

ORIGINAL ARTICLE

Road traffic injuries in the province of Grosseto

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Key words

Traffic accidents • Epidemiology • Prevention and control

Summary

Introduction. Road traffic injuries constitute a major public health issue. The Province of Grosseto is one of the territories most affected in the Region of Tuscany. The objective of the study, part of the Road Safety Provincial Council's project, is to describe the epidemiology of the road accidents in order to contribute to the reduction of the burden of deaths and injuries.

Methods. The data relative to road accidents occurring in the Province were drawn from the various sources available: Death Certificates (1991-2005), Police Reports (1991-2003), Hospital Discharge Records (1996-2005), Emergency Room visits (2004-2005).

Results. On average, each year road accidents cause 30 deaths, at least 530 hospitalizations, and approximately 3,300 Emergency Room visits. The standardized mortality rate (2003-2005, males: 20.6; females: 6.0), the mortality ratio (2003: 34.6 deaths for every 1,000 accidents), and the severity ratio (2003: 1,432 injured for every 1,000 accidents) are higher than regional figures.

Discussion. The greater relative number of fatalities, casualties and crashes can be explained by various physical and social environmental factors such as vast flatland, few greater urban settlements, deprived area. The territory specifically demonstrates an accentuated seasonality in August, a month in which a peak in both the number of accidents and their severity is reported, brought about by the intense volume of commuter and transit traffic, and highlighted by the fact that in that same month approximately half of Emergency Room visits concern non-residents.

Conclusion. The complexity of the issue, the number of determinant factors involved, and the disproportionately greater impact on the more disadvantaged and vulnerable segments of society require the development of inter-sectoral strategies and the sharing of responsibility among individuals, groups and communities.

Introduction

The "epidemic" of road accidents appeared at the end of the 19th Century with the introduction of cars on roads. Since August 17th, 1896, when *Bridget Driscoll*, a London pedestrian, became the first reported victim [1], road accidents have increased with the rise of motorization, and their death tolls by 1997 had reached 25 million worldwide [2]. World Health Organization (WHO) data show that in 2002, 1.2 million people were killed in road accidents, that is approximately 3,000 people per day [3].

Geographic differences are considerable, with values of standardized mortality rate per 100,000 population that vary from the highest of the rising nations of Latin America (El Salvador 1999, males: 41.7; females: 18.0), of Eastern Europe (Latvia 2001, males: 22.7; females: 10.4) and of Asia (Thailand 1994, males: 21.0; females: 7.9) to the intermediate levels of Mediterranean Europe (Italy 1999, males: 12.1; females: 5.0), to the lowest levels of some Northern European nations (Great Britain 1999, males: 5.6; females 2.8). The male/female ratios are also quite variable, from the highest values of more than 3/1 of various Muslim countries (Tajikistan and Singapore) to the lowest of approximately 1.5/1 of the United States, Canada and New Zealand, probably explainable by the differing prevalence of women drivers [3].

The trend over time of the number of worldwide deaths has registered an increase of approximately 10%

from 1990 to 2002, and a further increase of 50% is expected by 2020 [3-5]. The overall figure hides opposite trends between developing countries, in which a marked growth has been registered both in terms of absolute numbers and of rates, and industrialized nations, in which a decrease has been registered [6-9]. Various factors can be useful to explain these contrasting trends: on one hand, in developing countries, the large growth of the youngest age groups united with economic development and rapid motorization, sustained in particular by the availability of very economic two-wheeled vehicles, and therefore characterized by elevated proportions of vulnerable road users. On the other hand, in industrialized nations, the realization of constantly new systematic interventions aimed at improving the safety of vehicles, roads, and consumers, with results that are particularly evident in the Netherlands, Sweden, and Great Britain [10]. In Italy, even though a reduction in death rates was registered in the period 1969-1998, this did not regard the 15-29 year-old age group [11].

In fact, it is precisely the young age of the victims, more than 50% of whom are young adults between ages 15 and 44, that represents one of the issue's most afflicted notes. In this age group, the most important from the productive point of view, road accidents represent the first cause of death in industrialized nations and the second in developing countries [3].

Deaths represent only the “*tip of the iceberg*” of the total waste of human and societal resources from road accidents. WHO estimates that, worldwide, between 20 million and 50 million people are injured or disabled each year [5]. Total economic costs associated with both fatal and non-fatal injuries have been estimated in terms of 1-2% of the Gross National Product. By the year 2020 road accidents are projected globally to rank third in DALYs (*Disability-Adjusted Life Years Lost*), a measure of population burden of mortality and morbidity. Nevertheless, despite the heavy economic, healthcare and social costs and the concerns immediately expressed, the problem has not received proper attention. One reason for the historical neglect is the traditional view of “*accidents*” as random events, that are neither foreseeable nor preventable. However, a motor vehicle crash is almost never an event attributable only to chance, but is the result of a set of determining or favouring causes that recognize a number of risk factors of the man, the vehicle, and the physical and social environment [12] (Fig. 1).

Among the first Authors to have taken an interest in the problem from an epidemiological point of view was William Haddon [13], who some forty years ago defined the road system as an ill-designed, “*man-machine*” system in need of a comprehensive systemic treatment. The “*systems*” approach produced a wide number of strategies carried out and evaluated in North America, Europe, and Australia, which ultimately brought about a reduction in the frequency and severity of accidents [14-16].

The Province of Grosseto is one of the territories most affected by road traffic injuries in the Region of Tuscany [17-21]. The objective of the study is to describe the epidemiology of road accidents in the Province of Grosseto in order to contribute to the reduction of the burden of deaths and injuries in this territory.

This study is part of the Road Safety Provincial Council’s project, based on other local similar experiences, born in order to build a new culture of road safety that involves all sectors, organizations, and associations that are in some way involved [22]. This process, provided for by objective n. 9 of the document “*Health 21*” of

the WHO and drawn from references in the National Healthcare Plan 2003-2005 [11], from the enactment of the National Road Safety Plan as well as from the recent norms of the New Highway Code, provides for a 40% reduction by 2010 of the number of deaths and injuries caused by road accidents (L. 144/1999).

The Province of Grosseto (4,504 km²) occupies the Southern tip of Tuscany and is made up of the vast coastal plains of the Maremma, once swampy and malarial, the low ranges of the Colline Metallifere hills, and the isolated Mount Amiata. The Province counts 220,000 inhabitants, and is one of the Italian provinces with the lowest population density (48.4 inhabitants/km²).

Methods

Road accidents are recorded with varying tools and aims by numerous bodies and institutions, which therefore originate a plurality of informative sources (Tab. I).

The Road Accident Report carried out by the law enforcement (Traffic Police, “*Carabinieri*”, Municipal Police) includes information regarding the dynamics of the accident, the types of vehicles involved, and its location. In Italy, the survey began in 1952, and was restructured several times, most recently in 1991. Since 1991, only the accidents with at least one injury are recorded, but without reporting information regarding the seriousness of the damage sustained.

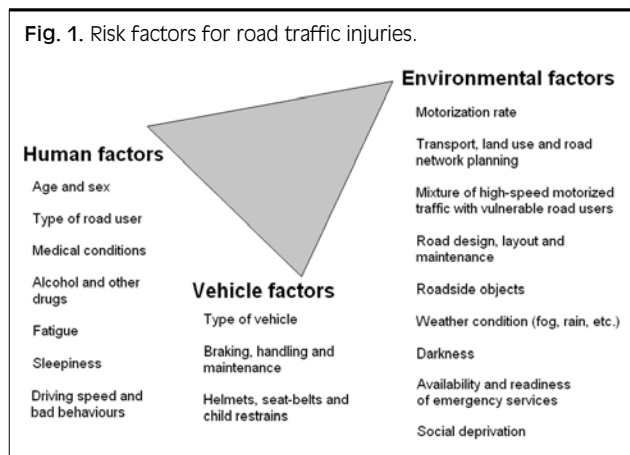
The Death Certificate is completed by a doctor, who verifies the cause of death, and by the Municipality’s Registrar, who compiles the registry information of the deceased. Since 1987 a regional archive is available of deaths and their causes in Tuscany.

The Hospital Discharge file is the tool for gathering information relative to every patient discharged by public and private hospital institutions for ordinary and “*day*” recoveries. The hospital discharge file was instituted by the Health Ministry decree of 28 December 1991; the following decree of 26 July 1993 analytically specified its contents and the modalities of transmission of information gathered, and since 1 January 1995 it has definitively replaced the previous surveying of recoveries; the computerized archive of data has been available since 1996. The file has a field to codify the type of trauma/accident (optional compilation).

The Emergency Room represents a preferential source for obtaining information relative to injuries that may also be minor [19]. Unfortunately, the various Emergency Rooms present different computerization systems and a significant variability of data gathered. The only homogeneous data is that relative to the number of admissions for all causes and accident typologies. This data was surveyed in 2004 by the Regional Health Agency [20].

Furthermore, we have conducted a survey with an ad hoc questionnaire in order to draw further information (during the weeks 20-26 June, 11-17 July, 15-21 August, 19-25 September, 17-23 October of 2005) from the Emergency Room of the Grosseto Hospital that reports

Fig. 1. Risk factors for road traffic injuries.



Tab. I. Sources of road traffic injury data.

| Source | Data | Limitations | Indicators |
|-----------------------|--|--|--|
| Police Report | <ul style="list-style-type: none"> - Age and sex - Types of road users involved - Types of vehicles involved - Location and sites of crashes - Police assessment of causes of crashes | <ul style="list-style-type: none"> - Underreporting, particularly for crashes where only one vehicle is involved and for non-fatal injuries - No medical information - Quality of data linked to the level of collaboration of people involved in the accident - Georeferencing of the location of the accident difficult or imprecise | <ul style="list-style-type: none"> - Number of deaths, injured persons and road accidents - Mortality Ratio (deaths per 1,000 accidents) - Severity Ratio (injured persons per 1,000 accidents) |
| Death Certificate | <ul style="list-style-type: none"> - Age, sex and area of usual residence - Type of trauma - Type of vehicle involved - Type of road users involved | <ul style="list-style-type: none"> - Only fatal events - Lack of data regarding the accident - Georeferencing of the location of the accident impossible | <ul style="list-style-type: none"> - Number of deaths - Standardized Mortality rate per 100,000 population (Reference: Europe) |
| Hospital Discharges | <ul style="list-style-type: none"> - Age, sex and area of usual residence - Type of trauma - Costs of treatment | <ul style="list-style-type: none"> - Only the most severe events (injuries with significant traumas) - Poor quality of completion of the trauma/accident field - Lack of data regarding the accident - Georeferencing of the location of the accident impossible | <ul style="list-style-type: none"> - Number of admissions |
| Emergency Room Visits | <ul style="list-style-type: none"> - Age, sex and area of usual residence - Type of trauma - Destination (discharge, hospitalization, etc.) | <ul style="list-style-type: none"> - Only events with injuries (including minor) - Absence of standard survey file - Lack of data regarding the accident - Georeferencing of the location of the accident impossible | <ul style="list-style-type: none"> - Number of visits |

the number of admissions for road accidents, and in the case of accidents without police intervention, information was gathered regarding age, sex, residence, type of accident, injury, prognosis, *triage* code.

Data from different sources are not easily comparable because of different definitions and criteria of inclusion adopted. For example, in the case of the Police Report, only people who died by the thirtieth day (by the seventh day up to 31 December 1998) from when the accident occurred are counted, while in the case of the Death Certificate, this survey includes all cases, even if the interval between the injury and the death exceeds 30 days. For this reason, at the national level, the overall number of fatal accidents observed from death certificates is higher (by approximately 25%) than that deriving from the police report [21]. At local level, a comparison between the total number of deaths registered by the two sources is not straightforward, as in the Police Report the location of the accident is registered,

while on the Death Certificate is reported the place of residence of the deceased.

Results

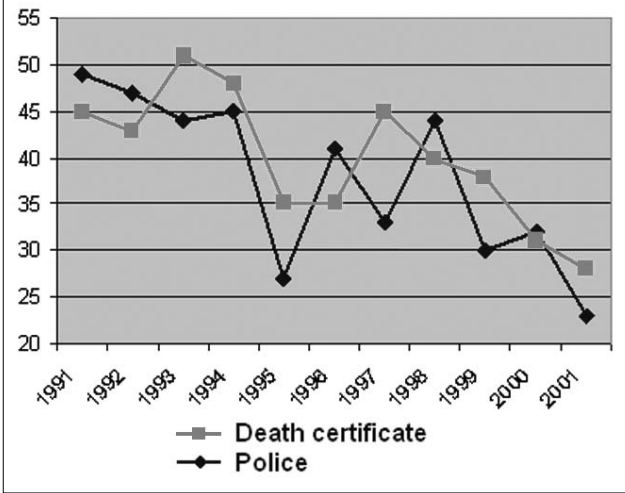
The comparison between the numbers of deaths recorded by Death Certificates and by Police Reports at the provincial level finds the data of the latter to be equal, or in some years even greater (Fig. 2).

DEATH CERTIFICATE DATA

The number of deaths and the respective standardized rates of the province (Tab. II) are decreasing, both for males (-28.3%) and for females (-48.3%).

Males are more affected than women (ratio 3/1), at every age and particularly in relation to the two peaks, in young age corresponding to the beginning of driving, and in old age.

Fig. 2. Number of deaths due to road accidents surveyed by Death Certificates and Police Reports.

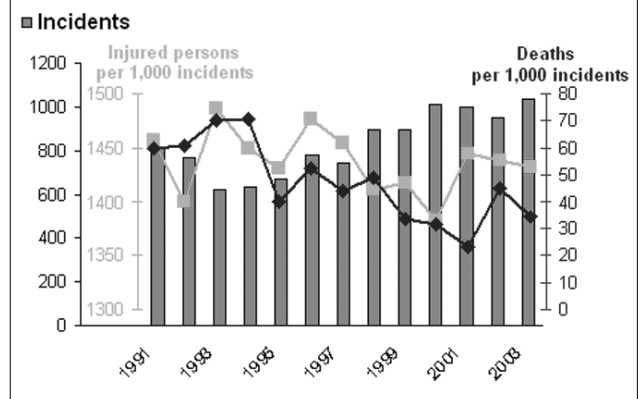


Regarding the different types of road users killed the data has been codified in only 175 (31.3%) out of 559 deaths. Table III shows the corresponding figures.

POLICE REPORT DATA

Based on data from Police Reports in the Province from 1991 to 2003, 10,839 accidents occurred (723 accidents per year) that implied 15,551 injuries (1,037 injuries per year) and 494 deaths (33 deaths per year). In the

Fig. 3. Road accidents, ratio of severity (injured persons per 1,000 accidents) and mortality (deaths per 1,000 accidents) per year from 1991 to 2003.



period from 1991 to 2003, the number of road accidents increased by 26.9% (1991: 819; 2003: 1039), while the values of injured persons per 1,000 accidents (1991: 1,457; 2003: 1,432) and deaths per 1,000 accidents (1991: 59.8; 2003: 34.6), that are indicators of severity of fatal and non-fatal accidents, decreased (Fig. 3).

Regarding the seasonality, the number of accidents increases from February to August, and then decreases again. August presents the highest values, both in terms of numbers of accidents and of mortality and severity ratios (Fig. 4).

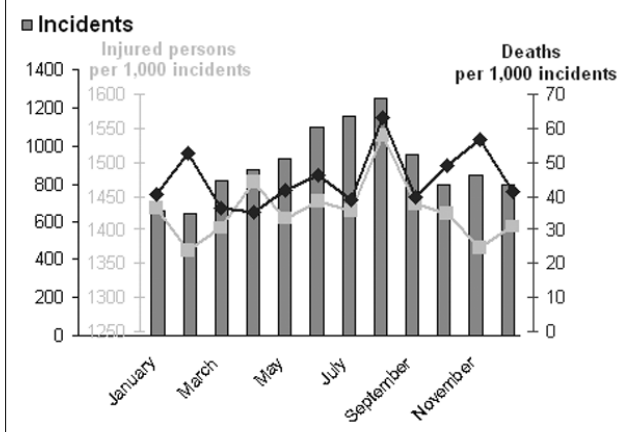
Tab. II. Number of deaths and standardized rates (European population) in the Province of Grosseto from 1991 to 2005.

| | 1991-1993 | | 1994-1996 | | 1997-1999 | | 2000-2002 | | 2003-2005 | |
|--------|---------------|---------------------|---------------|---------------------|---------------|---------------------|---------------|---------------------|---------------|---------------------|
| | No. of deaths | Rate (IC 95%) | No. of deaths | Rate (IC 95%) | No. of deaths | Rate (IC 95%) | No. of deaths | Rate (IC 95%) | No. of deaths | Rate (IC 95%) |
| Male | 103 | 29.4 (23.6-35.2) | 95 | 25.8 (20.4-31.1) | 97 | 27.7 (21.5-33.0) | 68 | 19.2 (14.3-24.1) | 70 | 20.6 (15.3-25.8) |
| Female | 36 | 8.9 (5.7-12.1) | 23 | 6.9 (4.0-9.8) | 26 | 7.8 (4.5-11.2) | 21 | 6.3 (3.3-9.4) | 20 | 6.0 (3.1-8.8) |
| Total | 139 | 19.2 (15.8-22.5) | 118 | 15.8 (12.8-18.8) | 123 | 17.3 (14.0-21.0) | 89 | 12.6 (9.7-15.4) | 90 | 13.0 (10.0-16.1) |

Tab. III. Road users killed and proportionality mortality (percentages) in case of specified code of type of road user in the period from 1991 to 2005.

| | 0-64 years - Male | | 0-64 years - Female | | 65 years and more - Male | | 65 years and more - Female | | Total | |
|-------------------------|-------------------|------|---------------------|------|--------------------------|------|----------------------------|------|---------------|------|
| | No. of deaths | % | No. of deaths | % | No. of deaths | % | No. of deaths | % | No. of deaths | % |
| Pedestrians | 5 | 5.3 | 11 | 44.0 | 20 | 46.5 | 9 | 69.2 | 45 | 25.7 |
| Cyclists | 8 | 8.5 | 2 | 8.0 | 0 | 0.0 | 0 | 0.0 | 10 | 5.7 |
| Motorized two-wheelers | 34 | 36.2 | 2 | 8.0 | 13 | 30.2 | 1 | 7.7 | 50 | 28.6 |
| Motorized four-wheelers | 47 | 50.0 | 10 | 40.0 | 10 | 23.3 | 3 | 23.1 | 70 | 40.0 |

Fig. 4. Road accidents, ratio of severity (injured persons per 1,000 accidents) and mortality (deaths per 1,000 accidents) per month of the year from 1991 to 2003.



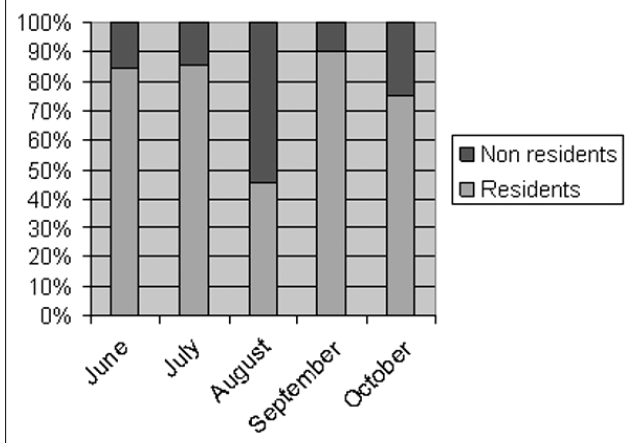
HOSPITAL DISCHARGE FILE DATA

Over the last 10 years, a maximum of 531 recoveries (354 males, 177 females) were registered in 1996, and a minimum of 37 (25 males, 12 females) in 2005 for road accidents among residents of the Province. In 1999, the data corresponded to 10.8% of cases codified in the traumatism field. Nevertheless, in 80.2% of cases, data were absent (code 0) or non-specific (code 9).

EMERGENCY ROOM DATA

In the Province of Grosseto, there were 2,909 admissions for road accidents at the Emergency Room in 2004 (2,062 of which were in the city of Grosseto), or 3.3% of all admissions; this figure is considerably lower than regional data, and can be only partly explained by the non-computation of data relative to the Pediatric Emergency Room of the Grosseto Hospital and of the Massa Marittima Hospital. With regards to the Pediatric Emergency Room, we know from an *ad hoc* survey that in 2003 approximately 80 admissions occurred for road accidents (data non-published).

Fig. 5. Proportion of Province of Grosseto residents and non-residents among Grosseto Hospital Emergency Room admissions in 2005.



Our survey found 303 Emergency Room admissions in 5 weeks during 2005, so the overall number at the Grosseto Hospital in one year, duly considering the seasonality, could be approximately 2,300-2,700 admissions, therefore notably higher than the 2,062 admissions registered by the Regional Health Agency study in 2004 [17]. The corresponding provincial figure should be of at least 3,300 visits each year.

Figure 5 shows how, in the month of August, simultaneously with the tourist bathing season, approximately half of the visits involve people who are not residents of the province.

Discussion

The sources of data available allow to outline the issue in the Province of Grosseto, producing conservative estimates. Each year road accidents cause 30 deaths, at least 530 hospitalizations, and at least 3,300 visits to the Emergency Rooms of the Province's hospitals. The calculation of the relative ratios among deaths, hospitalizations, and ER visits would be 1:18:110, similar to national and international figures. Epidemiological studies have produced estimates of the nature of 1:15:70 in most countries [3]. In Italy, based on elaborations by the National Institute of Health, these ratios would be 1:19:78 [22].

Hospitalization data is surely underestimated, as evidenced by the poor quality of compilation of the traumatism field of the discharge file similarly to regional and national data [23]. Furthermore, the trend over the years to reduce the number of codified accidents, in contradiction with the trend to improve the coverage of institutions and overall quality, determines that, up to today, hospital discharge files cannot be utilized as a reliable source on road accidents [24].

The greater values of death rates, mortality ratio and severity ratio in comparison with other provinces of the Tuscany highlight the excess of mortality and occurrences of accidents [17]. These figures may be explained (likewise with figures of the Provinces of Siena and Arezzo and in contrast with the Provinces of Florence and Prato) by the rural characteristics of the territory (low population density and few greater urban settlements) and therefore a smaller number of crashes but with more serious consequences. Furthermore, the Province represents an economically disadvantaged territory, and epidemiologic evidence from a number of studies have showed that people living in deprived areas present a greater risk of death by road accidents [25, 26].

The morphology of the territory could also influence the occurrence and severity of accidents; level areas, such as the Maremma, could favour speeding, one of the most important risk factors. A study on injury mortality in Tuscany revealed a gradient of risk for road accident deaths among level, hilly, and mountain municipalities [27]. Furthermore the comparison of the number of deaths surveyed by the Death Certificates and by the Police

Reports that finds similar values, while national data shows that deaths surveyed by Death Certificates are approximately 25% more, can indicate an excess of deaths of non-residents due to the condition of the roads or to an increased flow of vehicles entering the territory.

The Province presents elevated flows of commuter and transit traffic, particularly in the month of August, when the seaside resorts are full of tourists. The results show that a peak in the number of accidents and their severity is registered in August. The survey at the Emergency Room also showed that in the same month approximately half of visits for road accidents involved people who were not residents of the Province. Unfortunately there isn't information relative to traffic volume and then it isn't possible to take this factor into consideration.

Ultimately, it is fitting to remember that road characteristics are important parameters that influence road safety. The Province is characterized by the absence of highways and the presence of roads outside urban centres, that may be not well suited to the volume of traffic in the summer period.

Over the course of recent years the overall number of road accidents has increased whilst the severity, both in terms of deaths and injured persons per 1,000 accidents, has decreased, similarly to regional and national data [17, 21]. These trends can be explained by the increasing motorization and then a greater number of crashes but less severe, but also to the new safety equipment available (*abs* and *airbags*), the improvement of the road network, the increasingly diffused organization of rescue systems, the prevention campaigns and the traffic legislation (point systems for driver licenses).

Although in the analysis was adopted a population point of view highlighting the environmental factors to explain the greater risk of people living or driving in the Province of Grosseto, it is important to remember that the occurrence of road accidents in 90% of cases recognize the intervention of human factors due to incorrect driving behaviours, such as not respecting speed limits and driving under the influence of alcohol.

In Italy the prevalence of people driving under the influence of alcohol or other psychoactive substance is very high, especially during the weekend nights [28]. In fact also in the Province of Grosseto, similarly with regional and national data, the most severe accidents occur most frequently on roads outside urban centres, in the summer periods, on the weekends, dur-

ing the night hours, and involve young males most of all [17, 21].

Conclusion

The complexity of the issue, the number of determining factors involved both individual and environmental, the disproportionately greater impact on the more disadvantaged and vulnerable segments of society, require the development of intersectoral strategies and the sharing of the responsibility among individual, groups and communities [29, 30].

Limiting prevention strategies to any single aspect of the many causes of road traffic injuries is an ineffective and narrow approach. Successful strategies will incorporate many countermeasures and involve many different professionals. The start point was represented by the coalition building with the constitution of the Road Safety Provincial Council, auspicated by the agreement of March 2004 among the Province, the Prefecture, the Education Unit of the Local Health Authority and the Research Centre for Health Educational and Promotion (CREPS) of the University of Siena. The Province is an important level since its authority on roads outside the urban centres and motorway schools and the organization on a regional and provincial basis of police, education and health systems.

The objective of the reduction of the burden of deaths and injured makes necessary to dispose of reliable information that allows for monitoring the events, analyzing the role of the risk factors, and evaluating the most effective countermeasures at local level [31]. To overcome the limits of the different data source is necessary to integrate the information available. The integration of the different sources is feasible as demonstrated in the Province of Trento, where an integrated Surveillance System has been realized with a computerized unification of medical data with data collected by the police force [32].

It is necessary to sustain the reduction of the frequency and severity of road accidents through policy aimed at modifying both environmental (for example: design and layout of the roads) and human factors. In particular human error is involved in nearly every road crashes and then educational interventions about lifestyles (alcohol use) and driving behaviours should form the backbone of road injury prevention in settings such as school and motorway school [33].

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