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Epidemiology and Prevention of Traffic Accidents in Cuba

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1. Introduction

At the beginning of the XX century, Cuba's economy was not diversified or developed. The main source of income was sugar cane production, a technology which, seen from nowadays, could be considered almost artisanal. It involved an ox-driven mill which squeezed the juice out of the cane, first step in order to obtain sugar.

We must tie the development of the sugar cane, rum and the tobacco industries to the progressive increment of the number of vehicles, as they were also instrumental to that development. The first automobile that circulated in our country made it for the Havana streets in 1898, and it is said that the first accident reported in Cuba was in 1906, in which a pedestrian was implied. That brought along the fact that car accidents began to be considered the eighth cause of death in 1958, from being almost nonexistent (Dirección Nacional de Registros Médicos y Estadísticas de Salud [DNE], 2011).

CAUSES OF DEATH	Deaths	
	No.	rate
Cardiovascular	9 996	147,8
Malignant Tumor	5 327	78,8
Gastritis, enteritis, duodenitis and colitis	2 784	41,2
Newborn related diseases	2 302	34,0
Vascular lesions affecting the Central Nervous System	2 245	33,2
Pneumonia and flu	1 943	28,7
War injuries	1 635	24,2
Accidents	1 266	18,7
Tuberculosis	1 076	15,9
Nephritis and nephrosis	984	14,5

Source: DNE, 2011.

Table 1. Deaths and mortality rate (by 100 000 inhabitants). Cuba 1958.

To the first clunker cars manufactured in North America, more vehicles were added predominantly from the United States, which in turn dictated the characteristics of the vehicle inventory. After 1959 vehicles coming from the extinct Soviet Union and others European countries were added to the stock. Starting 1990, there is an economical crisis the country must face against, resulting in important changes in the Cuban society, which in turn changed the way vehicles were employed due to fuel shortages. As an alternative transportation mean, bicycles are started to be used massively by the population to run their usual chores as well as to go to workplaces. At the same time animal-hauled vehicles, especially those using horses are starting to show up in cities throughout the country, less often in the nation's capital.

To remedy the shortcomings of the capital city's public transportation system, alternatives are sought as well, basically employing trucks and tractors without the required safety standards. Along this period, due to the same financial crisis which affected the public transportation system, the pavement of the city's thoroughfares began to deteriorate as well, along with the transit signals. All these factors increase the risks of car crashes and the injuries and casualties' toll.

Regarding the increased use of bicycles it should be stated that the modifications needed in the traffic system in order to protect bicycle riders -- as dedicated lanes or mandatory use of helmets -- were not immediately adopted.

However since the beginnings of the XXI century, the number of bicycles has dwindled significantly, which today circulates simultaneously to old built vehicles in North America in the fifties (e.g. Chevrolet, Chrysler), with others of European origin built in seventies (e.g. Lada, Moskvichs, Polski) and other more modern vehicles (e.g. Peugeot, Mercedes Benz, Toyota).

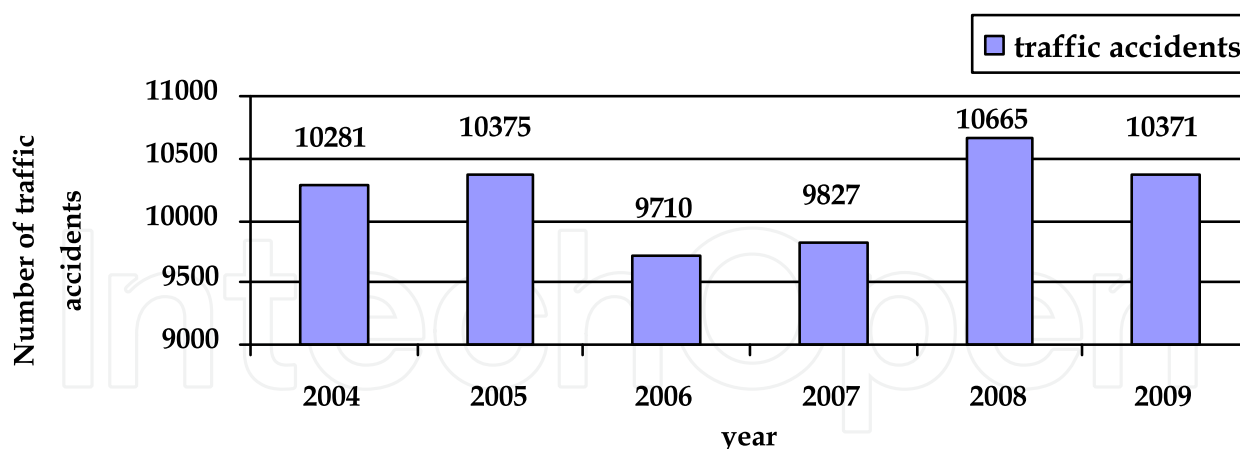
2. Incidence, mortality and economic impact of traffic accidents

Before 1970, there are recorded health statistics only from 1958. And they recorded all accidental fatalities together regardless the cause, although the vast majority comes from road traffic accidents (table 1).

According to official reports, there are 10,000 car accidents a year in Cuba (Graph 1). Most of them happen in Havana, followed in descending order by Santiago de Cuba and Holguin (Graph 2), which happens to be the more populated cities in the country with population of 2 147 539, 1 048 377 and 1 036 504 respectively (Oficina Nacional de Estadísticas [ONE], 2010; DNE, 2010).

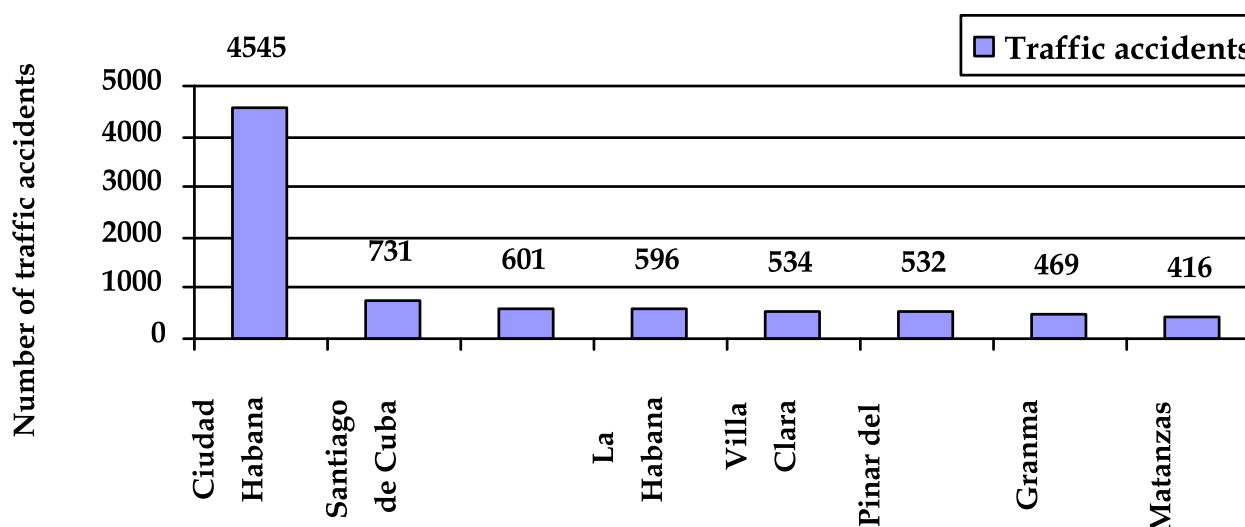
Each year, injuries account for more than 1.3 million deaths globally, and more than 90 per cent of these deaths occurred in low and middle income countries. The World Health Statistics 2008 Report predicts that road traffic injuries will be one of the most rapidly growing public health concerns over the next 25 years, primarily owing to increased motor vehicle ownership and use associated with economic growth in low and middle income countries (WHO, 2008). According to this report, in 2004 traffic accidents constituted the ninth cause of death of the world population. In 2030 it is expected that it would be the fifth cause of death, displacing infectious and tumor diseases, with countries with low-to-middle income rates having the bigger share (Peden et al., 2002; WHO, 2010).

In Cuba, from seventies of last century, accidents in general have constituted between the fourth and fifth cause of mortality, preceded by the cardiovascular disease, stroke, cancer and influenza and pneumonia. The traffic accidents together with the accidental falls constitute a fundamental cause of deaths for accidents. (DNE, 2010).



Source: ONE, 2010.

Fig. 1. Traffic accidents. Cuba 2004-2009

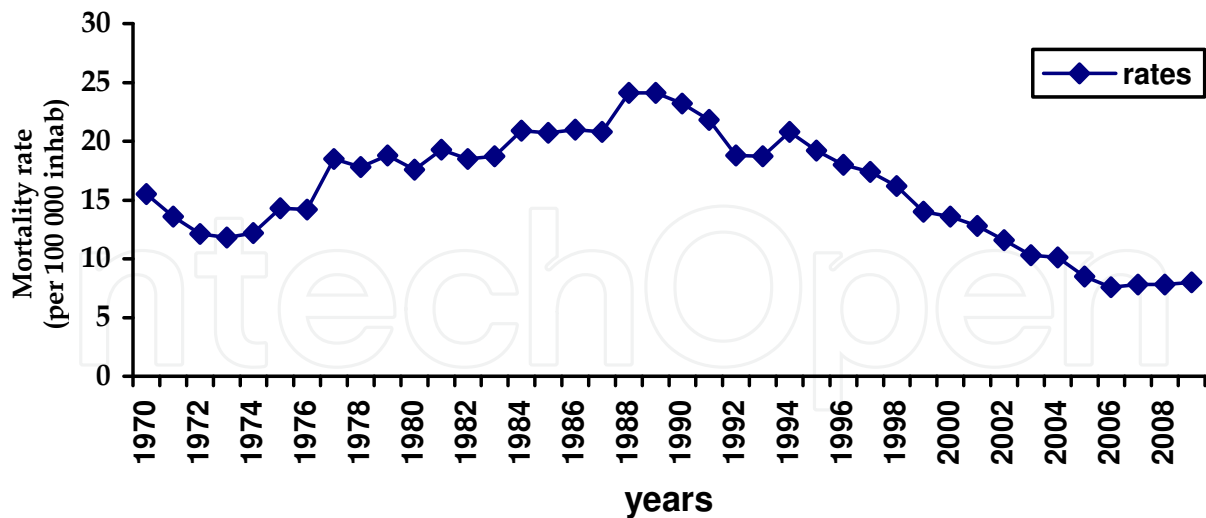


Source: ONE, 2010

Fig. 2. Traffic accidents in Cuban counties (2009)

Traffic accidents mortality had an increasing trend in the 1970 to 1989 period as can be seen in fig.3, in which it soared up to 24.1 deaths by 100,000 habitants (Asamblea Nacional del Poder Popular, 1987; Ministerio de Salud Pública, 2010). Afterward it became evident its decrease down to 7.8 in 2008, which is related to changes in the national prevention strategy as it is reflected in the 60 Act, which includes:

1. Mandatory use of helmets in motorbikes.
2. Mandatory use of safety belts.
3. Increased measures to avoid driving under influence (DUI) of alcoholic beverages.
4. Strengthening of the medical emergency system, increasing the number of ambulances and skilled medical personnel.
5. Public education throughout the broadcasting of many factors concurring in traffic accidents.
6. Mandatory technical supervision of motor vehicles, especially those involved in the public transportation system (Ministerio del Transporte, 1999).

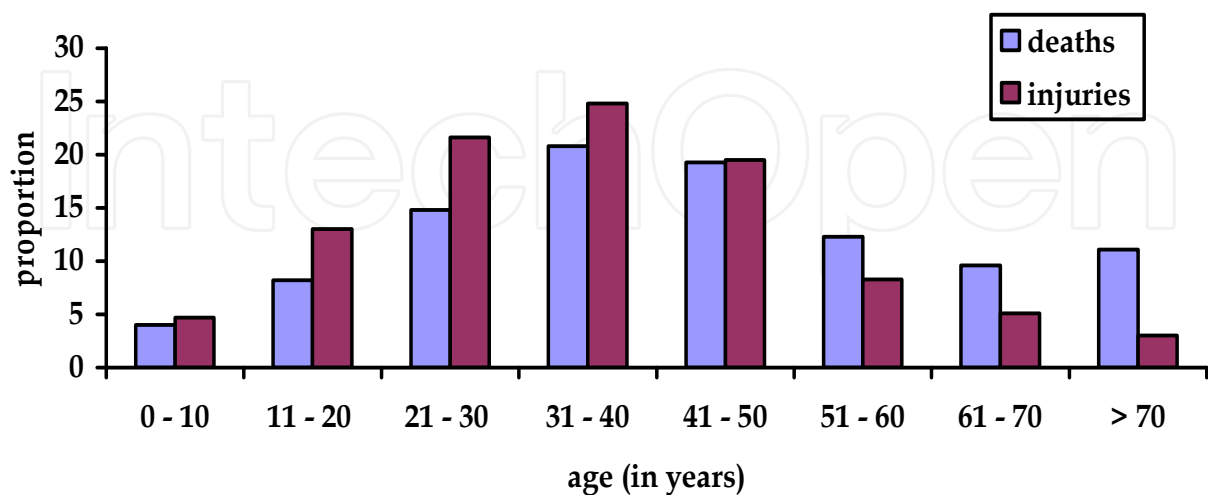


Source: Dirección Nacional de Registros Médicos y Estadísticas de Salud, 2010.

Fig. 3. Traffic accidents adjusted mortality rate (by 100 000 hab), Cuba, 1970 -2009.

An element strongly related to traffic accidents mortality's incidence, starting from the 90 decade, was the massive introduction of bicycles on the streets as a mean of transportation. This related with economic problems that reduced in an important way the use of vehicles that use fuel. Although the number of bicycles have since decreased significantly, in 2009 the bicycle related accidents accounted for the 6.5% of the traffic fatalities.

To the death casualties should be added, as an additional burden, the lesions and injuries, with figures that, as a whole, soar to a staggering 7000 a year. According to Graph 4 there is a dominance of male individuals at productive age (fig 4) (DNE 2010). In 2009 the accident mortality rate in Cuba was 14.5 by 100,000 habitants (male) and 3.4 by 100,000 habitants (female) (ONE, 2010). Similar outcome was observed at the Villa Clara Project, where 65% of fatalities and 70% of injuries were male individuals (Guanche, 2008).



Source: ONE, 2010

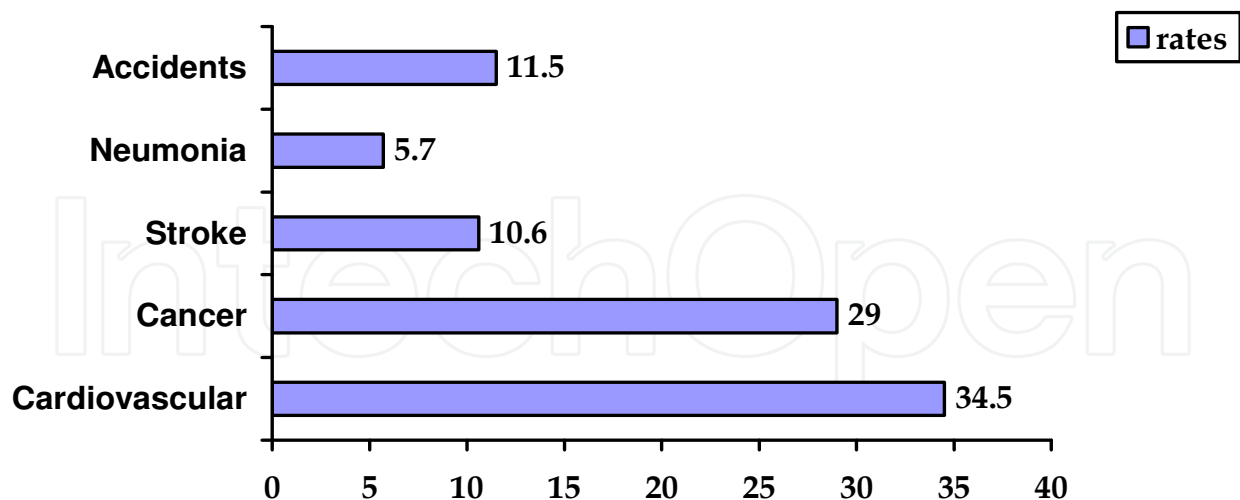
Fig. 4. Proportional distribution of deaths and injuries in traffic accidents according age. Cuba 2009.

In national reports there is no evidence of the relative impact of the employment of bicycles as a mean of transportation in the traffic accident's mortality notwithstanding the primary role this vehicle had as such. In 2009 bicycle related accidents yielded the 6.5% of all fatalities (DNE, 2010). A study conducted in Cienfuegos, province located amid Island, the mortality rate related to bicycles was 6.44 by 100,000 habitants, mainly from the 15 - 44 age groups, males (Jorge et al., 2010). Vulnerability of bicycle-riders circulating in thoroughfares is a world class problem (WHO, 2004).

Traumatism due to traffic accidents occupied the ninth place in the 2009 worldwide as morbidity and lesions agents, considering their share in years of life potentially lost due to incapacity. It forecast for 2020 is the third place, getting the lion share countries among low-to-middle GDP (WHO 2009).

In Cuba, traffic accidents were the fourth cause of years of life potentially lost, behind cardiovascular diseases, stroke and cancer, which should be considered when it comes to evaluate its impact on society (DNE, 2010). According to evaluations in Villa Clara, in 2003, the years-of-life potentially lost rate was 11.58 by 1000 habitants, with males yielding 14.46 and females 8.35.

The impact of traffic accidents in healthcare system could be evaluated by means of use of emergency services for healthcare of injuries, admission in hospital and rehabilitation of patients to survive. Detailed information about this it is not included in the official statistics in Cuba and few published articles in national biomedical journal and in Infomed, the national medical web, refers to this topic. A descriptive study of patients admitted in the main rehabilitation center in Cuba, Hospital Julio Díaz, show that neurologic injured and amputated patient, as consequence of traffic accidents, are the major cause of admission, displacing other previous causes of disability as infectious diseases (Berbes VL, no date).



Source: DNE, 2010

Fig. 5. Rates of potential life years lost (per 1000 habitants) according selectec causes of death. Cuba 2009.

Studies dealing with the economic impact of traffic accidents are scarce in Cuban literature, and the existing ones do not analyze the problem integrally, as they do not

account the direct and indirect costs involved, as should be considered medical assistance and rehabilitation. Main biomedical publications deal fundamentally with clinical aspects, centering on the description of injuries (Scielo Cuba, 2011). A study in the province of Villa Clara which is one with a high incidence of traffic accidents, first semester of 2009, described the use of hospital services by traffic injuries patient (Guanche, 2008). About 25% of patients were admitted to critical care units, 30% underwent major surgery and 31.3% were prescribed antibiotics. Rough estimates using the abovementioned information give that traffic accidents in Cuba account for some 50 million pesos a year.

According to the National Statistic Office (ONE, 2010), damages caused by traffic accidents to public or private property amounted to 5 978,2 million of pesos in 2008 and 4 390,4 million of pesos in 2009. The global economic loses due to road traffic injuries are estimated to be US\$ 518 billion with a particular impact in low and middle income countries (WHO, 2009).

3. Risk factors of traffic accidents

An integral vision of risk factors for traffic accidents and its consequences should consider those related with the man (drivers or pedestrian), the vehicle and the roads (WHO, 2009). Classically it has been postulated that an important proportion of the risk is contributed by the man, basically drivers, with smaller participation of other factors. Researchers have indicated that only one of them is the cause of each traffic accident, although it would be necessary to consider the influence of several factors in their genesis.

Among more importance factors they are those related with technical deficiencies of vehicles (for example, controls, tires, suspension), atmospheric factors (darkness, fog, rain, hail, snow, ice, others), the design and conservation of roads, but it is the human factor the one that explains most of the accidentality.

In Cuba most of companies vehicles are government's property, about which the information that we present information in Tabla 2 (ONE, 2010). Bus and passengers transported in these they possess very similar values in the period 2004 - 2007, with an increment in the years 2008 and 2009. Bus constitutes the main way of the population's transport as much in the cities as in rural areas, in which is reflected an important variability of makers and years of construction, modern (Ej. Yuton, China) and old (Girón, built in Cuba with Soviet Union components), being able to observe in the roads of the Havana a Leylan Bus built in the United Kingdom in the seventies. In a similar way it happens to the trucks and taxis.

The technological variability of vehicles determines the frequent observation of vehicles without good conditions for its roads circulations, in relation to the natural deterioration of its components, the difficulties of purchase replacement pieces adapted for their repair, with the frequent adaptation of components of other classes of vehicles to maintain their operation (fig 6).

In rural areas is more frequent to observe the massive transportation of passengers in trucks or in vehicles of animal traction, where it is equally more frequent the use of bicycles as a fundamental way of population's and goods transport, example agricultural products and little animals. In the Cuban cities, including the capital of the country, the bicycles are used as rent vehicles, calls in Castilian "bicitaxis", being able to be used in the transport of goods for small business.



Fig. 6. Antique and modern vehicles in urban roads and risk of accidents

variables	2004	2005	2006	2007	2008	2009
Government vehicles						
Ómnibus	11.491	10.561	11.319	10.460	11.979	12.194
Taxi	3.306	3.544	4.280	4.243	4.310	3.015
Trucks	12.510	15.014	11.658	11.893	10.249	11.326
Passenger transported (million of passenger)						
Ómnibus	647,5	679,5	697,9	755,6	898,1	922,6
Taxi	40,4	41,3	40,2	43,7	45,6	46,7

Source: ONE, 2010

Table 2. Government vehicles and passengers transported. Cuba 2004 – 2009.

Related with quality of road infrastructure, was evident an important deterioration in the nineties, that included physical damage of roads and deficiencies in signalings (horizontal and vertical). The construction activities and maintenance of roads net is responsibility of state entities. Recently, in correspondence with the economic recovery, a program of improvement of roads has been developed, included the construction of asphalt factories and solutions to signaling deficiencies (Salgado, 2010).

Is important consider that in national road infrastructure they are few alternatives to protect pedestrians, elevated bridges for traffic of vehicles in the cities and others, partly determined by financial possibilities for their implementation. Also, the employment of exclusive roads for the circulation of bicycles that was used during the nineties, has decreased in a significant way, although its circulations continues in urban and rural roads, which increased vulnerability to occurrence of traffic accidents. WHO Report of Road Safety (WHO, 2009) define as vulnerable road user to pedestrians, cyclist and user of motorized of two wheelers.

According to National Highway Traffic Safety Administration (USA), the human factor is implied between the 71 and 93% of the cases, the roads factors 12 and 34%, and those related to vehicles between the 4,5 and 13% (NHTSA, 2010).

At the present time they are recognized a series of risk factors of the driver that affect capacity to drive motor vehicles. Among these they are diseases or conditions that can affect the conscience, for example myocardial infarction and other acute coronary syndromes, high blood pressure, cerebrovascular disease, rupture of the aorta, vasovagal syncope, epilepsy and hypoglycemia. Also known the transitory influences of alcohol, certain medications, the drugs and the fatigue. Other factors are related with the training level and style in driving, the knowledge and fulfillment of regulations and laws, psychophysical conditions (sensorial, physical and mental), the disposition to act (attitudes and motivation) and the efficiency, capacity, know-how, psychomotor coordination, and skills to overcome situations during driving.

Among man related factors, we wish highlighting the existence of diseases and psychophysical, as well as the effect of alcohol and drugs (legal or not) that can interfere in driving capacity. Non communicable diseases or chronic conditions as diabetes mellitus, hypertension and ischaemic heart diseases, bronchial asthma, chronic obstructive pulmonary disease and stroke are frequent in Cuban population (DNE, 2010).

Diabetes mellitus is estimate to be affects 8% of Cuban population's, alone 50% has been diagnosed, and constitutes the eighth cause of death (Dominguez, 2008). In relation with accident risks depends on the effect of the variability glycaemia in neurological system, including the increased risk of hypoglycemia, conditioned by antidiabetic drugs and non adherence to the treatment. Also it should be considered the adverse effects of retinopathy in visual acuity, neuropathy in sensibility and strength in extremities, and macrovascular complications and the risk of cerebral or heart ischaemia (Ministerio del Interior, 2004).

High blood pressure affects 30% of Cuban population, more frequent in adults, and is associated to the incidence and mortality of ischaemic heart disease and cerebrovascular diseases, which constitute the first and third cause of the Cuban population's death (DNE, 2010; Buergo, 2008). The possibilities of ischaemic symptoms and signs in this diseases and its effect on the level of conscience and the degree of attention constitute elements compactly associated with risk of accidents (Ministry of the Interior, 2004).

Also cancer, that constitutes the second cause of the population's death, has demonstrated growing incidence in the last decades, in correspondence with the world tendencies (DNE, 2010). Its relationship with risk accidents associated with this health problems, not depends alone of the own clinical manifestations but of the effects of the treatments. Should be considered the increment of its survival of current therapeutic resources. (Ministry of the Interior, 2004).

It is estimate that 2,5 million people die worldwide from harmful use of alcohol a year standing out deaths related with traffic accidents (WHO, 2011). Numerous studies carried out have been demonstrated the important paper of alcohol in traffic accidents. In this investigations it has been evidenced that accidents related with alcohol, are of more prejudicial results, what increases the risk of suffering mortal lesions, partly to the reduction of answer to trauma, besides other circumstances that surround him (Hingson, 2003). According to studies carried out in USA, of the population of drivers 32% are abstemious, 45% moderate social drinkers, and 23% strong social drinkers, frequent drinkers or alcoholic (Korelitz, 1993). In Cuba it has been considered that at least 5% of the population's with

more than 15 years old are alcoholic (abuse or alcoholic dependence), not including in these those with non advisable consumption patterns (Gonzalez, 2008).

The main studies on drink and driving in Cuba were carried out between 2001 and 2006, which were published by our team in national biomedical journals (SciELO Cuba, 2011) and in *Gaceta Sanitaria* (*Gaceta Sanitaria*, Elsevier, 2005 - 2008). We demonstrate that drinking and driving constitutes an important and frequent risk factor for traffic accidents, which is underestimated in official statistics. In these the main violations are not assist the vehicles control and not respect the right of road circulation identified in 29% of accidents, while alone in 3% of drivers was found under the effect (ONE, 2010). The results above mentioned related with the systems and procedures of detection of drivers under the effect of alcohol.

For decades they are known in Cuba the equipment for mensuration of alcohol in exhaled air, initially equipment of qualitative mensuration as knows as "globitos", and in recent years more modern have been used that allow to quantify the amount of alcohol present in exhaled air. However the use of these technologies has been for short periods, given its low readiness, not existing in our country a methodology of surveillance of drivers under the effect of alcohol, and still to certify if a driver ingested alcohol the testimonial of a doctor is demanded, by means of a legal written document (Ministerio de Salud Pública, no date).

An important proportion of population drive vehicles take medications, some of which can alter driving capacity. Important to mention between this drugs those that generate bigger risk like those used for treatment of psychiatric disorders, hypoglycemics, antiallergic with depressor effects in central nervous system. Due to it is essential that healthcare professionals know the effects of drugs commonly used and its effects in driving capacity and they can make recommendations to diminish the risk of occurrence of traffic accidents.

In Cuba the illicit drugs are little consumed, being those most used marijuana and cocaine. Their deleterious influence is known in conduction capacity by its effects on central nervous system. (Ministry of the Interior, 2004). Equally it should be considered the mixture of medications with alcohol, especially in young population, which produces stimulating or depressors effects in central nervous system.

4. National prevention program and activities for prevention of traffic accidents

Traffic accidents prevention activities constitutes a world priority, with special focus in those countries where they constitute fundamental cause of morbidity and mortality, and produce an important economic impact. Many have been strategies applied in prevention activities, that in general pretend to act on their potential causes: man, roads and vehicles (OMS, 2004), that includes activities for the prevention of accidents and its consequences.

In 1987 the Law 60, Code of Traffic, was approved (Asamblea Nacional del Poder Popular, 1987) that established the main regulations related with the prevention of traffic accidents. This law was modified in 2010 by means of the Law 109, which introduced as novel elements the definition of *beginner driver's* to refers to those with less than two years experiences in driving, and of *pedestrian with disability* to refers to those with any type of disability (motor, visual, other), also valuable modifications focus on risk controls like drinking and driving, use of drugs or substances that alter capacity to drive, the employment of cycles or animal traction vehicles, the massive transportation of passengers, passengers' of vehicles procedures and pedestrians. It highlights the recommendations for the technical revision of the vehicles and for population education in this topic.

Next we will comment important aspects included national strategic plan for traffic accidents prevention.

1. Drinking and driving (article No. 93 and 95 of Law 60)
 - a. Professional drivers cannot drive under the effect of alcohol. Similar restrictions should fulfil the beginner drivers and applicants during the period of learning, elements of new introduction in the law.
 - b. In non professional drivers are accepted a low level of alcohol as permissible. This level are not defined in the law, assigning to the Ministry of Public Health the responsibility of determining the levels of concentration of alcohol in blood, exhaled air or in other corporal fluids incompatible with driving.
 - c. Also, constitutes a novel element in law, the prohibition of ingestion of alcoholic drinks inside vehicles or their transportation in the compartments dedicated to the driver and the passengers
2. Regulations about the circulation of cycles (article 112). Prohibits the conduction of cycles to individuals smaller than 12 years old, not being clearly defined the obligatory use of the protective helmet for their drivers.
3. For massive transportation of people (article 135). Consider the frequent use of massive transportation of people in load vehicles (ex. Trucks) is established that these they should circulate to inferior speeds with security conditions for the passengers.
4. Technical vehicles revision (article 211). The technical revision of vehicles using specialized equipment is carried out by Ministry of Transport as a requirement for determination of state of security systems and other excellent aspects as emission of combustion gases. Bigger emphasis must be attributes to vehicles dedicated to passenger's transport or those driven by professionals, which should carry out revision every two years.
5. Education related to prevention of traffic accidents.
 - a. The education and promotion program constitute an essential component in the preventive strategies, being reflected in the articles 239 - 248 of the Law 109.
 - b. Prevention program focus in children and adolescents includes the use of massive means of diffusion (television, radio, newspapers) and scholars programs address to the population's sensitization about the topic , offering information on risk factors, consequences and accidents prevention (Comisión Nacional de Prevención de Accidentes, 2010).
 - c. Related with the conduction under the effect of alcohol. National promotion programs have demonstrated to be very effective for the confrontation of other health problems, measures have been applied as: control of prices of beverages containing alcohol, actions on localization, schedules of opening and density of places of distribution of drinks, control of the social readiness, community education in general and to drivers.
6. School for drivers. These entities are made responsible of preparing the applicants to driver's licenses, and the training of professional drivers, as well as of promoting preventive strategies in the population.
7. Animal traction vehicles (fig 7). Drivers of vehicles of animal traction should have more than 16 years old, and these they won't be able to traffic for roads of quick circulation (e.g. Freeways), neither in night hours. They will also possess measures of security for its restrain.



Fig. 7. Vehicles of animal traction in urban roads

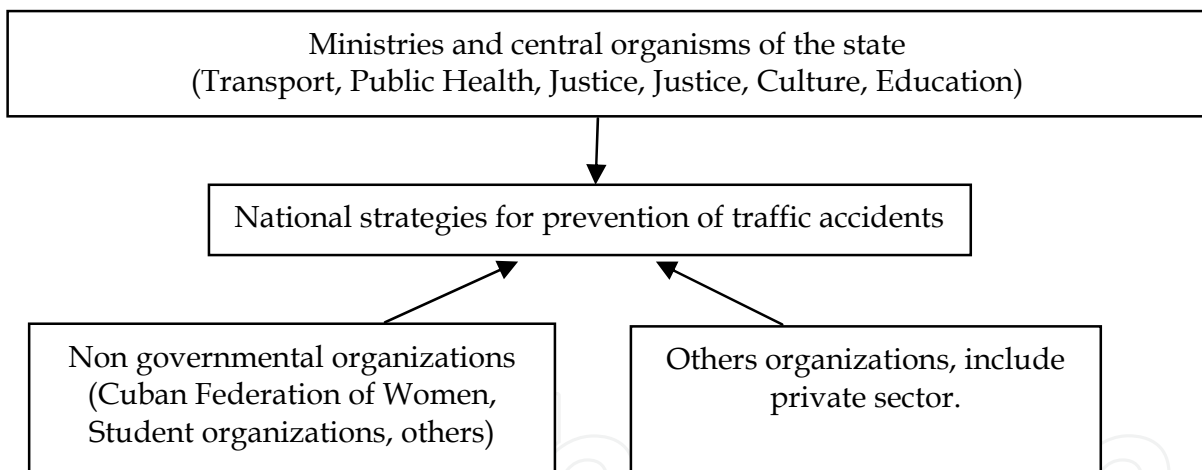


Fig. 8. Intersector system in prevention of traffic accidents in Cuba.

8. Medical evaluation of drivers (Ministerio de Salud Pública, no date)
 - a. The current methodology for medical exams of drivers, edited by the Ministry of Public Health possesses more than two decades of having approved.
 - b. The medical exams to obtain or renovate the conduction license in carried out in communitarian healthcare services by a team of professionals that included general practitioner, specialists in ophthalmology, psychology and others.
 - c. Considering current knowledge on this topic is evident, that this methodology has several limitations due that includes health problem that at the moment are not considered that interfere with driving capacity, example hiperinsulinism, renal disease, epilepsy. Equally they are not defined differences in the requirements to drive vehicles for professional and non professional's drivers.

- d. An element highlighted in the practical application of medical exams constitutes the non systematic application of valid methods for diagnosis of alcoholism.
9. The national program of accidents in Cuba is sustained fundamentally in intersector actions by means of the participation of the Ministries of the Interior, Public Health, Transport, Culture and other non government organization and state organisms (fig. 8).

5. Future research and development activities

1. Precise information about this health problem, obtained by means of scientific research and analysis of information, is essential to define the priorities of these problems for their prevention and control. (Borse & Hyder, 2009). Still when is included in the strategies and national programs of prevention, research published on the topic in biomedical journals, included peer review journals, could be considered insufficient. Also, like we mention previously, they approach clinical aspects related with those injured during traffic accidents, while investigations focused to identification of risks and to demonstrate the effectiveness of prevention practices were scarce.
2. Methodology of medical evaluation of drivers. It is required a revision of this methodology and bring up to date in correspondence with the new evidences.
3. Prevention and control of traffic accidents related with drinking and driving. Since this constitutes a relevance factor related with accidents and its severity, bigger emphasis is required in its control by means of the application of procedures that have demonstrated its effectiveness (e.g. Sobriety Checkpoint) (Shults RA, 2001)
4. Strengthen the intersector actions directed in a national strategic plan for prevention of traffic accidents.

6. Conclusion

Still when traffic accidents have had in Cuba a tendency to decrease in recent years, they continue being a major health problem when constituting the fourth cause of years of potential life lost, besides an impact in healthcare in relation to the attention of those injured and the disabilities, that which additionally generates important economic lost for society. Evident potentialities exist for the prevention of traffic accidents, superior to the main causes of Cuban population's death, that which can be achieved by means of the consolidation of prevention program prevention with the introduction of more recent evidence about this topic.

7. Acknowledgment

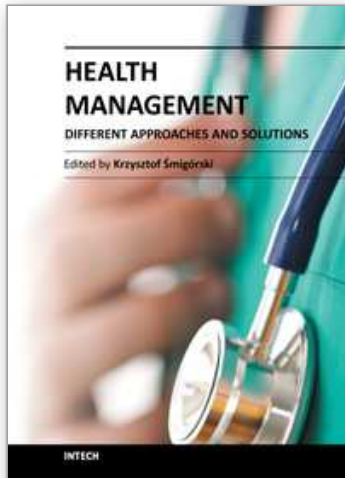
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