 months after the accident[7].

A phone contact was attempted with all the victims that had authorized it, however the answer rate the first month was 69.6% (392 victims) and of these contacts 92% yielded finalized interviews and 5.8% dropped out. In 2% of the cases the interview began but for several reasons was not finalized and a new contact was not possible. The non-answering occurred for various reasons, such as, wrong phone numbers, situations where on finding out what the phone call was about requested to be called at a different time and would no longer answer the phone, among others. In the cases where the interview continued, in subsequent months (for the cases where accident related costs were foreseen for the next month and fulfilled some criteria for the current month) a refusal rate of 4% arose at each new contact.

After data collection these were processed together with the data from the emergency and normal medical records. Three hospital treatment and post-hospital cost invoicing scenarios were established to measure costs, involving rehabilitation and later treatment or medical procedures for sequelae of accidents. The first used the price in force for the SUS (Unified Treatment System) . The second one used the 1999 List of Medical Procedures of the AMB (Brazilian Medical Society) (AMB,1999) which is currently used for the Compulsory Personal Damage Insurance for Land Motor Vehicle (DP VAT) to cover expenses with proven medical-hospital treatment[8]. Finally the values of the fifth edition of the Classificação Brasileira Hierarquizada de Procedimentos Médicos – CBHPM (Brazilian Hierarchical Classification of Medical Procedures) (AMB, 2008) were applied. Besides this, concerning medication costs in all scenarios the Brasíndice Table published at the time of the data collection (October to November 2008) (Brasíndice, 2008) was used. Loss of productivity was based on the salaries informed by the victims themselves.

Sub-Study 2 – Rescue Units and EPTC

The data on rescue costs were obtained from public entities that are responsible for police procedures at the place where the traffic accident occurred. This process is shown below:

1. Rescue consists of the first medical attention to the victim and transporting him to hospitals, which, in Porto Alegre, is carried out by Serviço de Atendimento Móvel de Urgência – SAMU, which made its cost structure available for estimating the average value per event in the Porto Alegre unit.

[4] Data were collected in the treatment files for outpatient cases and medical charts when the victim was hospitalized.

[5] Available at the site of the Observatório Brasileiro de Informações sobre Drogas (OBID) of SENAD.

[6] The phone calls were made through the SKYPE software and also through conventional phones and cell phones. The data collection structure that required Internet connected computers was at the Faculdade de Economia O(School of Ecnomics) at Universidade Federal do Rio Grande do Sul on the premises of the Economy Post-graduate Program.

[7] Available at site www.obid.senad.gov.br

2. EPTC, the company responsible for regulating and inspecting transportation and traffic related activities in Porto Alegre, and which is called on whenever there is a traffic accident. EPTC has a constantly updated database with several variables both as to accidents and victims. Therefore, the average cost of this activity was considered , data being delivered by this entity[9].

3. The costs of hauling away vehicles that had been involved in accidents as well as the daily charges for the impound lots were obtained from the Departamento Estadual de Trânsito – DETRAN-RS (Traffic Department of the State of Rio Grande do Sul).

Sub-Study 3 – Medical-Legal Department and DPTRAN

Concerning fatal traffic accident victims in the city of Porto Alegre, costs due to loss of productivity were estimated from data that were contained in the police incident enquiry reports on manslaughter caused by the traffic accident file in the DPTRAN (traffic police) for 2007. The fact that weighed most in choosing the data for that year was the time, usually four months, that it takes for these reports to be filed (many take much longer, up to two years). This is one of the things that hindered data collection, the intention having been to use more recent information but it was not possible to use 2008 inquiries due to this problem.

The problem can be perceived in the data collection of data in 2009, since in June of that year, 2007 case data were still being collected. An attempt was made to collect data directly from the DML(Medical Examiner's Office) but this entity's records do not have sufficient characteristics to draw up a profile of the victims and the accidents, just data on blood alcohol and basic victim data. The solution to arrive at a profile was to continue using DML data from the DPTRAN Data System. In view of the inconsistency between the two systems, and DPTRAN access depending on an employee, data collection from DPTRAN is as yet not concluded and therefore will not be described in this book. The data collected from DML-DPTRAN are from July 2008 to June 2009.

Data collection began in October 2007, after pilot studies had been made. We had the support of DPTRAN to carry out data collection, through their allowing us to access police inquiries against an undertaking by all the collectors to maintain confidentiality. The final version of the questionnaire is available to interested parties[10].

Loss of productivity from fatal victims was calculated using the Human Capital methodology, and based on data such as age, gender, life expectation and income, the loss of productivity was estimated for the fatal victims. The age and gender data were obtained from the DPTRAN data collection while the life expectancy from IBGE table of Life Expectancy and income data were taken from PNAD 2006 (IBGE, 2007). The mortality costs are measured as a function of the time potentially lost and calculated from an estimate of future gains by the affected workers. This involves using a discount rate of 5% suggested for Brazil by the Ministry of Health (Saúde, 2007). The average annual income of R$ 15,066.45 was considered and the loss of productivity for fatal traffic accident victims in the city of Porto Alegre in 2007 was considered, updating the values for 2008.

Data Extrapolation

In order to calculate total costs, the average cost of each component is calculated and then extrapolated based on information supplied by EPTC as to the total number of traffic accidents w in the city of Porto Alegre, for 2008, with non-fatal victims (injured) over 18 years old according to the victim situation (driver, passenger or pedestrian) and type of vehicle involved. These data are presented in Table 1.

Table 1 – Information for data extrapolation.

Variable	Annual units and proportions
Victims of traffic accidents over 18 years old	6,664 (93% of total victims)
Injured > 18 years	6,531 (98% of 6.664)
Injured + post-death > 18 years	6,597 (99% of 6.664)
Injured according to victim situation in Traffic accident > 18 years	• Driver: 4,431 (66% de 6,664) • Passenger: 1,224 (18% of 6,664) • Pedestrian: 1,009 (15% of 6,664)

Source: EPTC

On the other hand, considering that the main objective is to estimate the social costs of traffic accidents due to

[8] *The compulsory insurance for motor vehicles - Seguro Obrigatório de Danos Pessoais Causados por Veículos Automotores de via Terrestre – DPVAT is an insurance policy covering victims for death ,permanent disability and medical-hopital costs caused by traffic accidents with motors (therefore ex cluding bicycles) . In the data collection period DPVAT could be used to compensate the Hospital Pronto Socorro (HPS) and only by emergency outpatients (therefore excluding hospitalized patients).At Hospital Cristo Redentor (HCR) treatment expenses were only invoiced y SUS. When patients managed to activate the DPVAT insurance the process of invoicing these costs was carried out according to the AMB 99 table which corresponded to the value to be reimbursed to the Hospital. Amongst those receiving emergency treatment at HPS (365) 20.27% (7ª persons) had invoicing finalized by the AMB99 table, to be covered by DPVAT insurance.*

[9] *The Military Police is also present in accident cases with victims. They are responsible to the DPTRAN for recording such events. The latter follows-up the investigation. The costs of these procedures have so far not been obtained and therefore will not be taken into account in this study.*

[10] *Available at www.obid.senad.gov.br*

alcohol abuse, an epidemiological tool was used to derive the percentage of traffic accidents that can be attributed to abusive alcohol consumption. For this the Population Attributed Risk (PAR) was estimated (Tsuang and Tohen, 2002), which refers to the probability that a person exposed to a risk factor (in our case alcohol) will be in traffic accidents more frequently than a person that has not been exposed to alcohol.

In this case, considering the lack of information in Brazil concerning the relative risk of traffic accidents caused by alcohol consumption, the Relative Risk factor was not calculated. Therefore, based on a revision of international literature Relative Risk was considered 4.9 as estimated in Petridou et al. (1998).

Results

The data will be presented below in two subsections. In the first the socio-demographic characteristics and those of the accident are shown, both in the sample of non-fatal victims and in the population of fatal victims. The second analyzes the cost of total traffic accidents and the costs associated to alcohol consumption.

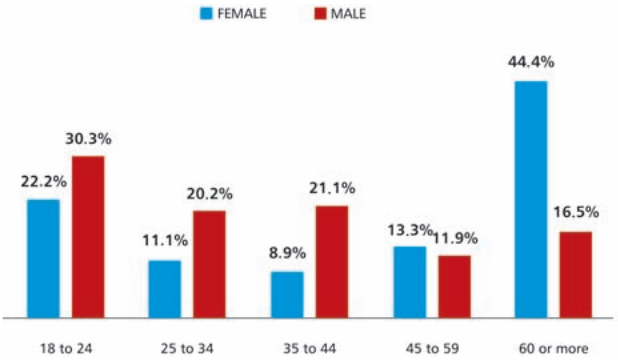
Characteristics of the Victims and the Accidents

Fatal victims

The data collection of inquiries allowed a full study of fatal traffic accidents to be carried out, since it covers data both of the victim and the accident and blood alcohol (the data include DML reports). Data collection showed 170 cases for Porto Alegre in 2007. However having separated victims under 18 years and cases still unfiled as of June 2009, the database ended comprising 155 cases. In relation to fatal victims, the profile was majority (mostly)male (71%), caucasian (82.5%) and single (64.2%). Average age of the victims, not taking under 18 years into account, was 40.77 years, the mode - most common value - , being 21 years. Most of the victims were 18 to 24 years old. (27,9%), i.e., young. However the age group of people over 60 was the second most frequent with 24.7% of the cases.

It was also ascertained that the male victim percentage is greater in the 18 to 24 year age group while female victims are more common in the age group of 60 years, as shown in Figure 3.

Figure 3 – Gender by Age Group



Blacks had less chance of suffering traffic accidents than caucasians although they were more relevant than types of color. This result is within the expectations considering the composition of the Porto Alegre population. After single men, married men are the second most frequent marital status (23,20%), divorced, widowers, stable unions and others being less significant (Figure 4a and 4b).

Figure 4a. Color

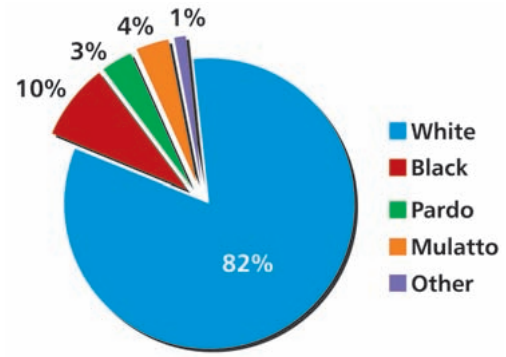
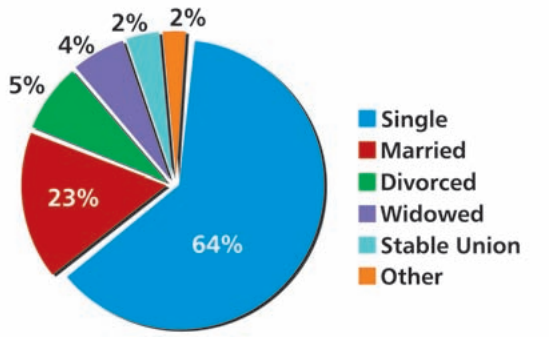
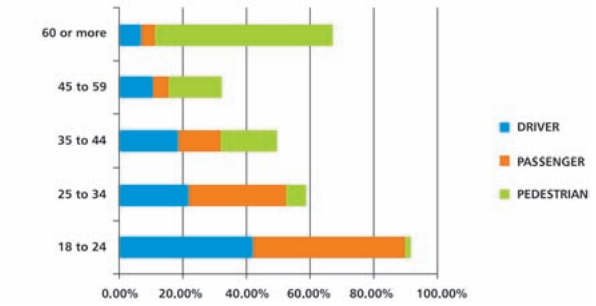


Figure 4b. Marital Status



Another major characteristic of victims is the situation in the traffic accident. Most victims were drivers (47.7%). Pedestrians came second with 37.4% and passengers were the least frequent (14,8%). The group with the most drivers and passengers was 18 to 24 while most pedestrians were in the age group above 60 (Figure 5). It was also observed that 63.5% were driving motorcycles and 56,5% of the passengers were in cars, the second largest category for drivers.

Figure 5 – Situation and age group in traffic accidents



Among professions, commerce was the most representative (8.8%). Other characteristic victim professions were homemaker ('housewife'), 5.4% and driver, 4.1%. In the case of approximately 30% of the victims it was not

possible to find information about a profession. Another item of information that is extremely important and that practically is not available in police reports on fatal victims is their level of schooling[11].

As to the type of traffic accident the most common was someone over (39.4%), followed by collisions between moving cars from the side or transversally (22.6%) (Figure 6a). Most accidents involved a single vehicle (60.8%). Such cases involved as much pedestrians as collisions against something public and falls from motorcycles. On the other hand, the type of vehicle with the highest percentage of victims was motorcycles (35.5%). However there were almost equivalent numbers of pedestrian victims (34.8%). Cars took third place with 19.4% (Figure 6b). This result shows that motorcyclists and pedestrians should be the subject of public policies in traffic accident prevention.

Figure 6a. – Types of traffic accident

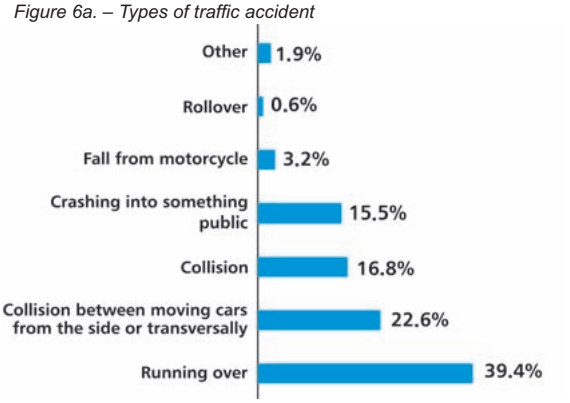
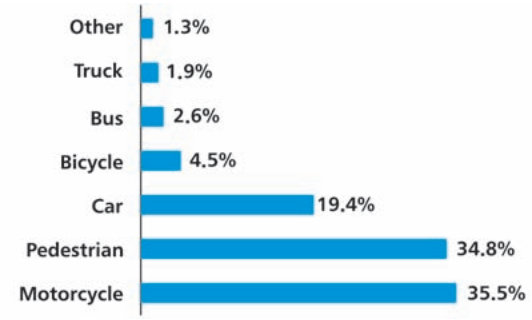
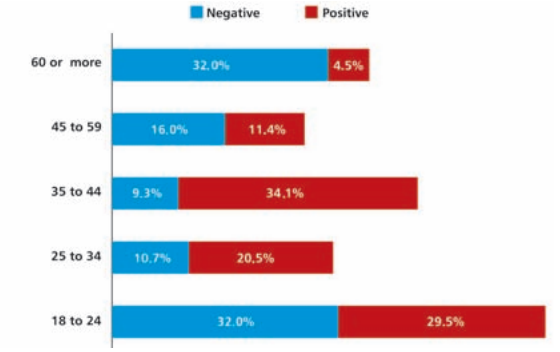


Figure 6b – Types of vehicle



The blood alcohol prevalence was 36.7% in victims, showing that alcohol is a very significant factor amongst causes of traffic accidents. The average alcohol level with a positive prevalence was 6.61 dg/l (above the level that before the "Dry Law" was considered serious). The average victim age was lower than the average of the full sample, falling from 40 to 34, indicating that, considering traffic accidents, blood alcohol is more closely related to younger people. The age group with the highest prevalence of positive blood alcohol was 35 to 44 years, although most fatal traffic accident victims are in the 18 to 24 year age group (Figure 7).

Figure 7 – Blood Alcohol by age group



Among victims with positive blood alcohol, the most frequent type of accident was collisions between moving cars from the side or transversally (27.3%). There is a big difference here between the most common type of accident as far as fatal victims is concerned which was running-over. This type of accident is percentually less frequent considering only drunken fatal victims, falling from 39.4% to 25%. Another great differential as to this positive blood alcohol criterion was for the type of crashes against lamp-posts which was the same as collisions between moving cars from the side or transversally in the first position with 27.3% frequency each. Collisions were 13.6% of the total, a percentage similar to the total sample (16.8%).

As to the type of vehicle the victim was in, considering only positive blood alcohol, motorcycles are still in the first place with 36.4% - a similar percentage to the total sample (35.5%). However pedestrians, who previously showed a high percentage, almost on a par with motorcyclists, fell from 37.4% to 25%. On the other hand cars rose in percentage from 18.7% to 31.8%. Therefore pedestrians are the least related to blood alcohol among fatal victims.

Non-fatal victims

Besides the socio-demographic data shown in Chapter IX concerning the sample obtained in Porto Alegre's Emergency Hospitals, HPS and HCR, the second block in the questions of the electronic interviews provided the information that 56% of the victims treated said they were single, 32% married and the remainder were divorced , separated or widowed. However 52% of the victims had a dependent person. This is relevant information considering that besides the suffering caused by the accident there is a greater possibility that family and dependents will be harmed in view of the risk of death or loss of income and employment by the victim, since 84% stated that they did remunerated work before the accident. Of these workers 7% lost their jobs and 28% began receiving less income than before the traffic accident (Figure 8a).

[11] *In conversation with DPTRAN workers it was found that investigators are not in the habit of bothering with this information although it is a differential to establish an individual's earnings.*

Figure 8a – Proportion of victims that lost income after traffic accident

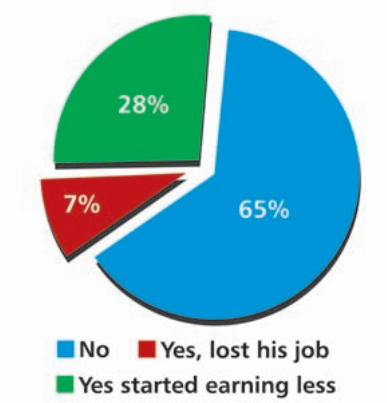
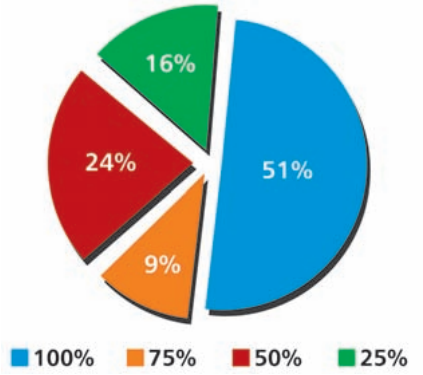


Figure 8b – Proportion of victims with loss of income by loss percentage



Of those suffering losses due to diminished income after the accident, more than half (51%) lost 100% of their income (Figure 8b). This condition represents an even greater loss to the victim and his family considering that after the accident they must cover expenses with medication, crutches, wheelchairs other treatment, doctors or in some cases, cover the expenses with damage to their own or another party's vehicle.

Of the interviewed victims 11.2% said their profession was that of "motoboy", 5.7% said they were professional drivers (of taxis, trucks or another vehicle) , which suggests that besides a large percentage of victims being drivers they drive professionally and end up being much more exposed to accidents than other drivers. The specificity of the profession itself, with its call for speedy and flexible deliveries conspires to cause such professionals to adopt a risky behavior.

Of the traffic accident victims involving some kind of vehicle, 77% stated that the vehicle suffered damage, and in 71% of the cases it was their own vehicle. (Figure 9a). However it is shown that in most accidents (73%) the victim was in an uninsured vehicle (Figure 9b). Therefore besides the other health related expenditures and the possible income reduction that were mentioned the victims had to defray costs generated by vehicle damage.

Figure 9a – Vehicle in which victim suffered injury

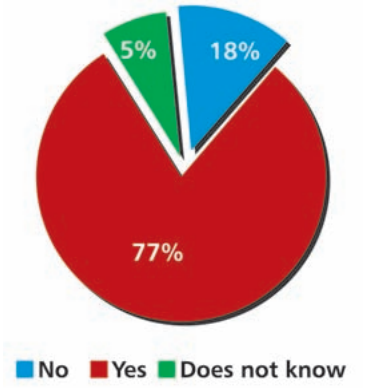
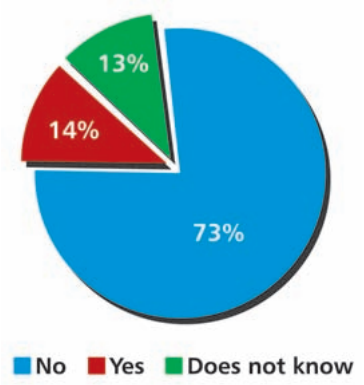


Figure 9b – Proportion of victims who said that the vehicle was insured



Cost of traffic accidents

Of the 563 who agreed to take part in the cost study, 10.9% were victims who were admitted to hospital which is a sign of the severity of the traffic accident. On the average they were 9.3 days in hospital, the average cost of treatment in the hospital being R$987.23, paid by SUS, which is a conservative scenario. However considering solely the people from the urban perimeter of Porto Alegre the value goes down to R$466.93 (average hospitalization of 4.3 days). However for victims of accidents in other cities in the area that were brought to HPS or HCR the amount increases to R$1,997.68. Therefore it can be perceived that the most serious accidents with higher medical-hospital costs were those that took place outside the Porto Alegre urban area.

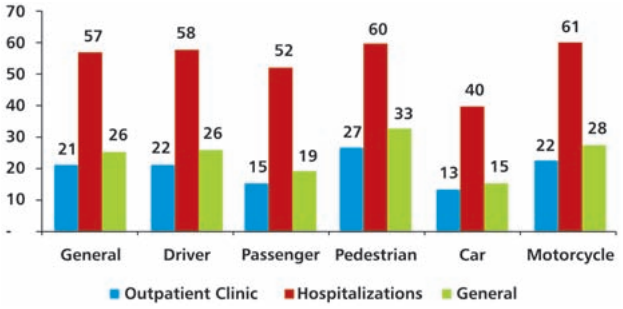
The medical costs due to both outpatient care and hospitalization increase further considering those generated after discharge from hospital, such as medical and surgical revisions, the purchase of medications and, later physiotherapy, among others. Thus Figure 10 shows the average values of total medical costs, including those generated in the initial hospital care, later medical expenses and those on locomotion for health care, besides other medical costs such as wheelchairs and crutches.

The highest medical costs per victim situation in all the invoicing scenarios were those of pedestrians, however, when dealing with hospitalized victims the highest costs are among the drivers. By vehicle type the costs are higher in the case of motorcyclists who represent 63.9% of hospitalizations, with an average hospitalization cost of R$1,911.27 (at SUS prices).

Even if medical costs are relevant and may represent a high proportion of the total cost of traffic accidents, there are greater losses generated later due to the victim's absence from work, loss of income to repay third party damage, upset to family members considering care given during rehabilitation, besides the damage to economic dependants. All such costs were estimated using the interviews by phone, it being possible to improve the victim profile and infer costs associated with the traffic accident after discharge from hospital.

The results in Figure 11 show that the interviewed victims lost an average of 26 workdays due to the traffic accident and more days when there was hospitalization (57 days). Emergency service patients, who received care on the day of the accident, might be expected to have a minimum loss of workdays because apparently they are less severe, however it can be seen that on the average they lost 21 days. Considering the victim situation in the accident, pedestrians lost most, both among those hospitalized (60 lost days) and amongst those treated as outpatients (27 days). Likewise, greater loss of workdays occurred in the case of accidents involving motorcyclists who were hospitalized (61 days).

Figure11 – Workdays lost by traffic accident victims according to hospital situation and vehicle.



Note: Average medical values calculated by phone interview of victims.

On the whole, it was noticed that the motorcyclists were the most serious traffic accident victims, requiring hospitalization. At the same time they were the ones who generated the highest costs through lost workdays, on the average R$3,296.25, above the average for hospitalization (R$2,553.09).

Total costs to society

In the city of Porto Alegre traffic accidents caused a social cost of R$66,445,528.63 in 2008 (at 2008 prices) according to the more conservative scenario for SUS medical costs (Table 2). Of this total cost the larger part are indirect costs (76.2%), due to loss of productivity and premature death of the victims and inability due to morbidity. On the other hand, direct costs were 23.8% of the total cost distributed amongst medical costs (6.5%) and the costs of other sectors such as the tow car to haul the vehicles away, property damage and rescue services (17.2%).

Considering total costs in the CBHPM scenario, which represents costs closer to market value we found that they are higher by a proportion of 8.2% than those estimated via SUS invoicing. This is due to the greater weight and detail allowed in measuring by CBHPM for medical-hospital costs, which represent 13.7% of the total cost in this scenario, a proportion twice the percentage of the same cost item in the SUS scenario.

On the other hand, the cost of traffic accidents associated with alcohol abuse were estimated considering the population attributed risk (PAR) for which a relative risk of 4.9% was considered (Petridou et al.,1998), and a prevalence of alcoholemia in non-fatal victims of 7.7% and for fatal victims of 36.7%.Therefore the cost of traffic accidents that can be attributed to alcohol consumption is R$31,.443.,367.91 (Table 3).

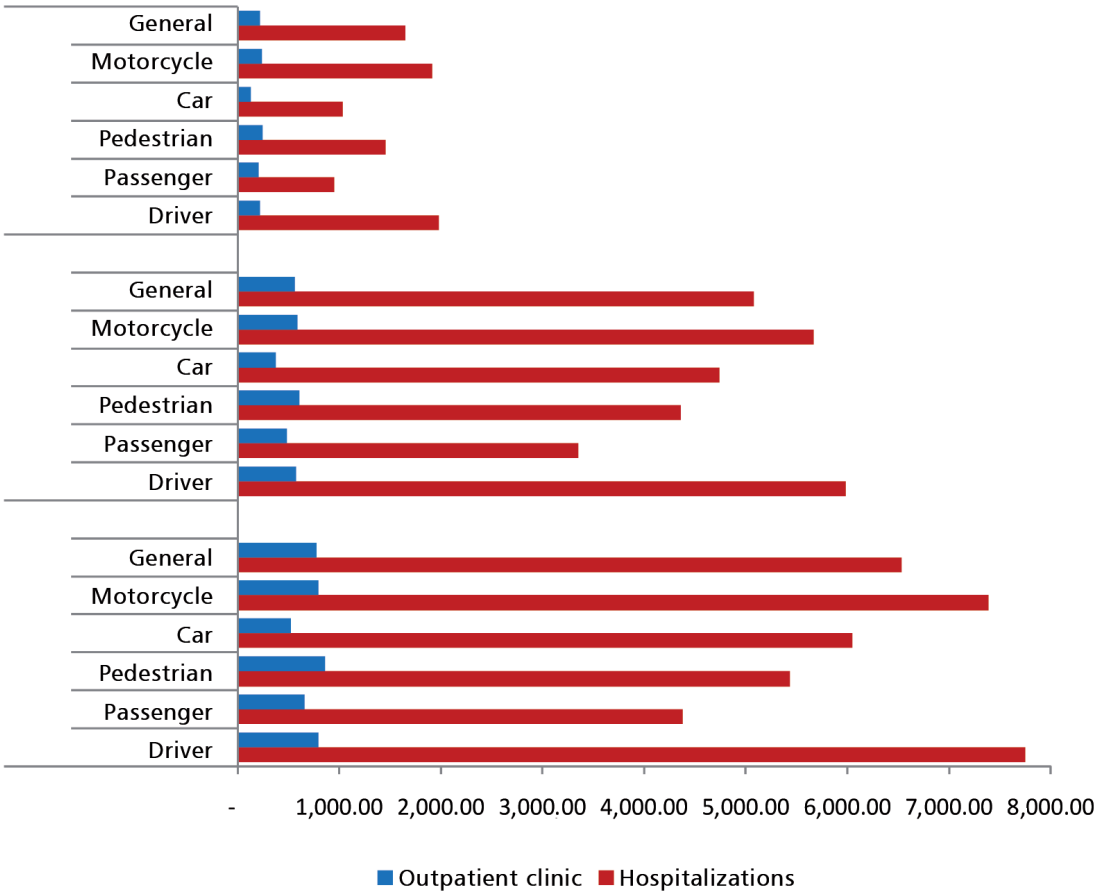
Table 3 shows that the cost of accidents due to alcohol abuse corresponds to almost half the global cost at a proportion of 47.3%. It should be noted that the costs increase when considering loss of productivity through death of victims, which represents 39.9% of the total cost. This is due to the greater prevalence of alcohol use amongst the fatal victims. This shows that alcohol abuse can cause more serious accidents because they lead to deaths and that they, in turn, may cause much higher costs from the perspective of society.

Conclusions

The estimates show that traffic accidents generate high costs for society, however almost half such accidents are caused by alcohol consumption, which means that costs can be lowered in that proportion by removing the exposure factor "alcohol". Thus the results are relevant as references to define public policies aiming at reducing traffic accidents and drinking.

On the other hand, one of the difficulties encountered in collecting secondary data was the fact that some information had not been completed in the consulted documents, therefore part of the contribution of this study concerns the need to establish the habit of investigating, questioning, asking and completing useful information for different kinds of survey such as the education variable that is used to estimate the incomes of individuals.

Figure 10 – Total Medical Costs in three invoicing scenarios, by situation in hospital, at accident and by vehicle (Reais)



Note: Average values in 2008 reais

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Table 2 – Summary of the total cost of Traffic Accidents (Reais 2008)

Costs	Number of Units	Total Cost SUS	%	Total Cost AMB	%	Total Cost CBHPM	%
TOTAL COST		**66,445,528.63**	**100**	**69,981,223.87**	**100**	**71,925,254.17**	**100**
Direct Costs		**15,796,021.35**	**23.8**	**19,331,716.60**	**27.6**	**21,275,746.90**	**29.6**
Medical Costs		**4,349,042.90**	**6.5**	**7,884,738.14**	**11.3**	**9,828,768.44**	**13.7**
Outpatient Costs*	5.821	306,978.76	0.5	1,215,051.52	1.7	1,619,700.05	2.3
Hospitalizations*	717	334,956.90	0.5	1,251,269.53	1.8	1,722,682.65	2.4
Medical (post-emerg)*	6.531	1,368,642.99	2.1	3,079,952.86	4.4	4,147,921.50	5.8
Cost of Rescue - SAMU	6.664	2,338,464.24	3.5	2,338,464.24	3.3	2,338,464.24	3.3
Non-Medical Costs		**11,446,978.46**	**17.2**	**11,446,978.46**	**16.4**	**11,446,978.46**	**15.9**
Locomotion	6.531	429,329.53	0.6	429,329.53	0.6	429,329.53	0.6
Rescue Cost - EPTC	6.664	404,238.24	0.6	404,238.24	0.6	404,238.24	0.6
Damage to Property	2.155	2,112,896.90	3.2	2,112,896.90	3.0	2,112,896.90	2.9
Removal and Vehicle Impound	6.901	8,500,513.78	12.8	8,500,513.78	12.1	8,500,513.78	11.8
Indirect Costs		**50,649,507.27**	**76.2**	**50,649,507.27**	**72.4**	**50,649,507.27**	**70.4**
Due to Morbidity							
Lost Workdays	33 .932	5,649,240.77	8.5	5,649,240.77	8.1	5,649,240.77	7.9
Due to Mortality							
Deaths	155 5881 years of life	45,000,266.50	67.7	45,000,266.50	64.3	45,000,266.50	62.6

Note: The only costs considered are those of victims over 18 years old and the cost of accidents on Porto Alegre streets and fatal victims for 2007. Monetary values in 2008 reais.

Table 3 – Summary of Total Social Costs of Traffic Accidents that can be attributed to alcohol.

Costs	Total cost that can be attributed to Alcohol SUS	%	Proportion (%) of cost that can be attributed to alcohol over total cost
TOTAL COST	**31,443,367.91**	**100**	**47.3**
Direct Costs	**3,647,301.33**	**11.6**	**5.5**
Medical Costs	**1,004,194.01**	**3.2**	**1.5**
Outpatient Costs *	70,881.40	0.2	0.1
Hospitalizations*	77,341.55	0.2	0.1
Medical (post-emerg.)*	316,019.67	1.0	0.5
Cost of Rescue - SAMU	539,951.39	1.7	0.8
Non-Medical Costs	**2,643,107.33**	**8.4**	**4.0**
Locomotion	99,132.19	0.3	0.1
Cost of Rescue - EPTC	93,338.61	0.3	0.1
Damage to Property - vehicles	487,867.89	1.6	0.7
Removal and Impound - vehicles	1,962,768.63	6.2	3.0
Indirect Costs	**27,796,066.58**	**88.4**	**41.8**
Due to Morbidity			
Loss of Workdays	1,304,409.69	4.1	2.0
Due to Mortality			
Deaths	26,491,656.89	84.3	39.9

Note: The only costs are those of victims over 18 years old. Monetary Values in 2008 reais.

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Valuing the benefits of reducing the risk of injuries and deaths due to traffic accidents caused by alcohol consumption in Porto Alegre

Tanara Rosângela Vieira Sousa, Sabino da Silva Pôrto Junior

There are at least three approaches to the economic valuation in health outcomes: the human capital method, the method of revealed preferences[1] and the method of contingent valuation. In the human capital method, health care programs are considered as investment in human capital, and the economic value is quantified in terms of qualification (in this case improved health status) of individuals and increased production[2].

The contingent valuation or "willingness to pay" – WTP – studies present to the responders or interviewees, hypothetical scenarios on the problem or program being evaluated, inviting them to consider the possibility that a market for such a program or health benefit might exist, and thereby inducing them to reveal the maximum they would be willing to pay for this good (Drummond et al., 2005).

Therefore WTP is a value measurement based on the premise that the value of a good is simply what it holds for those who consume and the subjective benefit that can be extracted from it. Thereby the amount that an individual is willing to pay in order to not be without access to a certain specific good can be higher, lower or equal to the costs of this good, and will vary from one individual to the other, besides possibly being reduced as a function of the quantity of this good already held by the individual. This methodology is used for goods for which no defined market exists but it can be presumed that theoretically, the goods could be evaluated exactly like goods sold in the marketplace[3]. (Krupnick, 2002; Alberini et al., 2004; Alberini, 2005)

Besides, many of these goods for which there is no explicit market, are considered "public goods" – goods whose benefits are simultaneously taken advantage of by many people, much as, for instance, the reduction of the adverse effect to health of exposure to a particular disease. According to this alternate vision, the value of the health risk reduction is the sum of the WTPs of all the individuals (Krupnick, 2002).

Therefore, besides allowing individuals to reveal what they would be willing to pay to reduce risk to themselves, the methodology of contingent valuation also reveals the WTP for risk reduction for other people or for society as a whole, thereby identifying an altruistic component especially in the case of severe disease or risk of disability or death.

The WTP for risk reduction assumes that individuals use their subjective perception of risk to determine it; therefore in the study we develop here, individuals are questioned about their perception of risk associated with the combination of traffic and the consumption of alcoholic beverages. The "risk" concept is very important in behavioral studies both concerning health and any other area of economic activity, since choices under uncertainty are part of the individuals' daily life. Moreover, individuals have different 'perceptions' and 'preferences' of risk, which partially explains the diversity of choice available, even in an environment of uncertainty.

It is understood that the perception of risk by individuals manages to reflect real risks. In the absence of external effects, it would then be possible to obtain optimum results – from the point of view of society. However risk perception by individuals can be developed in a wrong way, which would carry systematic biases, for instance, with small magnitude events being overestimated or the contrary. Using the perspective of "Welfare" it is possible to diminish these deficiencies in risk perception by supplying information on the real risks to which individuals are exposed, thereby encouraging them to make decisions that will reflect the quantity of information they have received (Viscusi, 1990; 1991; Viscusi and Hersch, 2001; Lundborg and Lindgren, 2002; Lundborg and Andersson, 2008).

[1] *The studies that use the method of revealed preferences examine the relationship between health risk as a function of possible work accidents, and the salaries that individuals demand in order to accept it, which are based on individual preference and choices of the present consumption (Drummond et al 2005).*

[2] *See Chapter XIV for further details on this method.*

[3] *In the case of the goods market, the comparison between the price and WTP determines if the good is bought or not: if the price is lower than the WTP the individual will buy it, receiving the "consumer surplus", if the price is equal the consumer will also consume it, but if the price is higher the individual will not purchase the good.*

These aspects of the process of choice are particularly noticeable in the consumption of alcoholic beverages since individuals make choices as to the quantity alcoholic beverages consumed and afterwards perform certain actions – that end up by characterizing risk behavior, such as driving, exposing themselves to relationships that could result in violence consuming other psychoactive substances and exposure to STDs. The consequences to society of these actions and/or decisions end up involving situations that are very far from the social optimum, since they generate costs to the individual and to society. These costs appear as direct costs , resulting from medical costs, material damages and for other economy sectors, loss of productivity due to mortality and morbidity, besides intangible costs such as grief due to the premature death of a loved one. The latter are not taken into account in most economic evaluations on health in view of the difficulty in measuring them.

The study described here adds information to the analysis of the impact of unrestricted access to alcoholic beverages in Brazil, as one of its objectives is the investigation of the Porto Alegre population's perceptions of the risk of being involved in a traffic accident in which there is an association with alcoholic beverages and risk behaviors in traffic, thereby enabling measuring and estimating the willingness to pay for a reduction of the risk of suffering injuries due to traffic accidents. A feasible byproduct of these results is preliminary forecasts of the probable intangible costs of traffic accidents.

Method

A cross sectional study was carried out in the city of Porto Alegre to measure the WTP for a risk reduction of traffic accidents linked to alcoholic beverage consumption. A face to face interview was structured in three blocks whose variables are described in Table 1.

The questions on risk perception were asked in two stages: I) Perception of the risk of being in a fatal accident; II) perception of the risk of being in an accident after consuming alcoholic beverages. The questions were presented to the interviewees as follows:

- Ia) the objective risk of dying in a traffic accident in Porto Alegre was presented – 11 in 100,000[4] – and the interviewee was asked to reveal whether he had a greater, lesser or equal risk (relative risk);
- Ib) with the information above and the presentation of a card with six group[5], the interviewee was requested to reveal in which risk group he considered himself to be (absolute risk) (questions based on studies by Kidholm, 1995; Persson et al., 1995);
- IIa) after this several actions related to drinking and driving, behavior on crossing streets and accepting rides from people who had been drinking were presented in a rising risk scale from one to five, as well as matters that are well within road users' daily lives: use of

Table 1: Structure of the interview and variables of interest

I – Individual Characteristics
Gender, age, district of residence, color, marital status, family relationship, schooling, occupational status, profession, family income and religion.
II – Personal Experience
Behavior in traffic
Time in traffic, vehicle used daily, drive according to type of vehicle, use of lifts and frequency, use of seat belt and helmet, driver's license.
Experience with traffic accidents
Of the interviewee (situation in accident and seriousness) and of family member and/or close person (situation in accident, seriousness and relationship to person in accident).
Alcoholic beverage consumption
Consumption of beverages by type and frequency, place of consumption and monthly expenditure (in reais).
Consumption of beverages associated with traffic
Return home after consumption, taking a flift with driver who drank, and driving after drinking.
Information
Information on the association of alcoholic beverages with traffic accidents and means of obtaining, information on the maximum limit allowed by law for blood alcohol for drivers.
Risk Perception
Perception of risk of fatal accidents and alcoholic beverage consumption associated with behavior in traffic.
III – Contingent Valuation
Willingness to pay for reduction of the risk of suffering three kinds of possible injury in a traffic accident.

[4] Based on data of the Empresa Pública de Transporte e Circulação (EPTC) for 2007.In order to have an idea of what this number represents in practical terms the respondent was shown a printed grid with 100,000 white squares each measuring 1mm² and only 11 painted squares – the strategy used in this kind of study.

[5] The tracks were: 0 to 5, 6 to 10, 11, 12 to 15, 16 to 20, 21 and +. All with the 100,000 denominator usually used in epidemiological risk presentations.

pedestrian crossings, safety belts and helmets (subjects based on the studies by Glik, Kronenfeld et al., 1999; Rosenbloom, Shahar et al., 2008), requesting that the perceived risk for each situation be assigned to each action;

- IIb) the perception of risk of traffic accident due to alcohol consumption was questioned by asking the following: "For every 100 people who drive after drinking 2 doses of any alcoholic beverage how many do you feel could suffer a traffic accident?"[6]

The third block of questions, of contingent valuation, consisted of the presentation of three hypothetic scenarios describing both the disease and the benefits of the intervention and/or regulation that was suggested besides presenting a vehicle or means of payment[7]. As one of the objectives of the study was obtaining the intangible costs of traffic accidents, the respondent was also requested to not take into account expenditures on medical-hospital treatments, losses of salary and time and also the fact of having some kind of life or vehicular insurance, thereby only considering pain and suffering from a possible traffic accident.

All the scenarios presented described different types of injury caused by an accident in a simplified form but one by which the individual could perceive the differences between scenarios. The option chosen as the vehicle for payment was defined as good 'private' (such as an airbag that, instead of only being used in vehicles could be also used by pedestrians, motorcyclists and cyclists and that would be deployed in case of accident, reducing injuries by different levels) that could not be confounded like taxes and rates, due to marked refusal and protests regarding a supposed "contribution[8] " at the time of the pilot study[9].

Thus, after the explanation of the general purpose of the study, the first question was "Would you be willing to pay for this device to reduce the risk of injury in a traffic accident?" If the answer was positive[10] the first hypothetic scenario was presented to the respondents with the following question: "Consider an accident where you would have to remain in hospital for a few days and stop your usual activities (work, study, etc.) for at least 3 months with continued physiotherapy for another 6 months. What is the highest amount you would be willing to pay to reduce such a risk by half?"

Also for the purpose of reducing the average interview time and the number of unfinished questionnaires, when the interviewee answered the above question, for the second scenario the tone became more serious. "And if this device could reduce the chance that you would suffer an even more serious accident such as, for instance, one where you would lose the use of your legs, how much would you be prepared to pay to reduce such a risk to one third?" The third and last scenario confronted the respondent with the "willingness to pay" to reduce the chance of a fatal accident to zero.

After each question a "payment card" with 26 different values (obtained in the pilot research) was shown besides the option of "any other value[11]". The model using payment cards is one of the forms of obtaining a WTP in a study of contingent value. In this methodology the questions can be open or closed. The open questions have the advantage of supplying maximum WTP directly and have as most common formats free bids, payment cards and bidding games. The closed questions, on the other hand enable respondents to only state if they wish or not to pay a single price amongst a set of predetermined prices – but close to what happens in markets (Mitchell e Carson, 1989; Rascati, 2010).

For the monetary values presented in this chapter, the exchange rate for 2008 should be taken into account. This was US$ 1.00 = R$1.834.

Sample

The sampling by quotas of the population over 18 years old residing in Porto Alegre, took place in the period from August 04 to September 22 of 2009. The option chosen to obtain a sample that would contain the individuals from every stratum of the population was to use quotas based on age group (18 to 24 years, 25 to 34 years, 35 to 44 years, 45 to 59 years and over 60 years) and also on city regions (16 regions as per Observatório da Cidade de Porto

[6] *Question constructed as suggested in the literature (Viscusi, 1990; 1991; Lundborg and Lindgren, 2002).*

[7] *The payment vehicle is important as it explains how the respondent would effect payment.*

[8] *A pilot study was carried out to adapt the data collection methodology and the questions with 92 interviews in the city of Porto Alegre from the 16tyh to 22nd June 2009. 29.4% of the responders said they would not be interested in paying and 40.7% declared they would not want to pay as they already pay many taxes, charges and contributions.*

[9] *The means of payment for this device also was established so that the value could be used as an annual measure , in the form of rental and not as a purchase (as the durability would be raised in discussion and would make the annualization of the value difficult).*

[10] *If rejected the reason for not being willing to pay for such a device was discussed.*

[11] *This vehicle option for bids was used to increase the response rate as it confronts the respondent with an orderly sequence of bids where he chooses his highest WTP (Mitchell and Carson 1989, Rascati 2010). The average values obtained in the WTP pilot study were less seriousness - R$ 381,20 (IC 95%: R$121.31-R$641.08); average seriousness - R$ 583.59 (IC 95%: R$267.89-R$899.29) and highest seriousness - R$1,229.35 (IC 95%: R$489.91-R$1968.78).*

Alegre and Atlas do Desenvolvimento Humano da Região Metropolitana de Porto Alegre, called "regions of the Participating Budget"[12]). Thus 128 quotas were obtained with the percentage distribution of the estimated population for each on of them. The size of the sample was estimated at N=1067[13].

The interviews were made at places with a heavy circulation of people (such downtown, plazas, parks, streets with large circulation), the selection criterion being district of residence (for later region identification), gender and age group. The data collection team was composed of 11 trained interviewers using hard copies of the questionnaire (supported by colored cards to present extra information to the respondents), that were entered by the interviewers themselves at a site developed for data storage. Later the data was processed by Excel and SPSS softwares version 16.

Results

Socio-demographic Profile of the Sample

The interviewers' approach yielded a sample of 1,132 entered cases; after the data base had been cleaned. 1,104 interviews had been completed up to at least the second block of questions. The interviews lasted on the average 13.5 minutes.

The interviewees' average age was 39.9 years (CI 95%: 39.0-40.9) and 45.6% stated they were single, 39.3% married or in stable relationships, 10.1% divorced or separated and 6.1% widowers. The average family composition was 3.1 individuals (IC95%: 3.04-3.22) and 48.5% stated that they had dependents.

The number of years of schooling showed temporal[14] and gender differences only amongst the youngest where the women (between 18 and 24 years of age) had in average 7.8 years more years of schooling than the men.

As to the occupational situation 49.4% of the individuals stated they were employed, 14.8% were self-employed, 13.4% were retired, 10.9% were students (aged 18 to 24, 49% of the women said they were students against 35.5% of the men) and 8.9% unemployed – which is quite close to the rate of unemployment for the Metropolitan Region of Porto Alegre, estimated by the Pesquisa de Emprego e Desemprego (PED Employment and Unemployment Survey) for August 2009, of 8.8%[15]. The average monthly family income was R$2,881.98 (IC 95%: 2,703.36-3,060.61).

Behavior in traffic

Citizens of Porto Alegre spend about 12.5% of their days in traffic: the average daily exposure – as a driver, passenger/ lift beneficiary or pedestrian- is 2:59, men answering that they are longer in traffic – on the average 3:23 and women 2:32. This gender difference appears in the age group of 18 to 24 years (p= 0.064) and also in the groups above 45 years[16], as in the 18 to 24 years and 45 to 59 years a lower percentage of women work outside the home (the sum total of those that declared themselves to be employed or self-employed was considered).

The frequency with which the respondents drive also varies with the age group at 18 to 24 years and 25 to 34 years. Only 40.2% and 42.9% drive daily (Figure 1). According to Peden et al. (2004), the low frequency of driving amongst the young is a risk factor for traffic accidents, as they drive less and often in vehicles they do not know since they are usually loaned by family or friends.

Independently of whether they are used to driving, 46.6% of individuals had drivers' licenses, but of these only 82% drove – while 7.5% of those who say they drive currently had no drivers' license (amongst men between 18 and 24 this percentage rises to 26.7%)

As to the use of safety belts by drivers (only those who are used to driving) only 1% said that they never use it; of those who said they accept rides sitting on the front seat only 3% say they never use it. However of those who took rides and sat on the back seat only 34% reported always using the safety belt and 43% said they never use it. This is worrying because 41.5% of individuals of the people who accept rides, do so daily at least 1 or 2 times a week and the young are the main riders. Proportionally the use of helmets was greater amongst motorcyclists: 97.7% reported that they always use them as

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[12] *Available at : http://www.observapoa.palegre.com.br/.*

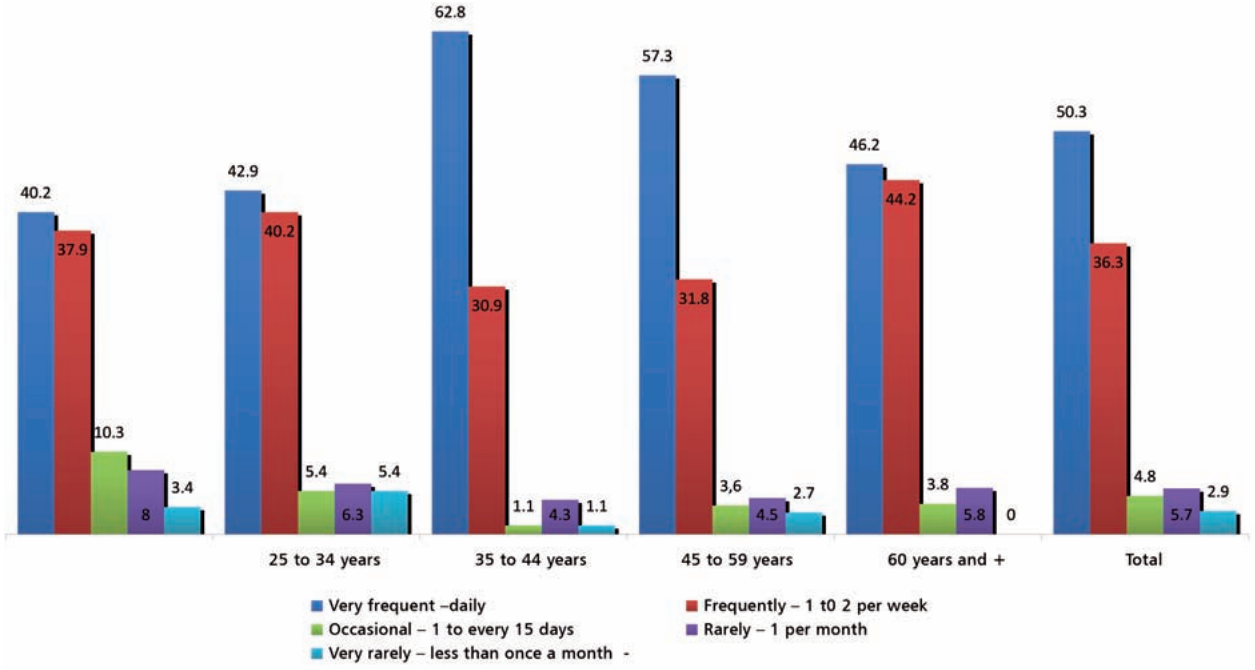
[13] *Considered error margin of 3%,confidence interval 95% and Porto Alegre population about 1.4 million inhabitants – IBGE survey for 2009.*

[14] *Average difference test by Kruskal Wallis – for non-normal distribution for age groups p=0.000 and for inter-bracket ages p=0.016).*

[15] *Research carried out in cooperation by Fundação de Economia e Estatística (FEE) with Fundação Gaúcha do Trabalho e Ação Social/Sistema Nacio nal de Emprego (FGTAS/Sine-RS), Fundação Sistema Estadual de Análise de Dados (Fundação SEADE-SP) an Departamento Intersindical de Esta tística e Estudos Sócio-Econômicos (DIEESE), with methodology developed by the latter two.*

[16] *Test of average difference by Kruskal Wallis – for non normal distribution by age groups p=0.005 and gender p= 0.000*

Figure 1 – Frequency of driving (%) x age groups

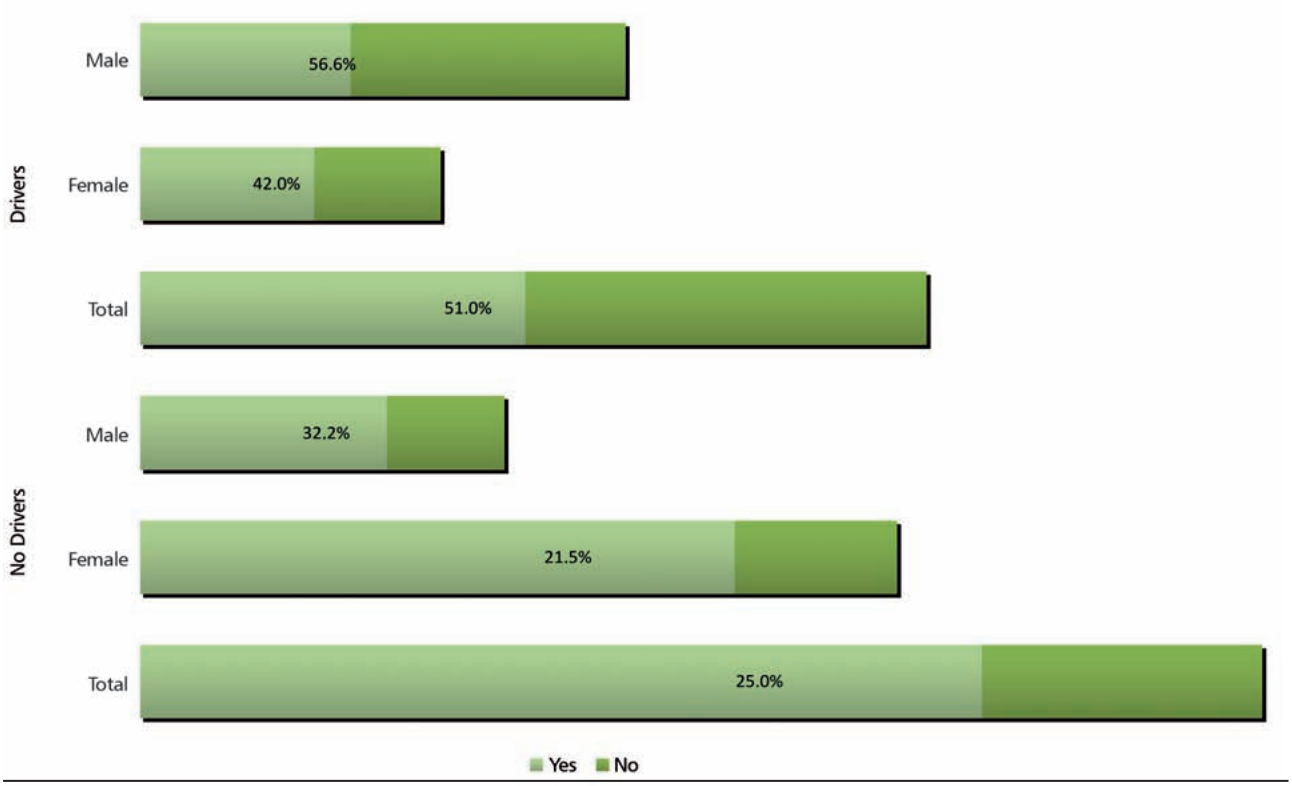


do the people who ride with them (95.6%). Generally, these percentages characterize a high usage of safety devices as foreseen by Brazilian law for at least the past decade[17].

Experience with Work Accidents

Experience with traffic accidents, both occurring to persons or to someone close to them, is part of the population's day-to-day routine in large cities: 35.7% of the citizens of Porto Alegre report having suffered some traffic accident – with injuries or not, a percentage that rises if they drive vehicles. There are relevant differences depending on gender: a larger proportion of men have been involved in traffic accidents, which corroborates the literature that shows men as the main victims of traffic accidents; however there are less differences

Figure 2 – Involvement in Traffic Accidents – drivers and non-drivers x gender



[17] *Lei Nº 9.503 – of September 23, 1997 instituting the Brazilian Traffic Code.*

amongst drivers (Figure 2).

The average number of accidents amongst males was 1.7 accidents against 1.4 accidents for women (p=0.017), confirming the previous evidence. The involvement of closely related contacts (family or friends) in traffic accidents cropped up in 65.7% of the interviews and of these 56% were first degree relatives[18]. As to the seriousness of the accidents, 19.6% reported at least one close person dying due to a traffic accident.

Alcoholic beverage consumption and the association to driving – Information and risk behavior

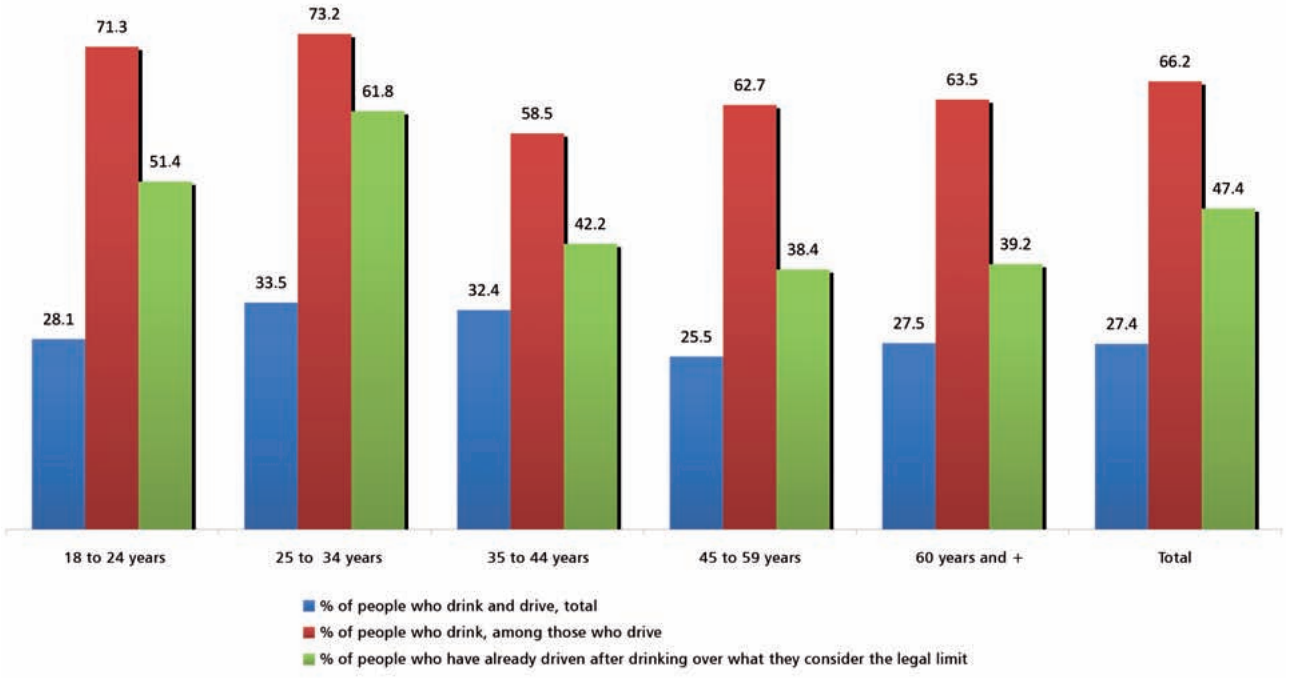
According to this study 58.3% of the Porto Alegre residents drink some kind of alcoholic beverage at least once a year, but among men of up to 24 years this percentage can reach 75.7%. Consumption is also frequent among the youngest, (at least once a week); for 48.9% of them the most frequent drink is beer and the average consumption each time is 6.0 doses which is considered 'binge drinking' – above 5 doses for men and 4 doses per woman each time (Evans, Grant et al., 2007). Alcohol consumption occurs at home for 65.3% of individuals who claim to drink any quantity and 74.5% stated they drink in restaurants, bars and at parties. The result of this consumption has an impact on the family budget: individuals reported average monthly expenditures of R$104.50 (64.3% spent outside the home) which on the average represents 4.4% of the family income. For families with one minimum salary expenditure on drink rises to 12.3%.

The information that the consumption of alcoholic beverages associated with driving could cause a traffic accident was known to 97.1% of those interviewed but as to maximum legally allowed blood alcohol for driving, only 30.3% said they knew of it in numbers while 48.8% said they understood the legal limit not to be above 1 dose and 18.4% to be 2 doses of some alcoholic beverage.

Despite information that accidents are the possible consequences of associating alcohol consumption with driving, the habit of catching a ride with drivers who have drunk any amount of alcoholic beverages is usual for 45.2% of the interviewees. Besides this, the risk behavior varies downwards with age, 66.1% of young people from 18 to 24 years old said they take rides under these conditions. while 83.3% of those over 60 said they never do.

As to the behavior of driving after drinking alcoholic beverages, 47.4% of the drivers stated they had already done so. The differences are perceived along age levels: between 25 and 34 years a significant number admitted this risky behavior (Figure 3). Of the drivers who admitted driving after drinking an amount of alcoholic beverages they consider above the legal limit, 13.5% declared that their perception capacity when driving was completely diminished and 51.6% said their perception was partially diminished.

Figure 3 – Behavior as to drinking & driving x age groups (%)



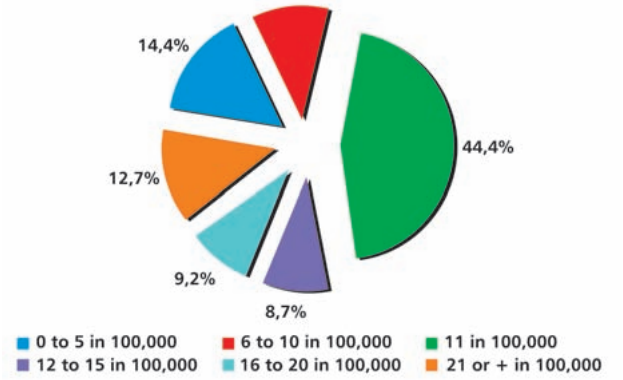
[18] *The relationship to the victim was classified as "close relative"(parents, children, grandparents and spouse) , other family member , and friend and other (for other relationships such as at work, neighbors, etc.).*

Risk Perception

The perception of the risk of suffering a fatal accident , to 44.4% of the citizens of Porto Alegre is the same as the objective risk – 11 deaths per 100.000 inhabitants , as a function of their exposure and behavior in traffic. 30.6% consider being at greater risk. For absolute values 14.4% and 12.7% said they believed respectively in a minimum and a maximum risk (Figure 4).

The risk perception as to behavior in traffic through a rising risk scale from 1 to 5 shows that the residents of Porto Alegre perceive risk as being from high to very high in most actions linked to traffic in the city (figure 5).

Figure 4 - Perception of the risk of suffering a fatal accident in Porto Alegre



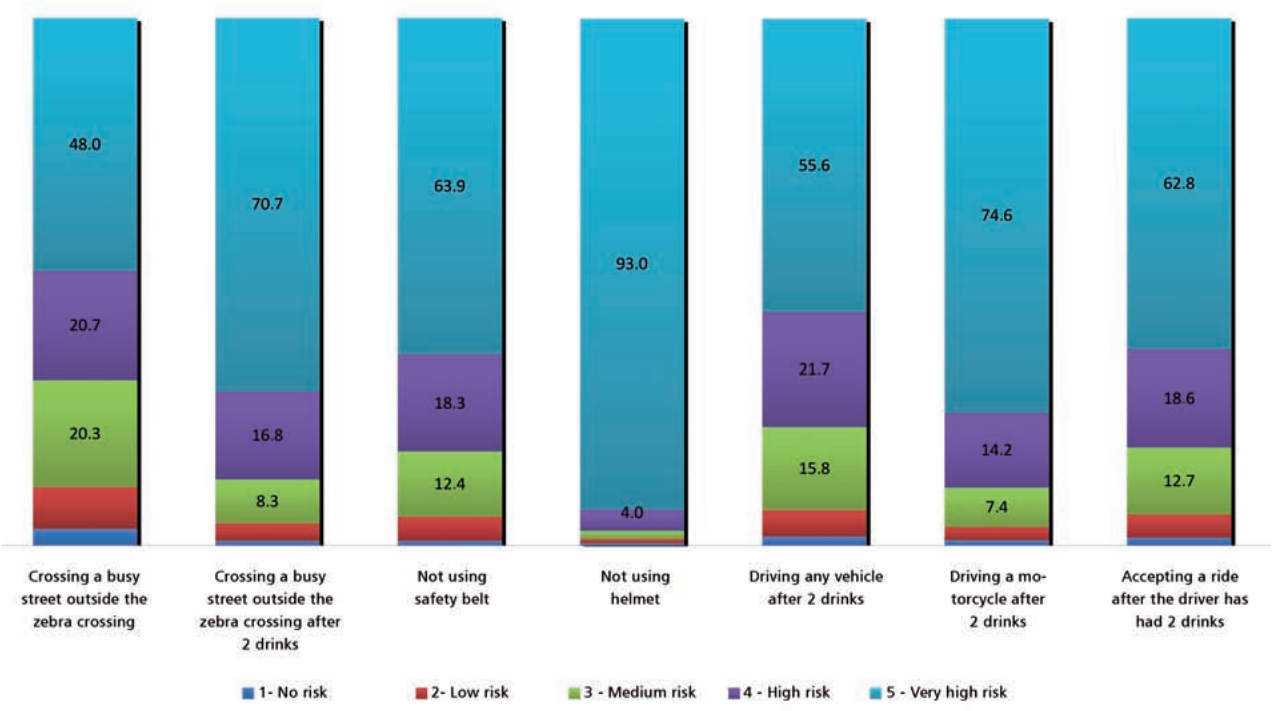
The addition of the alcohol element increases risk as can be observed in the matter of pedestrians crossing the street away from the zebra crossing sober or after having drunk two doses of any alcoholic beverage. The lower risk perception in two actions covered by laws and already incorporated to day-to-day living by street users19, as is the case of fastening seat belts or using helmets compared to driving after at least two doses of drink (Figure 5) may suggest that an adaptation and enforcement period is necessary until the law becomes effective. Besides, individuals who do not drink perceive higher risk in every action.

The indicator of risk perception associated with driving after drinking alcoholic beverages, obtained through direct questioning suggests that it is expected that 32.4% of the people who drive after 2 doses of any drink will have a traffic accident. This indicator suggests that it is a good reference of differences in risk perception: women present a perception of higher risk (p=0.00)20, as do the elderly (p=0.023), non-drivers (p=0.001), individuals who do not drink (p=0.000), or already have lost a relative due to traffic accident (p=0.000), although there is no difference as to whether the individual has had an accident or not.

Willingness to pay for the diminished risk of injury in Traffic Accidents

Having been confronted with the perception of risk of a traffic accident and the association of alcohol consumption with risk behavior, the interviewees were invited to reveal their willingness to pay for reducing this risk.

Figure 5 – Risk scale for actions involving or not alcoholic beverage intake



[19] See Section on behavior in traffic.

Of the individuals who went through the whole interview 76.1% said they were "willing to pay" for the safety device to reduce risk of injury in case of traffic accident. Among those unwilling to pay, 22.8% said they were not at risk of being in an accident, 25.8% because they did not want to pay anything more than the taxes they already pay and 20.8% feel the risk cannot be reduced. The unwillingness to pay is greater amongst men (p=0.058), and in the 45 years of age group (p=0.000), which in the case of the latter is justified due to a lesser accident risk perception both as to death due to traffic accident (p=0,039) and to accident risk related to traffic accidents (p=0.056).

The WTP grew with the severity of the injuries and there is a statistically significant difference in the average values between age groups: individuals between 35 and 44 are willing to pay more in the first two scenarios. The difference is statistically significant between drivers and non-drivers but not between those who are in the habit or not of drinking alcoholic beverages, besides which there is no difference by gender (Table 2).

Besides the values they would be willing to pay for the yearly rental of a device for themselves, it was questioned if they would be willing to pay for family, friends and strangers. Only 5.1% were not willing to pay anything for a family member, 25.2% for friends and 53.8% for strangers, which shows an altruistic component in the population (Figure 6, next page).

Conclusion

This study aimed at investigating the perceptions of the citizens of Porto Alegre as to the risk of suffering a traffic accident and the association of alcoholic beverage intake and risk behavior in traffic thereby enabling the measuring the willingness to pay for a reduction of the risk of suffering injury due to traffic accidents.

The results found show evidence that the population perceives that its lives are at risk due to traffic accidents, most of them equal to the objective risk of 11 per 100.000 and 30% perceive there is a greater risk, suggesting a sense of lack of safety in traffic. The risk of being involved in a traffic accident associated with alcohol consumption is perceived as high or very high, especially for pedestrians, which makes sense since they are among the most vulnerable on the streets (Peden et al., 2004). However the greater percentage of people consider getting a ride from someone who has been drinking alcoholic beverages a high risk, versus "driving under the effect of an alcoholic beverage". This result suggests that in spite of the fact that individuals perceive high risk in the association of alcohol and traffic they have less perception of the driver being responsible.

As to the willingness to pay for injury risk reduction due to traffic accidents, 76% of the interviewees said they were willing to pay for a risk mitigation mechanism. The average WTP shows age-dependence - the elderly are less willing to pay and pay less – and the fact of individuals being or not drivers. But there are no differences between WTP averages in relation to gender – although men are a longer time in the traffic, are the majority of drivers, and drink more than women.

The participation of the population in this type of study, both accepting data collection on hearing what it is about, and the low rate of unwillingness to pay for a reduction in the risk associated with traffic accidents besides the perception of high-risk in actions linking alcohol consumption to behavior in traffic suggest that traffic accidents have a high impact on society especially when linked to a risk factor such as alcohol which could easily be moderated.

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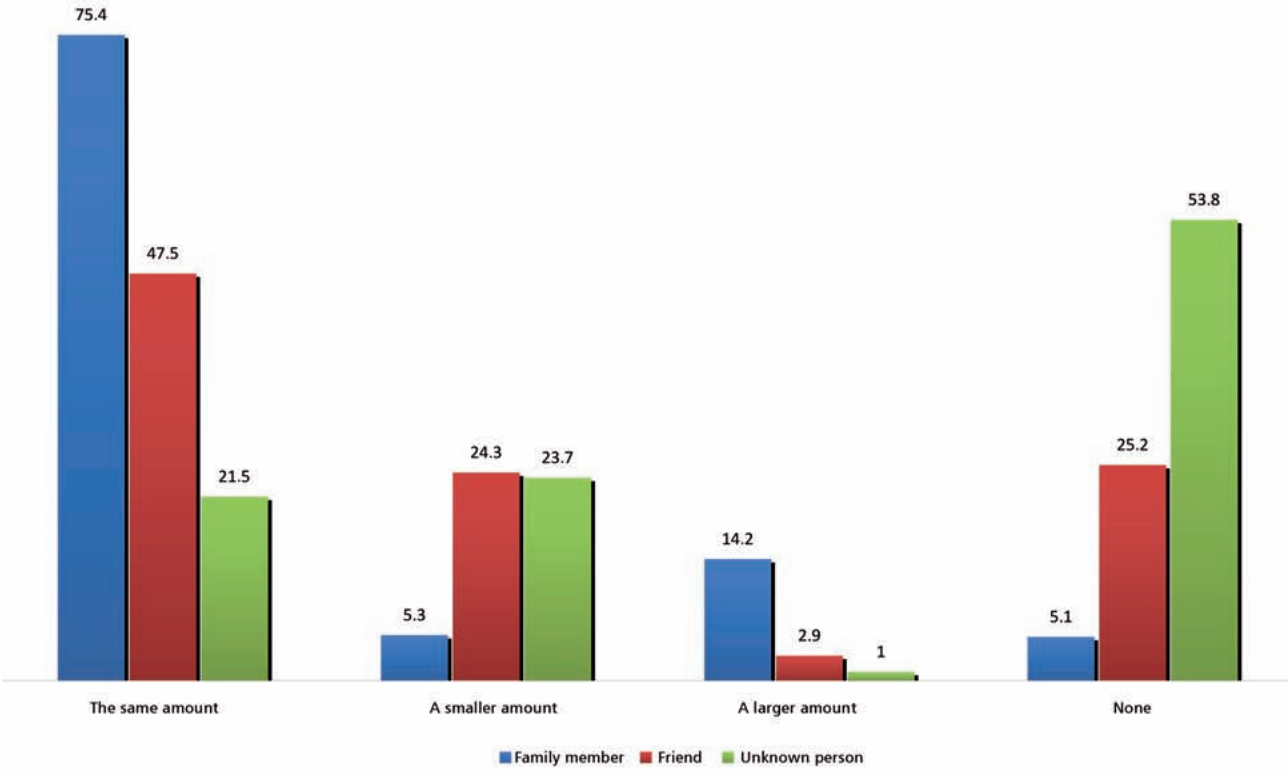
Table 2:WTP by reduction of injury risk for traffic accidents.

		Age group (YEARS)						Is in the habit of driving		
	ALL	18 to 24 years	25 to 34 years	35 to 44 years	45 to 59 years	60 years +	p=*	No	Yes	p=*
Scenario 1 (medium injuries)	944.4 (98.04)	1046.3 (135.7)	1271.3 (310.4)	695.7 (85.03)	799.8 (140.2)	791.6 (305.9)	0.0072	712.7 (73.57)	1263.0 (208.7)	0.0001
Scenario 2 (serious injuries)	2347.3 (223.5)	2779.1 (293.6)	2266.5 (526.0)	2337.2 (487.8)	2531.2 (587.7)	1517.7 (300.3)	0.0015	1798.7 (149.7)	3101.8 (486.8)	0.0001
Scenario 3 (deaths)	11619.5 (1032.9)	16605.5 (2809.3)	9371.7 (1895.1)	9870.8 (2102.9)	12826.2 (2244.6)	9114.2 (2511.4)	0.0015	9909.6 (1227.1)	13971.2 (1775.1)	0.0001

Note: Note: Average values in R$ and between brackets the standard deviation. The test of differing averages used was the Kruskal Wallis Test.

[20] *Test of difference between averages for variables with non-normal distribution Kruskal-Wallis test.*

Figure 6 - Willingness to pay for the reduction of injuries on other people(%)



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