International Transport Forum

ROAD SAFETY BENCHMARKING

METHODOLOGY AND APPLICATION IN A SELECTION OF COUNTRIES IN LATIN AMERICA

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1 BACKGROUND AND OBJECTIVES OF THE PROJECT

Background

In 2014, the International Transport Forum at the OECD and the Fédération Internationale de l'Automobile (FIA) signed a 3 year co-operation agreement focusing on the improvement of worldwide traffic crash data collection and analysis.

One of the projects jointly selected for implementation in 2015 is the "Benchmarking of road safety performance in Latin American countries".

Countries may learn to improve road safety from their own experiences and analyses but also from systematic comparison with other countries of both their safety performance and their safety interventions and policies. The Benchmarking can be defined as a systematic process of searching for best practices, innovative ideas and highly effective operating procedures that lead to superior performance (Hammer & Stranton, 1995). Countries benchmarking is a useful tool, which has been used in many regions in many areas, to compare countries and learn from each other.

The objective of this project is to develop a methodology to assess road safety performance in a selection of Latin America countries and benchmark their performance against a set of indicators and best practices. The expected outcome is to offer policy makers in Latin America a tool to assess the weaknesses and strengths of each country and identify areas deserving policy attention and where the experience of other countries may be usefully applied.

The results from this benchmarking analysis shall be useful to policy makers and researchers in understanding better road safety principles and in learning from each other in order to design effective road safety policies.

This work inspires from the SUNflower[1] project which was conducted in Europe (Koornstra et al., 2002). Following the presentation of the project to the Observatorio Iberoamericano de Seguridad Vial (OISEVI) General Assembly in April 2015, ten countries expressed interest in participating in the project: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay and Uruguay.

The project is implemented in five stages:

1. Development of a methodology – theoretical framework (November – June 2015).

[1] The SUNFLOWER project was originally developed to assess road safety in Sweden, United Kingdom and the Netherlands, and was then extended and applied to nine countries.

2. Workshop with data experts from Latin America (July 2015)
3. Collection of data and information (August – October 2015)
4. Benchmarking analysis (October – February 2016)
5. Final Seminar with data experts and decision-makers (Spring 2016)

Methodological approach

The purpose of this paper is to describe the theoretical methodology to benchmark road safety performance in a selection of Latin American countries.

The methodological approach is based on the road safety target hierarchy (see Figure 1) used in the Sunflower project (Koornstra et al., 2002). In this approach, it is essential to have a clear understanding of traffic safety processes at different levels in the hierarchy, and also the causes and consequences that lead to casualties and costs for society (Fred Wegman & Oppe, 2010):

- 'structure and culture' layer which captures country specific characteristics relevant for road safety: the 'structure' is related to the organization of the policy context (who legislates, who deals with operational issues, etc.), and the 'culture' relates to the perception by the society of road safety problems and the respective responsibilities of individuals and the government;
- safety measures and programmes (as the road safety policy performance);
- safety performance indicators (as intermediate outcomes);
- the numbers of accident fatalities and injuries (as the final outcomes) ;
- the social costs of accidents and injuries being at the very top.

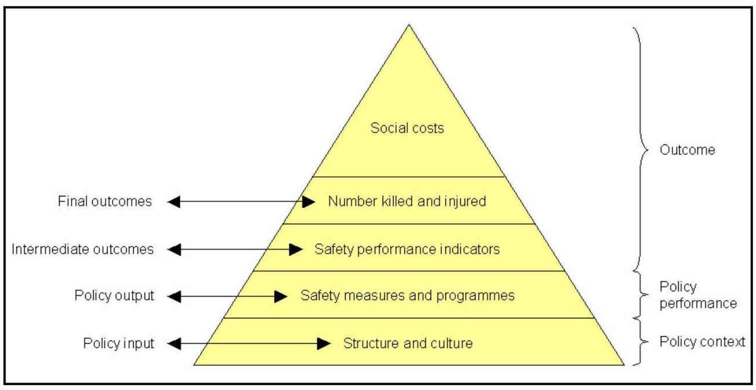

Figure 1 - A target hierarchy for road safety (Koornstra et al., 2002; LTSA, 2000)

The methodological approach includes:

- The development of a set of indicators, adapted to the road safety situation in Latin America. This will include:
    - Outcome indicators (for different road user groups, types of roads).
    - Safety performance indicators.
- The identification of road safety management practices in key road safety areas, as a basis for safety interventions benchmarking.

In this project on road safety benchmarking in Latin American countries, it is proposed to analyse information from all the layers of the pyramid, as well as the relationships between them.

This vision is in accordance with the three levels of road safety problems mentioned by Kare Rumars (Rumar, 2000):

- First level: Problems at a superficial analysis, related to the way accident and injury statistics are analysed, collected and organised, which varies from country to country.
- Second Level: Problems revealed by a deeper analysis of the first level problems, for instance unclear road traffic rules, inefficient enforcement of license requirements and traffic rules, insufficient control of road condition from the safety point of view,, amongst other.
- Third Level: Problems almost totally hidden, which assume a more general character, and are related to underlying processes or conditions of the traffic situation, namely the organisation and management of road safety work such as central or distributed responsibilities or the values and knowledge of road safety measures that the citizens in a society may have.

2 LITERATURE REVIEW

It is now well recognized, whatever the policy sector under review, that there are many lessons to be drawn from the analysis of a country's performance and policy in relation to practices in other countries from the same region or at the same level of development.

This type of analysis is called “benchmarking”. It consists of a systematic process of searching for best practices, innovative ideas and highly effective operating procedures that lead to superior performance (Hammer et al., 1995). Benchmarking is a tool to learn from the performances of others ‘in the same class’.

To review road safety performance of different countries, against various areas, and based on data availability and specific objectives, different types of benchmarking can be envisaged (Shen et al., 2015):

- Product benchmarking to compare road safety final outcomes, such as road traffic mortalities, without any kind of exposure normalization (International Traffic Safety Data and Analysis Group, 2013; OECD & ECMT Transport Research Center, 2006).
- Programme benchmarking to compare activities related to human–vehicle–infrastructure performance, such as drink driving, seat belt wearing, vehicle and road safety ratings, and corresponding policy action. This approach has been frequently used in current road safety studies since these activities are causally related to crashes or injuries and can provide a better understanding of the process that leads to crashes. (International Traffic Safety Data and Analysis Group, 2013; OECD & ECMT Transport Research Center, 2006).
- Strategic and organizational benchmarking to compare national road safety strategies, resources, management and the organizational framework. However, due to the lack of appropriate indicators characterizing their features, only some initial attempts have been carried out to date, such as (Al-Haji 2007), (Wegman et al. 2008), and (Eksler et al. 2009).
- Integrated benchmarking, requiring the use of a road safety index, which combines individual indicator values into one single score (composite indicator). This type of benchmarking is particularly useful for international comparisons, when a number of indicators are already available. Regular comparisons per indicator may only give a simplified vision of the road safety situation, and can be misleading since different countries may operate in different circumstances. The use of a composite road safety indicator (or index) allows to achieve a meaningful benchmarking (Shen et al., 2015).

Benchmarking of different types has been successfully undertaken in several countries (mainly in Europe). This section provides a summary of the most important road safety benchmarking projects and provides a literature review of the published results.

2.1 SUNflower Project

The first SUNflower project (Koornstra et al., 2002) compared road safety performances, programmes and policies in Sweden, United Kingdom and The Netherlands. The objectives were to identify key factors that contributed to road safety improvements in these countries and how these could be used in other countries to further improve their performance. The three countries were chosen because, although being considerably different, they present very similar safety records. They all implemented in the preceding decades targeted and well planned road safety programmes, their policies had similar objectives, but they differed in their implementation on several aspects.

The main goal was to better understand the relationship between the developments of road risks (through the reduction of the number of deaths and serious injuries) and the road safety policies, programmes, and measures effectively implemented in Sweden, United Kingdom and The Netherlands. Road safety was described as a pyramid consisting of several layers (as already mentioned in Figure 1).

The analysis focused on assessing the effectiveness of the main road safety measures implemented in each country and on the identification of the most effective measures. The analysis then assessed the potential benefits in each of the three countries of a full implementation of these measures and, therefore, areas where the countries could further progress were identified.

This methodology was applied in the analyses of national road safety strategies and fatality risks of comparable road types, road user modes and collisions between modes. Four case study subjects were considered: drinking and driving; seat belt and child restraint use; local infrastructural improvements on urban and minor rural roads; and safety on main inter-urban roads. Changes in overall national risk and several more specific risk trends between 1980 and 2000 were also considered. Based on these analyses, the fatality reductions between 1980-2000 were attributed to road safety measures and discussed in the context of the targeted fatality reductions up to 2010.

The general main conclusions reached were:

- all three countries achieved similar levels of safety through continuing planned improvements;
- policy areas targeted in these countries were similar but policies implemented differed at a detailed level;

- differences in focus for safety programmes result from both different relative sizes of accident groups and differences in the structure of road safety capability which influences their ability to deliver different types of policy;
- progress was achieved through directing improved policies to all three areas: vehicle, road and road users.

Specific recommendations and conclusions with respect to differences between the SUN countries are presented in Annex 1.

2.2 SUNflower+6 Project

In a second study, SUNflower+6, a similar method was applied to analyse the road safety performance of nine countries (Eksler et al., 2005; Hayes et al., 2005; Lynam et al., 2005; Morsink, Oppe, Reurings, & Swov, 2005; F. Wegman et al., 2005). To facilitate the benchmarking exercise, countries were classified in three groups with similar road traffic patterns:

- The Sun countries: Sweden, United Kingdom and The Netherlands;
- Southern European countries: Greece, Portugal, Spain and the Autonomic Community of Catalonia;
- Central European countries: Czech Republic, Slovenia and Hungary;

According to the specificity of each group, practical recommendations were proposed for their most problematic areas like vulnerable roads users, enforcement, legal system or speeding, amongst others. Important differences were found between the Northern Europe and Southern Europe. The specific recommendations and conclusions for each group and country are presented in Annex 1.

2.3 SUNflowerNext - Towards a composite road safety performance index (within SafetyNet project)

The SUNflowerNext study (F. Wegman et al., 2008) focused on 27 countries. The objectives were to identify the best performing countries, understand why they were performing better than other countries, and to analyse how outstanding practices from the countries which perform 'best-in-class' (Gitelman, Doveh, & Hakkert, 2010; F. Wegman et al., 2008) could be adapted to other countries.

Three different types of performance indicators were considered (see also Figure 1):

- road safety performance indicators;
- implementation performance indicators;
- policy performance indicators.

An overall road safety index combining the indicators in each layer of the pyramid was also developed. Two weighting schemes (principal component analysis[2] and factor analysis[3]), were examined based on the data collected for 27 European countries (see also Papadimitriou et al. 2013).

The performed analysis revealed that the countries' ranking based on the combination of indicators was different from the traditional ranking of countries based only on mortality rates or fatality rates. The inclusion of information on policy performance and implementation performance to the ranking and grouping process improved the results and made them more comprehensible.

2.4 DaCoTa project

The aim of DaCoTa project was to provide an instrument that facilitates the comparisons of the overall road safety situation between countries (Bax et al., 2012). This instrument results from the combination of indicators, called the overall Road Safety Index (RSI) of a country, which describes the road safety outcomes and the road safety policy performance. These performance indicators were compared at three different levels (see Figure 1):

- final outcomes (injuries and crashes);
- intermediate outcomes (safety performance indicators such as drink driving, speeding, car safety);
- policy output (safety measures and programs).

A method to combine the indicators of final outcomes, intermediate outcomes and policy output layers into one single composite index was developed. The authors calculated the

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[2] Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.

[3] Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors.

composite index for each layer, and then investigated the value of combining the composite layer-indices in one overall Road Safety Index. This was made using weighting schemes in order to deduce a weight for each indicator, and to compute an index score for each country subsequently. However, different weighting methods have their own advantages and limitations, and imply different end results.

The DaCoTa project was a follow-up of the SafetyNet and the SUNflower related projects. In SafetyNet and SUNflowerNext, the pyramid structure was developed, the concept of road safety performance indicators were appointed and elaborated and first calculations were made. The following four issues were considered an add-in to the work of the SUNflowerNext project:

1. To investigate whether indicators for road safety management can be used in the Road Safety Index.

2. To extend the work on indicators for structural and cultural differences among countries.

3. To aggregate the indicators into one single score per layer of the pyramid.

4. To investigate whether further integrating the four layers into one single score for the composite index as a whole would provide an added value.

Ideally, an overall Road Safety Composite Index would provide an unambiguous ranking of all countries, taking into account all indicators of safety outcomes. However, specific theoretical and practical problems on the weighting of layer-indexes were encountered, which require further research.

2.5 International benchmarking of road safety : State of the art

The work done by Shen et al. (2015) refers to the fact that for those countries within the same region or that have already passed through similar stages of challenges and development, there are several common problems that can be identified in a close cooperative work, and improvements can be expected by learning lessons from existing best practices in other countries (even if the final solutions or priorities may differ from one country to another, in accordance with their own safety characteristics) (Shen et al., 2015).

This author presented a road safety benchmarking cycle, adapted from F. Wegman et al. (2008), with five core activities (see Figure 2): determining the key components for road safety benchmarking, identifying the benchmarking partners (or countries), constructing indicators for meaningful comparisons and data gathering, examining gaps in performance and their root causes, and finally, establishing future attainable performance and monitoring progress. The development of a road safety index was also addressed, and some theoretical and practical issues on this subject were discussed.

Shen et al. also refer to the work of Al-Haji (2007) and (Hermans, Van den Bossche, & Wets, 2008). Al-Haji proposed a road safety index (RSDI), considering three main areas: fatality rates, road user behavior and system (safer vehicles, safer roads, socio-economic level, enforcement, and organizational performance). For this purpose, four weighting methods were adopted, which were: equal weighting; expert judgments; subjective weights based on previous experience; and principal component analysis.

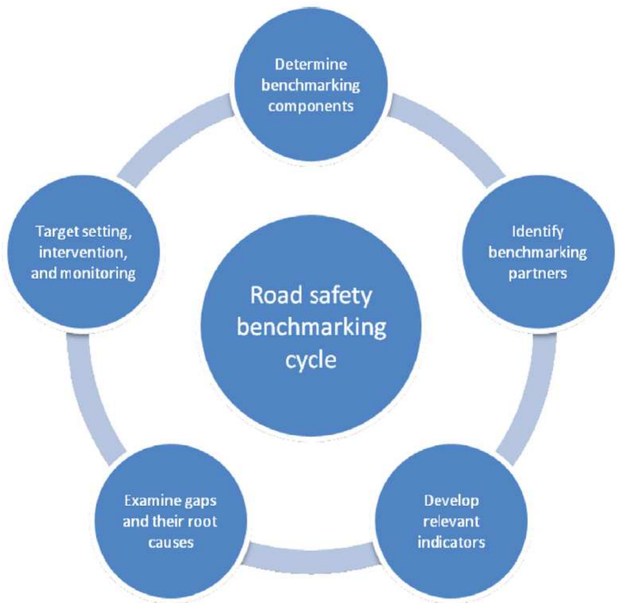

Figure 2 - The road safety benchmarking cycle (Shen et al., 2015; F. Wegman et al., 2008)

Hermans et al. (2008) proposed a road safety performance index for cross-country comparison. One safety performance indicator was defined for each one of the six risk factors: alcohol and drugs, speeds, protective systems, vehicles, roads, and trauma management. Five weighting approaches were investigated to combine the separate indicators into one overall index: factor analysis, budget allocation, analytic hierarchy process, data envelopment analysis, and equal weighting. The results were then compared with the number of fatalities per million inhabitants. The data envelopment analysis method was considered the best approach to the road safety ranking.

2.6 Designing a composite indicator for road safety

The work done by Gitelman et al. (2010) aimed at the development of a composite road safety indicator for benchmarking countries' road safety performance, for 27 European countries (see also 2.4). The purpose of the analysis was to explore different ways for creating a composite road safety indicator and evaluating the robustness of the basic indicators involved. It was demonstrated that both tasks can be realized by the statistical weighting methods applied. The RSI indicator combined the four layers of the road safety pyramid: policy performance (road safety programs), final road safety outcomes (fatality rates, scope of traffic injury), intermediate outcomes (wearing rates of seat belts, crashworthiness and composition of vehicle fleet, alcohol-impaired driving), and background characteristics of countries (motorization level, population density) (Gitelman et al., 2010).

The combination of these indicators was made through the use of weights, using Principal Component Analysis and Common Factor Analysis, enabling to rank and group the countries according to their safety performance. These authors refer that the use of a composite road safety indicator which includes different components of the road safety pyramid is realistic and meaningful, since it gives a more enriched picture of road safety than a ranking based only on fatality rates, which is the most common current practice.

3 METHODOLOGY

For this project, the purpose will be to compare, for different countries in Latin America, crash trends and characteristics, road safety strategies, policies and measures that have been implemented, and to analyse which have been the most effective in reducing traffic casualties and under which specific conditions.

The comparison will identify similarities and differences between countries, in particular regarding factors, circumstances and developments that have an influence on crash risk and the severity of their outcome. More specifically, the work will encompass the following tasks:

- define indicators and collect the data required to analyse the specific case studies and overall policy;
- provide insights concerning the reliability of different data sources for comparing road safety policies and actions in Latin America countries;

- identify the strengths and weaknesses of each country or region through comparative benchmarking (data availability and quality);
- develop a scientifically based understanding of differences between benchmark values;
- draw conclusions on best practices and success factors in different areas, and propose how these could be applied in the countries under review, to enhance the implementation of their road safety policy.

To undertake this analysis, it is proposed in particular to collect and analyse data and information in the following areas (see Annex I for more details):

- Road safety policy and organization;
- General data on the road transport system;
- Road crashes and casualty data, and traffic and road safety trends;
- Key road safety areas that can be identified to carry out case studies (the defined preliminary list (section 3.1.2) may be changed based on specific interests or available data).

Facing the fact that for most countries a whole set of data will not be available, two options were discussed with interested countries on how to proceed in case of serious data problems:

- Regional or municipal analysis: depending on data availability at regional or municipal level, a benchmarking analysis for 3-4 selected cities or provinces may be undertaken.

- Case studies: to make an in-depth analysis on a specific road safety policy area, case studies will be included that allow a thorough characterization of the legislative framework of each participating country and their safety outputs. A transversal comparison between countries will allow determining which safety policies are more effective and recommended for implementation.

All the countries' representatives considered to have enough data to participate at the national level, so neither the regional nor municipal analysis were considered. As for the case studies approach, it was decided to submit a data availability questionnaire that covers all the case studies, and according to the available data, the project coordinators will suggest the inclusion or exclusion of each country in each particular case study.

In order to improve the benchmarking analysis, it is proposed to group the countries that present similarities on key indicators (please see section 3.2). Nevertheless, as data availability is not yet fully known, it was agreed that the final grouping, if needed, will be made at a later stage, after a preliminary analysis has been made.

3.1 Data analysis

3.1.1. Review of the transport system and the national road safety strategies and plans

An initial task that facilitates the subsequent benchmarking is the description of the background provided by ongoing road safety plans, the content of the road safety policies, including key interventions and main stakeholders, and road improvement programs.

It is foreseen to collect general data describing the road transport system, which may be used as direct and indirect indicators for exposure to risk, namely: population, country area, road length, registered motorized vehicles, annual distance travelled by vehicles and passengers, or fuel sales for road transport.

The retrospective analysis of data trends (injuries and accidents) is also included in this analysis, as a way of finding insights to explain differences identified by the benchmarking, and then propose possible quantitative contributions according to the differences in actions of the listed chronological development of key actions.

3.1.2. Crash data

Specific analysis of road crash statistics and casualty data will be performed. After the workshop, several problems on data availability were identified, namely in what concerns information on severely injured and slightly injured victims: some countries did not consider the injury level on their records (only dead or injured), while others had underreporting problems for these levels of injuries. As a result, it was decided to reduce the analysis to fatalities and fatal accidents. Several disaggregations will be explored, in order to identify particularities of the data for each country: type of road users, age group, location, involved vehicles. Data will be collected up to the year 2013. It was decided that the analysis may be updated with 2014 data at a later stage.

In what concerns the time trends analysis, it was agreed that each country will decide on the most appropriate time frame to provide their data, taking into account that it should be provided for the longest timeframe possible in a consistent way.

Depending on the data availability, the development of a composite index, similar to the ones proposed in SUNflowerNext and DaCoTa projects might be considered. The feasibility and utility of this index will be analysed after the workshop that will be held with experts from each of the participating countries.

A preliminary list of data to be collected was elaborated, as follows:

1. Road safety policy and organization
    - Main road safety policies, plans and road network improvement programs
    - Organisation of Road Safety related activities
    - Selected key road safety legislation (eg. speed limits, maximum BAC level, seatbelt laws, etc.)

2. General data describing the road transport system
    - Population, Age Distribution of the population, Population in urban/rural areas
    - Driver licences (types, age limits)
    - Area (km^2), Road length (urban and rural) (km), Motorway length (km)
    - Registered motorised vehicles, by type: Passenger cars , Lorries (≥3.5 ton), Van / station-wagon (< 3.5 ton), Motorcycles, Mopeds/mofas, Other motor vehicles
    - Annual distance travelled:
        - Vehicle-kilometres
            - Road type (motorway, urban, non urban roads)
            - Vehicle type (passenger vehicles, bicycle, powered two wheelers)
        - Passenger-kilometres on roads:
            - Public transport
            - Pedestrians

3. Road crashes and casualty data:
    - Overall road safety indicators:
        - Number of fatalities;
        - Number of fatalities by type of user (driver, Car occupant, Lorry occupant, Bus occupant, Motorcyclist, Mopedist, Cyclist, Pedestrian, Other road users)
        - Fatalities distribution per age group and road transport mode (Passenger cars and station wagons, Bicyclists, Mopeds and Mofas, Motorcycles and Scooters, Pedestrians, Other road users)
        - Number of fatalities resulting from collisions, by type of user (driver, Car occupant, Lorry occupant, Bus occupant, Motorcyclist, Mopedist, Cyclist, Pedestrian, Other road users) and in single crashes or in collisions with different types of vehicles (Passenger Car, Lorry, Bus, Motorcycle, Moped/cycle, Animals, Train/Tram, Other)
        - Crash data by location (urban / non urban)
        - Underreporting of road crashes

    - Pedestrian crashes
        - Number of pedestrians deaths in collisions with Car, Lorry, Bus, Motorcycle, Moped, Tram, Train, Other type of vehicle
        - Age distribution of pedestrian fatalities
        - Trends in pedestrian fatalitiy rates
        - Pedestrian accident location - Urban vs. Rural
        - Pedestrian Fatalities per month, per day of week and by time of day

- Powered two wheelers (PTW)
  - Number of PTW fatalities trends, by type of accident
  - PTW accident location - Urban vs Rural
  - Age Distribution of PTW fatalities
  - Number of PTW drivers and passengers killed, with and without helmet

- Drink and driving
  - Number of screening tests per year, per vehicle car
  - Number of drink&drive infringements and Screening tests positive in crashes with casualties
  - Number of fatal crashes with driver over the alcohol limit
  - Number of screening tests on drivers involved in fatal crashes
  - Number of screening tests performed per accident

- Speed
  - Speed limits per road type and vehicle class and sanction regime
  - Number of speed limits infringements on different types of roads
  - Number of crashes and casualties due to excessive speeding on different types of roads and environment

- Seat belts
  - Seat belt usage among drivers and passengers, front seat, back seat for different road types
  - Seat belt use and child restraint systems (CRS) infringements
  - Seat belt use and CRS among fatal crashes, by age

- Young drivers
  - Number of drivers involved in crashes by driving license holders age
  - Number of loss of control crashes by age group
  - Number of new drivers trends (male/female)
  - Number of car drivers involved in fatal crashes by age group
  - Number of weekend night crashes by age group

- Infrastructure safety data form IRAP (International Road Assessment Programme)
  - Star Rating of roads by road user group:
    - Proportion of roads classified as 1, 2, 3, 4 or 5 stars for different road users (where traffic volumes > 5000 a day);
  - Road condition data (global and desegregated by urban/rural environment):
    - Roads where pedestrians are present and speed flows at 40km/h or more and have no footpath;
    - Roads where bicyclists are present and traffic flows at 40km/h or more that have no bicycle facilities;

- Roads with high motorcycle flows (>=20% of total) and traffic flows at 60km/h or more that have no motorcycle facilities;
- Roads carrying traffic at 80km/h or more that are undivided single carriageways;
- Curves where traffic flows at 80km/h or more that have hazardous roadsides;
- Intersections where traffic flows at 60km/h or more that have no roundabout, protected turn lane or interchange.

3.1.3. Cases studies on key areas

Identifying the major road safety problems faced by Latin America countries will involve the analysis of nine topics called "case studies", as proposed in the following lines:

- pedestrians,
- powered two wheelers,
- drink and driving,
- speeds,
- seat belts,
- young drivers,
- road infrastructure.
- vehicle safety
- trauma management

This list is not final, as the case studies will only be undertaken when a minimum of 3 countries has enough good data to provide. The final selection of case studies will be made based on country interest and data availability.

In each one of these case studies several analyses will be made, in order to characterize relevant aspects: age distribution of fatalities and accidents, trends, accident location (urban vs rural), accidents per month, day of week and time of day. The specificity of each case study will be considered in a more detailed analysis:

- For powered two wheelers, the use of helmets, risk according to accident location (urban/rural), drivers versus passenger injuries, types of accidents, age of motorcyclists involved in an accident;

- For the drink and driving issue, screening tests, infringements, and accidents involving drivers over the alcohol limit will be analysed;

- For the speeds aspect, a characterization of the legal speed limits and sanction regime will be analysed, also including the infringements number, and the accidents and injuries due to excessive speeding;

- For the seat belts case study, analysis on the seat belt and child restraint systems usage on and off accidents, and on their infringements;

- For the young drivers case study, the license holders age and sex and their involvement in accidents will be analysed;

- For the infrastructure safety data, resources like IRAP will be used, which has available data for some Latin America countries, namely on risk mapping, road performance tracking (in what concerns injury trends), road star rating through route's inspections and the existence of safer roads investment plans;

- For the trauma management case study, the total number of evacuations to trauma centre (by type of transportation), the average time values for arrival at scene, for treatment in the field, and for arrival for definitive treatment in hospital, the total length of hospitalisation, the number of EMS (Emergency Medical Stations), the number of trauma beds in permanent medical facilities, the number of hospitalisation in intensive care units and the number of EMS-vehicles will be analysed;

- And finally, for the vehicles case study, the total number of vehicles listed by year of manufacture (or year of first registration) and type, will be analysed.

3.1.3. Regional analysis

As previously mentioned, on the scenario of unavailable data for the whole country, the analysis focus may be shifted to a region or city with available data.

In the first case, it is foreseen that no alterations on the analysis will be necessary, as long as this region comprises both urban and rural areas.

In the case of cities, it is important to retain that the analysis based on urban/rural comparisons is compromised, which can be of high relevance since different road environments may correspond to different road users. One possible solution would be to compare these cities with select similar ones (in terms of population) from each participating country.

3.2 Country grouping

At the time of the development of this methodology, nine countries expressed their interest in participating on this project: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay and Uruguay.

As mentioned above, a meaningful benchmarking analysis requires comparing subjects that are comparable. In this respect it was considered useful to distinguish two groups of countries based on their motorization, geographical, population patterns, etc . It is not yet decided that this will be the final grouping to consider, as the data availability may constraint the grouping analysis. It was agreed that the final grouping, if needed, will be made at a later stage, after a preliminary analysis has been made.

It is expected that the country grouping will increase the degree of "natural association" among members of the same group and help to distinguish members from different groups (Anderberg, 1973), offering a more feasible basis for the safety performance comparisons and the transference of successful experiences.

A "grouping" analysis was undertaken taking into account the following factors:

- Population density
- Share of the population in urban and rural areas
- Motorization rate
- Road fatality rate.

Details of this analysis are presented in Annex 1. The results of this exercise allowed to identify the following similarities between countries:

a) According to population density

   Group 1: Colombia, Costa Rica, Cuba, Ecuador, Mexico

   Group 2: Argentina, Brazil, Chile, Paraguay, Uruguay

b) Percentage of urban versus rural population

   Group 1: Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay

   Group 2: Argentina, Brazil, Chile, Uruguay

c) Level of motorization

   Group 1: Chile, Colombia, Costa Rica, Cuba, Ecuador, Paraguay

   Group 2: Argentina, Brazil, Mexico, Uruguay

d) Mortality rate x Motorization rate

Group 1: Paraguay, Ecuador

Group 2: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Mexico, Uruguay

From these sets it is not easy to select two main groups, as similarities are not homogeneous. Nevertheless, it is possible to confirm that Argentina, Brazil and Uruguay are always together irrespective of the selected factor. In the same group it is possible to include Chile, (sharing similarities under three factors), and Mexico (sharing similarities under two factors).

Accordingly, the following country grouping is proposed (see also Figure 3):

Group 1: Colombia, Costa Rica, Cuba, Ecuador, and Paraguay

Group 2: Argentina, Brazil, Chile, Mexico, Uruguay

Figure 3 – Country grouping proposal

4 FINAL NOTES AND NEXT STEPS

The methodology described in this paper was fine-tuned jointly with ITF and OISEVI, based on data and information availability and on the outcome of the workshop that was held with experts from the participating countries in July 2015. At this workshop, a survey was undertaken to have a first idea on the types of data and information available.

The data to be collected was organized in a template that was sent to the countries representatives. This data collection is expected to be completed until the 1st of October, after which the benchmarking analysis can be initiated.

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6 ANNEX 1 – SUNFLOWER AND SUNFLOWER+6 PROJECTS SPECIFIC RECOMMENDATIONS AND CONCLUSIONS

SUNFLOWER PROJECT

Specific recommendations and conclusions with respect to differences between the SUN countries:

- British risks were highest for pedestrians and for motorcyclists, but lowest for car occupants, compared to the other countries. Factors, which may explain these risk differences include the higher traffic density on British roads, the greater use of roundabouts at junctions, and the lower average speed on main inter urban roads.
- Car occupant risk was highest in Sweden. Factors that may explain this were the higher Swedish average speed on main roads, despite lower speed limits, and the lower traffic density and lower speed limit enforcement level.
- Dutch mopedists had almost twice the risk of mopedists in the other countries, and drove more kilometres. Dutch cyclist risk was lowest, but is still higher than car risk even when the risk that cars inflict on other road users is included, and Dutch citizens cycle by far the most. Factors that may explain the low cyclist risk include the presence of large numbers of cyclists and the extensive implementation of cycle facilities.
- Sweden had 14% driver fatalities over 0.1% BAC in 2000 versus an estimated 17% in the Netherlands and a reported 20% in Britain. This may be explained by the differences in legal blood alcohol limit, enforcement policies, and penalties for offending in the three countries.
- The risk on Dutch roads other than motorways was about a third higher than the risk on these types of roads in the other countries. Factors, which might explain this include higher exposure and risk to mopedists, higher cyclist exposure, lower belt use, and higher junction density.

Main recommendations for future road safety improvements in the SUN countries:

- As car drivers had a higher risk in Sweden than in the other two countries; traffic safety effort in Sweden should concentrate on car drivers and their speed behaviour.
- Britain would benefit from a lower blood alcohol limit for drinking and driving, more intensively enforced, but with some relaxation of penalties for the new lower limit offences.
- Britain needed to find an infrastructure solution that enables pedestrian and motorized traffic to co-exist at lower fatality levels, for example by extending the length of urban roads with 20mph (30kph) speed limits.
- Britain should also give greater emphasis to developing a more extensive high quality road network of similar density to that in the other countries; this could encourage greater acceptance of lower speeds on other roads.
- The Netherlands needed to understand why its moped rider risk is so high, in order to identify an appropriate solution.
- The Netherlands also needed to review its drink-driving problem to identify how best to make further reductions in alcohol related fatalities.
- The Netherlands needed to identify an effective strategy to increase seat belt wearing rates to a similar level as the other two countries.

SUNFLOWER+6 PROJECT

The main conclusions/recommendations for the SUN countries were:

- Sweden
    - make the transport environment more forgiving, to reduce injuries when accidents occur; this could reduce the high proportion of elderly pedestrian and cyclist fatalities and also reduce injuries among elderly car occupants;
    - consider more efforts to improve public acceptance of enforcement initiatives possibly through more community partnerships. There would seem to be the opportunity to increase the use of automatic detection, mainly of speeding offenders. But increased enforcement also needs a change in the legislative system concerning both fines and vehicle owner responsibility to be as effective as possible;
    - seek in the longer term to move to a lower speed limit for two lane rural roads, and develop a network of higher quality rural roads which can safely sustain higher speed limits.

- United Kingdom

- focus more effort on seeking innovative road designs which cater for mixed vehicular and vulnerable road user activities at the higher traffic flow levels evident in Britain;
- improve facilities for cycling, especially in the context of the Government's desire to increase cycling;
- give more attention to helping drivers recognise the presence and behaviour of motorcyclists within the traffic flow, and give particular attention to countermeasures to reduce bend and overtaking accidents involving motorcyclists;
- ensure that the latest policy statements on enforcement promising greater visible presence are accompanied by sufficient resources to achieve this. Ensure that senior police managers demonstrate a genuine commitment to road safety by maintaining an appropriate level of traffic policing;
- improve its package of drink drive measures and particularly increase the real level of detection to the perceived level. The increasing number of speeding offences also suggests that the balance between enforcement and public awareness might be improved;
- seek in the longer term to move to a lower speed limit for two lane rural roads, and develop a network of higher quality rural roads which can safely sustain higher speed limits; through this approach there should be clearer separation in Britain between the road standards (and speed limit bands) in the rural network.

- The Netherlands

  - continue to increase the share of 30km/h roads in urban areas, and make pedestrian crossing design more consistent with road categories;
  - seek measures to reduce the high proportion of pedestrian fatalities involving mopeds;
  - continue to provide for physical separation of cyclists and motorized traffic on main roads and traffic calming measures at intersections;
  - increase the training required by moped riders aged 16-17 before access to the road, increase (correct) helmet wearing rates, and introduce a more structured licensing system and vehicle registration plates to help enforcement of the behaviour of this group especially as regards speeding;
  - seek ways of increasing the experience gained by young drivers before they take the driving test, including considering accompanied driving before the driving test;
  - seek ways to make the road environment help to comply with relevant speed limits and investigate particularly the situation on 80 km/h roads which have a high fatality risk;

- consider if the very high level of speeding offences suggests that a different approach to modifying speeding behaviour might be needed. Greater focus on enforcement of repeat or extreme offenders should be considered.

The main conclusions/recommendations for the Southern European countries were:

- Greece
  - Improving driver compliance with the existing seat belt law;
  - seek ways to improve pedestrian safety with new measures like artificial lighting or improvement of pedestrian visibility;
  - increase the level of helmet usage (both motorcycles and mopeds) by better police enforcement and increased sanctions;
- Portugal
  - Improve the use of seat belt wearing in rear seat occupants;
  - Seek ways to facilitate safe pedestrian movements on both urban roads and on rural roads passing through towns, with elderly people at night as the design criteria;
  - Consider re-training courses and/or enforcement of helmet usage to reduce the proportion of elderly mopedist fatalities;
  - Portuguese PTW users need improved training or the introduction of a points driving licence that can curb reckless driving.
- Spain
  - Improve the alcohol control made at accidents;
  - Stricter legal measures to be considered that include the setting of a standard BAC level of 0.2 g/l for motorcyclists, or the establishment of a common minimum punishment of unconditional suspension of the driving licence for 6 months for anyone passing the limit;
  - seek measures to improve rear seat belt use;
  - consider the introduction of automatic detection of speeding drivers to reduce their numbers and to change driver behaviour, in order to lower the number of fatalities due to speeding
- Catalonia
  - Increase police controls in order to reduce the drink and drive problem;
  - extend speed camera control to the entire road network (of locations with speed-related accidents) to ensure a change in driver behaviour;

- Improve the use of child restraint system and rear seat belt;

The main conclusions/recommendations for the Central European countries were:

- Czech Republic
  - Seek measures to reduce the high proportion of (elderly) pedestrians and cyclist fatalities and increased involvement of HGV in road accidents;
  - Consider more effort to improve public attitudes to enforcement possibly through more frequent community partnerships;
  - Consider the application of the special regulations controlling vehicle use by novice drivers;
  - Consider the recent system of Police enforcement: Make car owners responsible for the offences related to their vehicle, reconsider the amount of fines and make more transparent how they are used;
  - Revise the methodology of road accidents reporting by the Police in order to provide valuable information for road safety research community;
  - Reconsider speed management scheme, with a stronger emphasizes on general deterrence, prevention and possibly reconsider speed limits on road sections in rural areas. Give more support to zone 30 applications.
- Hungary
  - Consider the responsibility distribution, as it is not clearly defined which of the ministries has the main responsibility for road safety;
  - Increase the resources for road safety improvement, because the existing budget for this purpose is inadequate;
  - Focus at drivers' education and training courses in regard to road safety view, basically the selection of the safe speed and in general the strict requirement of rules obedience must get a greater role;
  - Develop effective speed management.
- Slovenia:
  - Consider the establishment of a central Road (Transport) Safety Agency with proper funding (budget) to coordinate/manage road (transport) safety activities;
  - Apply legislation changes regarding driving under the influence of alcohol (introduction of zero BAC limit) in order to influence the patterns of social behaviour related to excessive drinking in general;
  - Seek measures to reduce the high proportion of young drivers involved in injury accidents, especially those involved in weekend night accidents;

- Consider effective enforcement of zero BAC and pay even more attention to education and preventive work in the respective field;
- Encourage the implementation of effective speed management;
- Encourage further accelerated implementation of traffic calming schemes in built up areas;
- Improve the management of the Road Safety Performance indicators data collection system, including regular research surveys on protective systems use, speeding and alcohol level distribution among drivers.

7 ANNEX 2 – COUNTRY GROUPING ANALYSIS

At this stage, it was possible to collect basic information for each country: population, area, density, road length and number of motorized vehicles, as presented in the next tables and figures (GADM, 2015; Index Mundi, 2015; World Health Organization, 2013).

Table 1 – Basic information on Latin America countries

	Country	Population (2010)	Area (km^2)	Density (hab/km^2)
1	Argentina	40 412 376	2 780 400	14.5
2	Brazil	194 946 488	8 515 767	22.9
3	Chile	17 113 688	756 950	22.6
4	Colombia	46 294 842	1 138 914	40.6
5	Costa Rica	4 658 887	51 608	90.3
6	Cuba	11 477 460	109 884	104.5
7	Ecuador	14 464 739	256 932	56.3
8	Mexico	113 423 052	1 958 201	57.9
9	Paraguay	6 454 548	919 247	0.14
10	Uruguay	3 368 786	178 141	18.9

Figure 4 and Figure 5 present the number of inhabitants of each country and their respective densities. The countries from Central America and the northern part of South America are the countries more densely populated. The country which presents the highest density is Cuba, with 104.5 inhabitants/km^2, followed by Costa Rica, with 90.3 inhabitants/km^2. Mexico and Ecuador have very similar population densities: 57.9 and 57 inhabitants/km^2 respectively, followed by Colombia with 40.6 inhabitants/km^2. At a lower level, one can find Brazil and Chile, with very close density values of 22.9 and 22.6 inhabitants/km^2, followed by Uruguay with 18.9 inhabitants/km^2, Argentina with 14.5 inhabitants/km^2 and in the lower position Paraguay with 7.0 inhabitants/km^2 .

GROUP 1: CUBA, COSTA RICA, MEXICO, COLOMBIA, ECUADOR;

GROUP 2: BRAZIL, CHILE, URUGUAY, ARGENTINA, PARAGUAY.

Figure 4 - Population 2010

Figure 5 - Population density

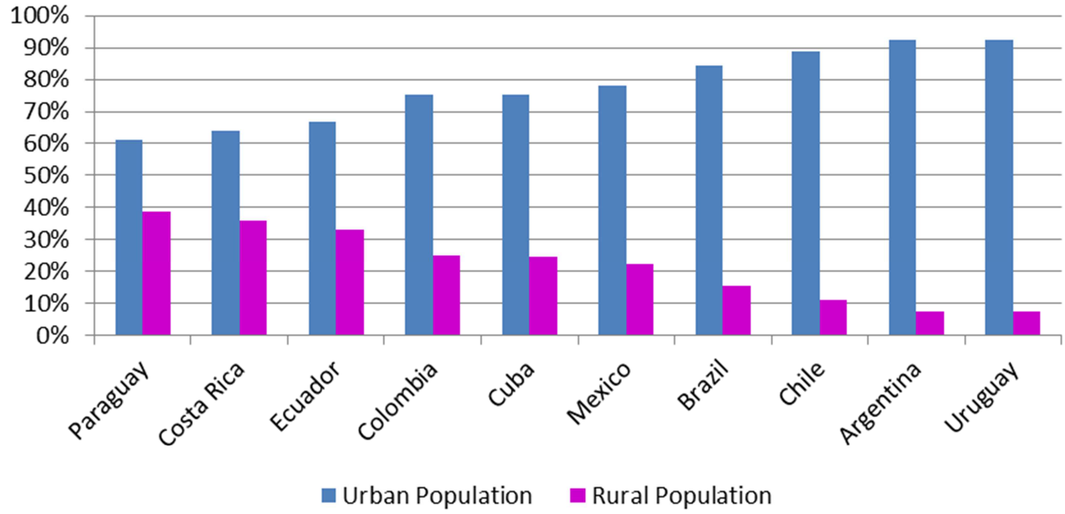

Figure 6 – Percentage of urban versus rural population

Figure 6 presents the percentage of urban population versus the rural population, which provides a comparison of an exposure measure in two considerably different road contexts: rural or urban. All countries present a higher percentage of urban population; however, there are wide variations in the percentage of rural population, with several countries having more than a quarter of their population living in rural areas; such as: Paraguay (38,63%), Costa Rica (36%), Ecuador (33%), Colombia (25%), Cuba (25%) and Mexico (22%). At the other end, with lower percentages of rural population there are four countries: Uruguay (8%), Argentina (8%), Chile (11%) and Brazil (16%).

Group 1: Colombia, Costa Rica, Cuba, Ecuador, Mexico, Paraguay

Group 2: Argentina, Brazil, Chile, Uruguay

A first data collection on the main road network length was performed, which is presented in Figure 7. Although indirectly, road network length can be related to road casualties, as an exposure factor. As presented in Figure 7, Brazil has the highest road network length (317925km), followed by Mexico (226933km) and Argentina (197994km). At a lower level, one can find all the other countries: Colombia (51780km), Chile (46518km), Paraguay (21198km), (Cuba (18101km), Uruguay (13554km), Ecuador (10935km) and finally Costa Rica (5160km).

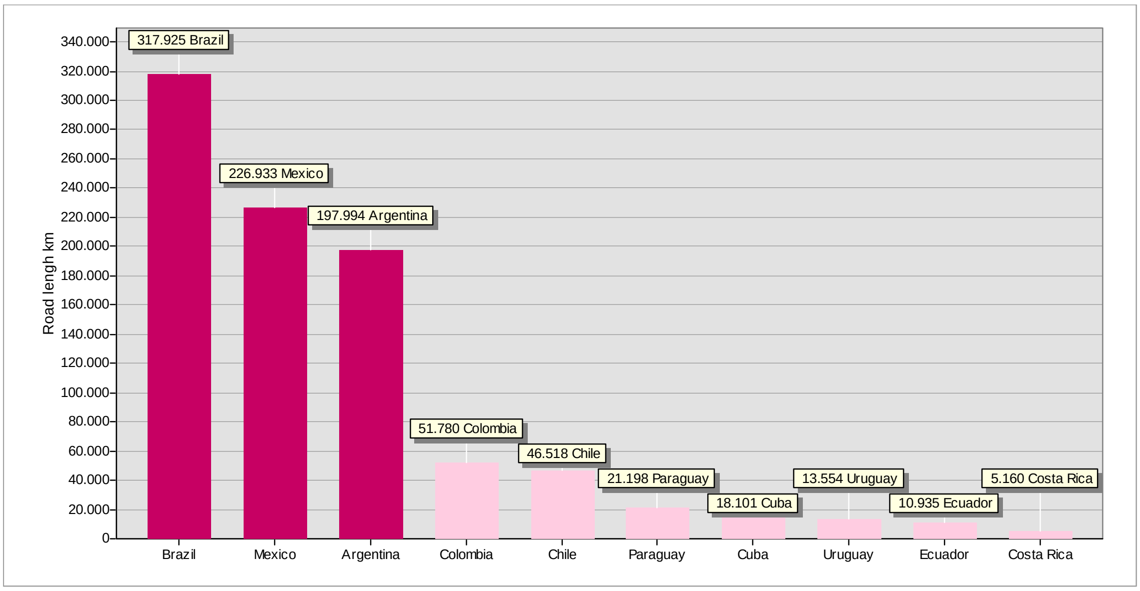

Figure 7 – Main road network length (2010)

The number of motorized vehicles information for the year 2010 are presented in Figure 8 (World Health Organization, 2013). Brazil is by far the country with the higher number of motorized vehicles, but doesn't hold the top position on the number of vehicles per inhabitant (0.33 vehicles/inhabitant) as presented in Figure 8. This value is presented by Uruguay (0.39 vehicles/inhabitant), which is on eighth place when we look at absolute values. Argentina has 0.35 vehicles/inhabitant, followed by Brazil (already mentioned), Mexico, with 0.27 vehicles/inhabitant, Chile and Costa Rica (0.20 vehicles/inhabitant), Colombia (0.16 vehicles/inhabitant), Paraguay (0.14 vehicles/inhabitant), Ecuador (0.08 vehicles/inhabitant), and finally Cuba with 0.05 vehicles/inhabitant.

Group 1: Chile, Costa Rica, Colombia, Paraguay, Ecuador and Cuba

Group 2: Argentina, Brazil, Mexico, Uruguay

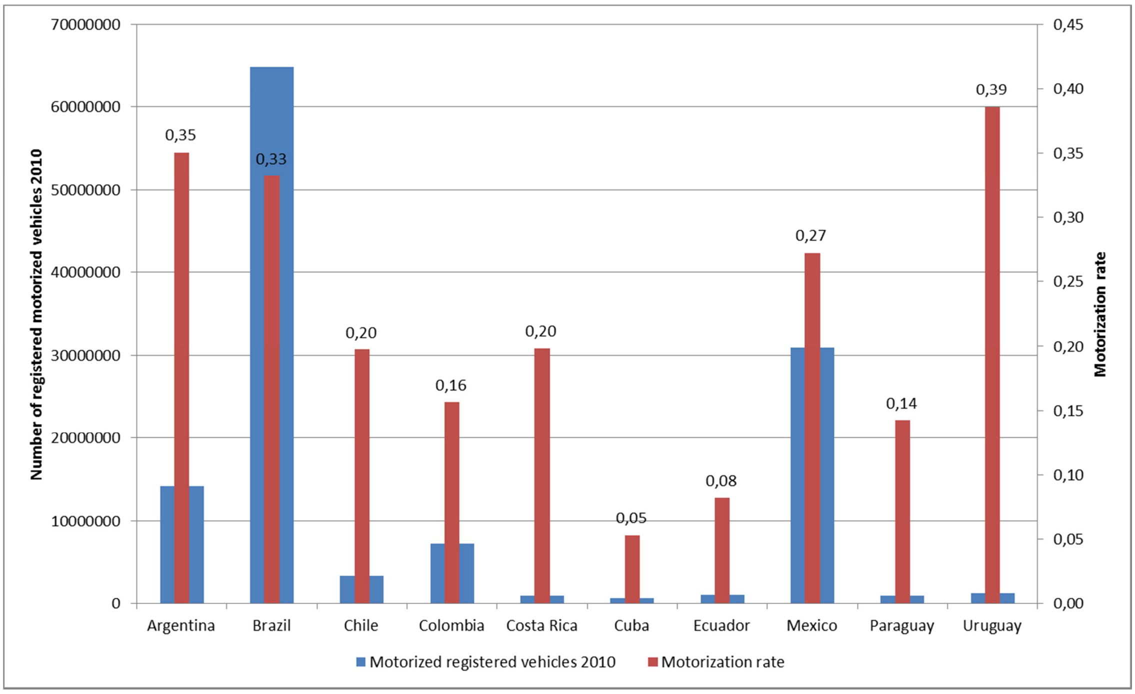

Figure 8 – Number of registered motorized vehicles and motorization rate (2010)

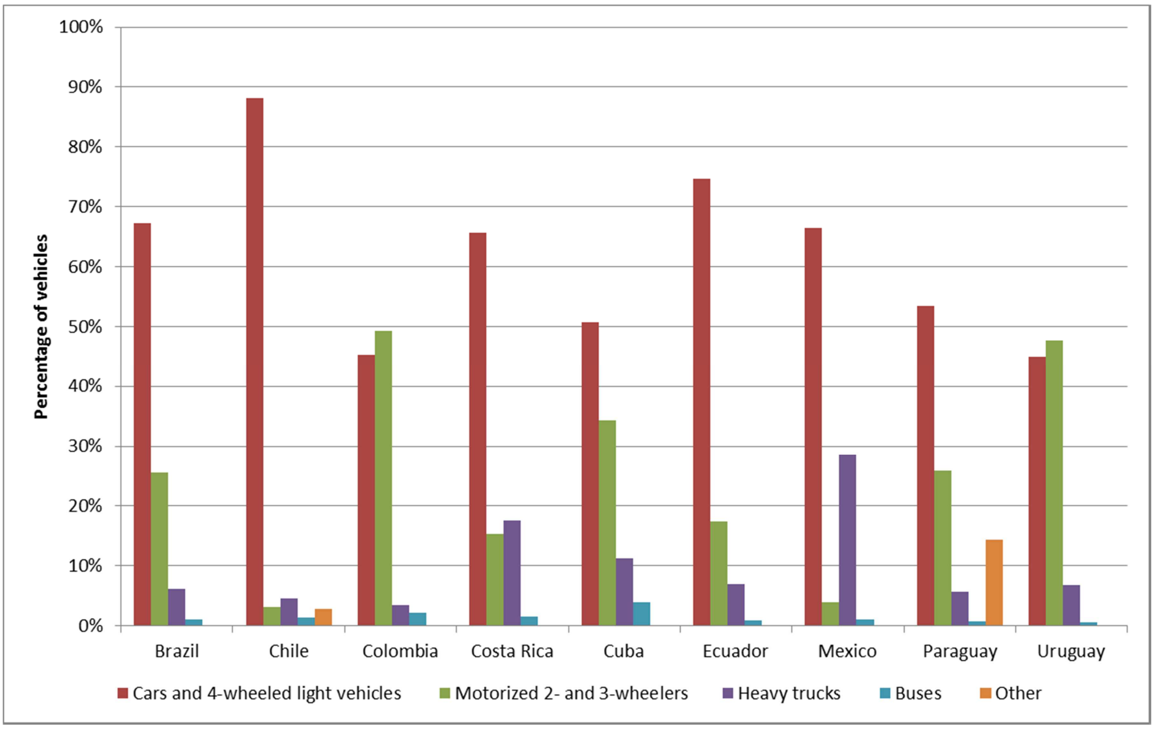

Figure 9 – Number of motorized vehicles disaggregated by type (2010)

Note: No information on Argentina.

Figure 9 presents the number of motorized vehicles disaggregated by type, for 2010. From the analysis of this graph, it is possible to identify some similarities. Colombia, Cuba and Uruguay have very high percentages of motorized 2 and 3 wheelers.

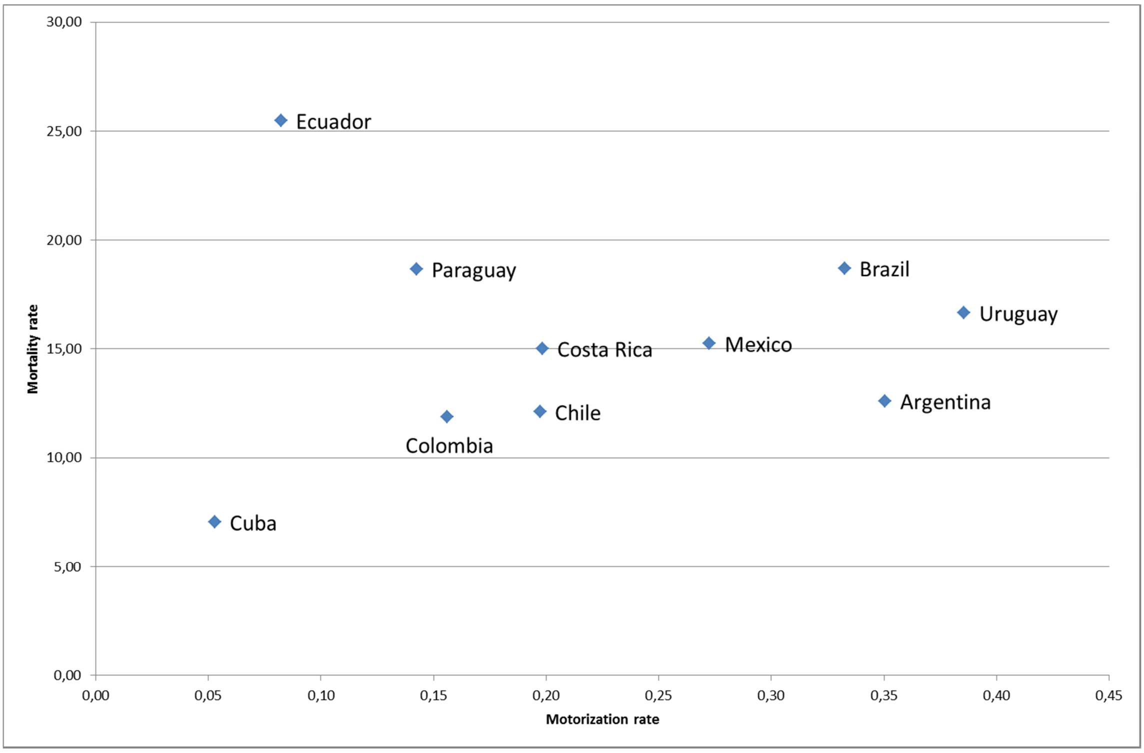

Figure 10 – Motorization rate versus Mortality rate (2010)

Figure 10 presents a scatter plot of the motorization rate versus the mortality rate for the year 2010. The countries which present a high motorization rate and a low mortality rate have better results in terms of road safety. However, good results also might be considered if the motorization rate is low and the mortality rate is also low. With these values it is possible to group Uruguay, Argentina, Brazil, Mexico, Colombia, Costa Rica and Chile. Lower road safety levels are presented by Paraguay and Ecuador.

Group 1: Paraguay and Ecuador

Group 2: Uruguay, Argentina, Brazil, Mexico, Chile, Colombia, Costa Rica and Cuba

Information on road traffic deaths for 2010 is presented in Figure 11 (World Health Organization, 2013).

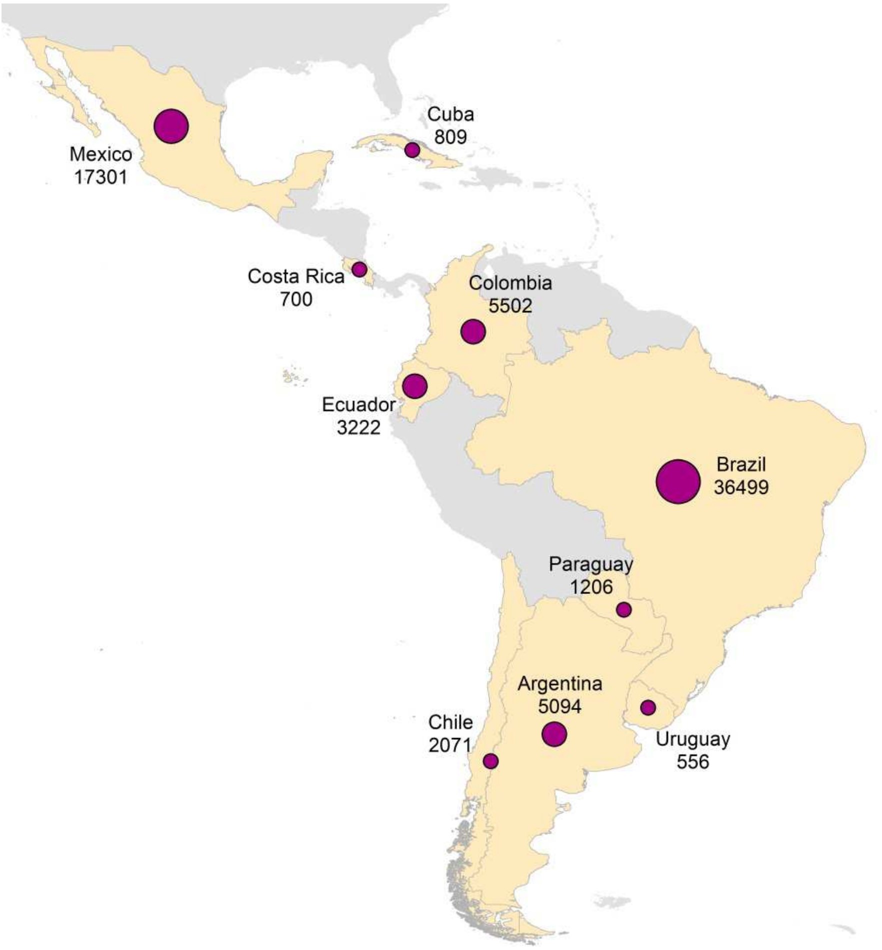

Figure 11 – Road traffic deaths for 2010 (30 days definition)

A more complete time series on road safety indicators is provided by International Traffic Safety Data and Analysis Group (2013), but only for Argentina (see Table 2).

Table 2 – Reported safety data 2008-2011 for Argentina (International Traffic Safety Data and Analysis Group, 2013)

						2011 % change over		
	2005	2008	2009	2010	2011	2010	2008	2005
Fatalities	4 391	5 759	5 219	5 094	5 040	-1.1%	-12.5%	+14.8
Injury crashes		97 474	90 851	89 403	99 466	+11.3%	+2.0%	
Deaths/100 000 population		14.5	13.0	12.6	12.3	-1.98%	-14.96%	
Deaths/10 000 registered vehicles		3.7	3.2	2.9	2.6	-8.3%	-29.4%	

Figure 12 presents road traffic deaths per 100 000 inhabitants for the year 2010. The higher value is presented by Ecuador, with 22.0 deaths/100 000 inhabitants. Brazil, Paraguay and Uruguay follow, with 18.7, 18.7 and 16.5 deaths/100 000 inhabitants, respectively. Lower values are presented by Mexico (15.3 deaths/100 000 inhabitant), Costa Rica (15.0 deaths/100 000 inhabitants), Argentina (12.6 deaths/100 000 inhabitants), Chile (12.1 deaths/100 000 inhabitants), Colombia (11.9 deaths/100 000 inhabitants) and finally Cuba (7.0 deaths/100 000 inhabitants).

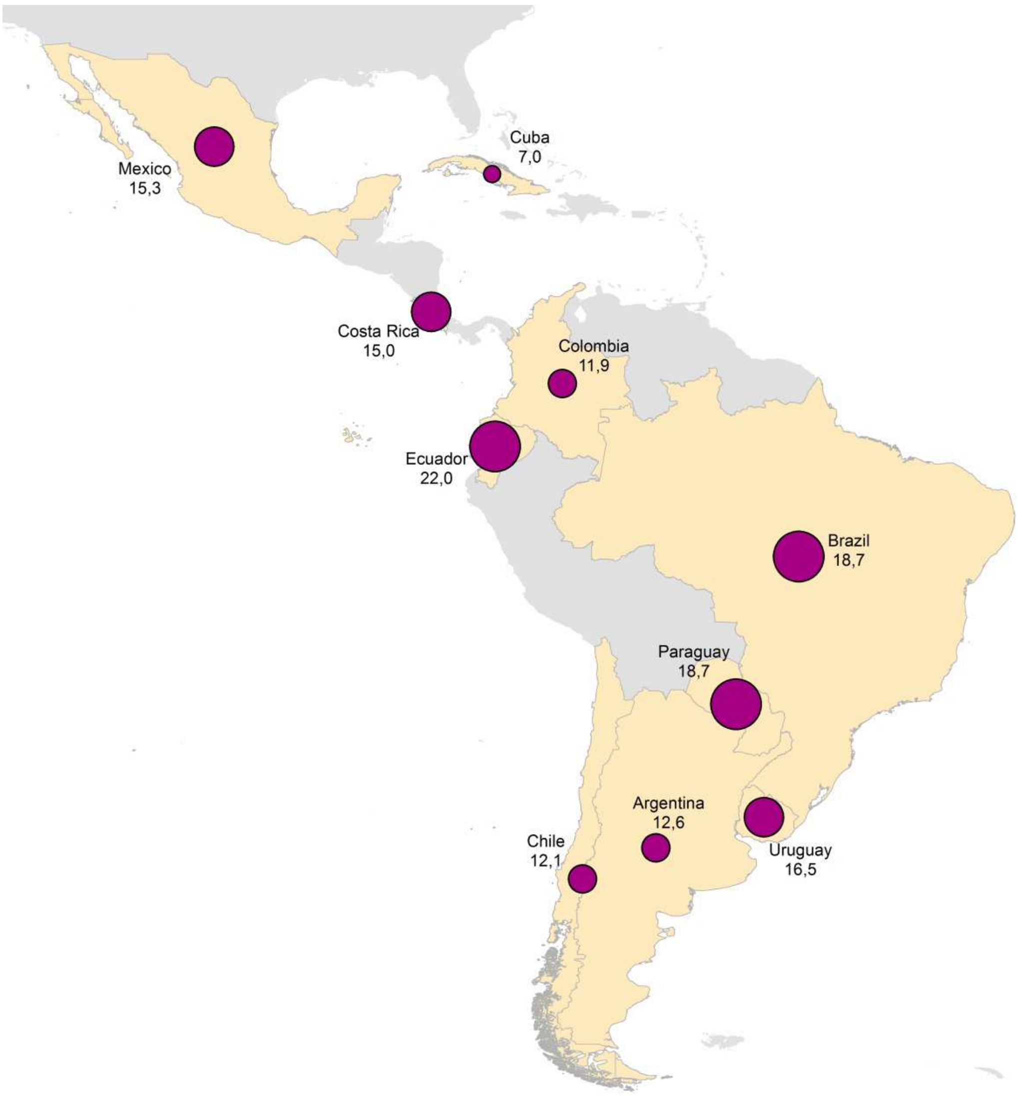

Figure 12 – Road traffic deaths per 100 000 inhabitants (2010)

Figure 13 presents the number of road traffic deaths per 100 000 motorized vehicles in 2010. The higher values are presented by Ecuador, with 310 deaths/100 000 vehicles. Cuba and Paraguay follow, with 133.1 and 131.2 deaths/ 100 000 vehicles, respectively. Colombia and Costa Rica present similar values, with 76.1 and 75.8 deaths/ 100 000 vehicles, respectively. At the other end, we find Chile, Brazil, Mexico, Uruguay and Argentina, with 61.4, 56.3, 56.0, 43.2 and 36.0 deaths/ 100 000 vehicles, respectively.

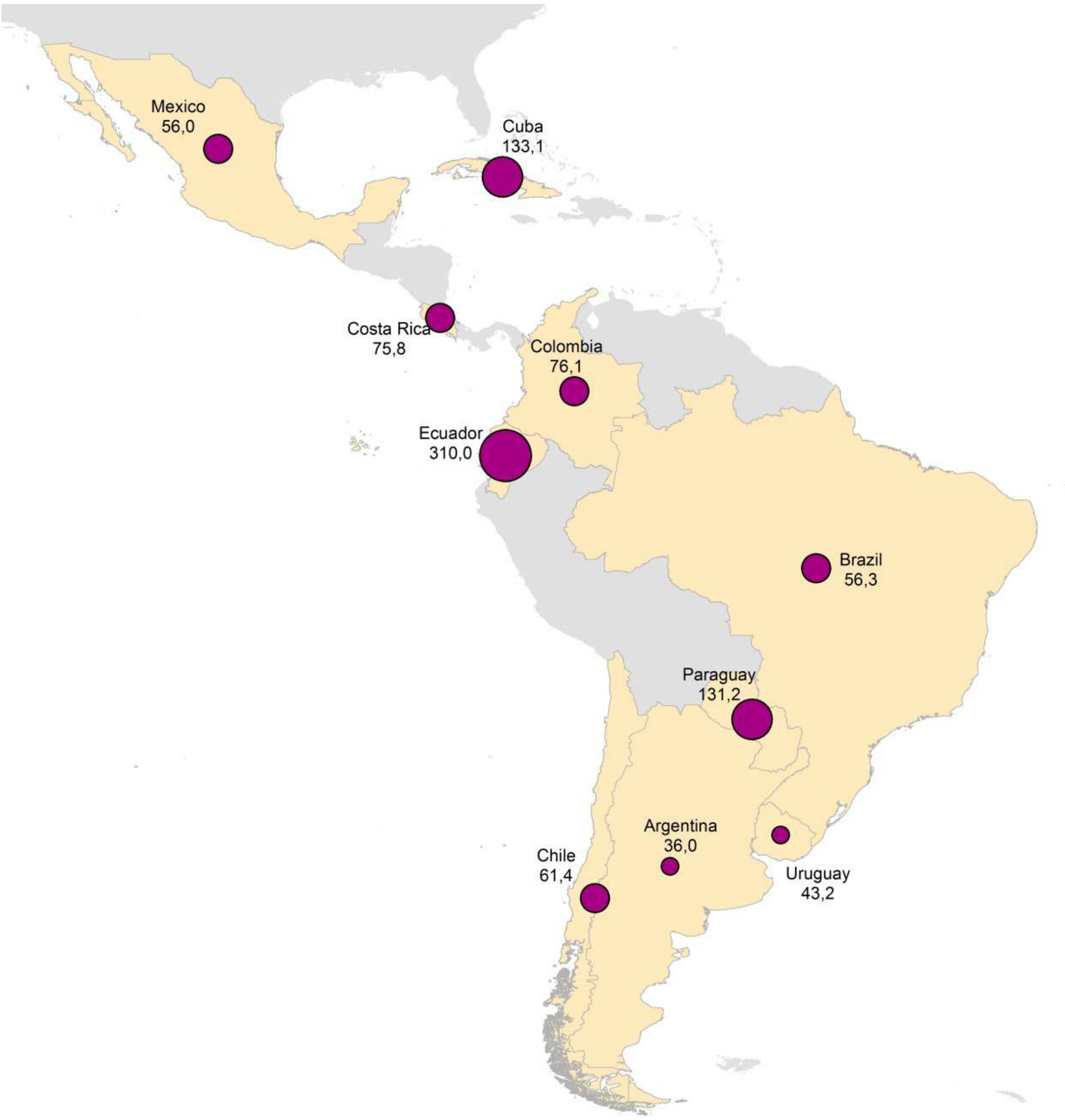

Figure 13 – Road traffic deaths per 100 000 motorized vehicles (2010)

Figure 14 presents the number of road traffic deaths per 100 kilometers of road length in 2010. The higher value is presented by Ecuador, with 29.5 deaths/100 kilometers. Costa Rica, Brazil and Colombia follow, with 13.6, 11.5 and 10.6 deaths/100 kilometers. Lower values are presented by Mexico (7.6 deaths/100kilometers), Paraguay (5.7 deaths/100kilometers), Chile (4.5 deaths/100kilometers), Uruguay (4.1 deaths/100 kilometers), and Argentina (2.6 deaths/100 kilometers).

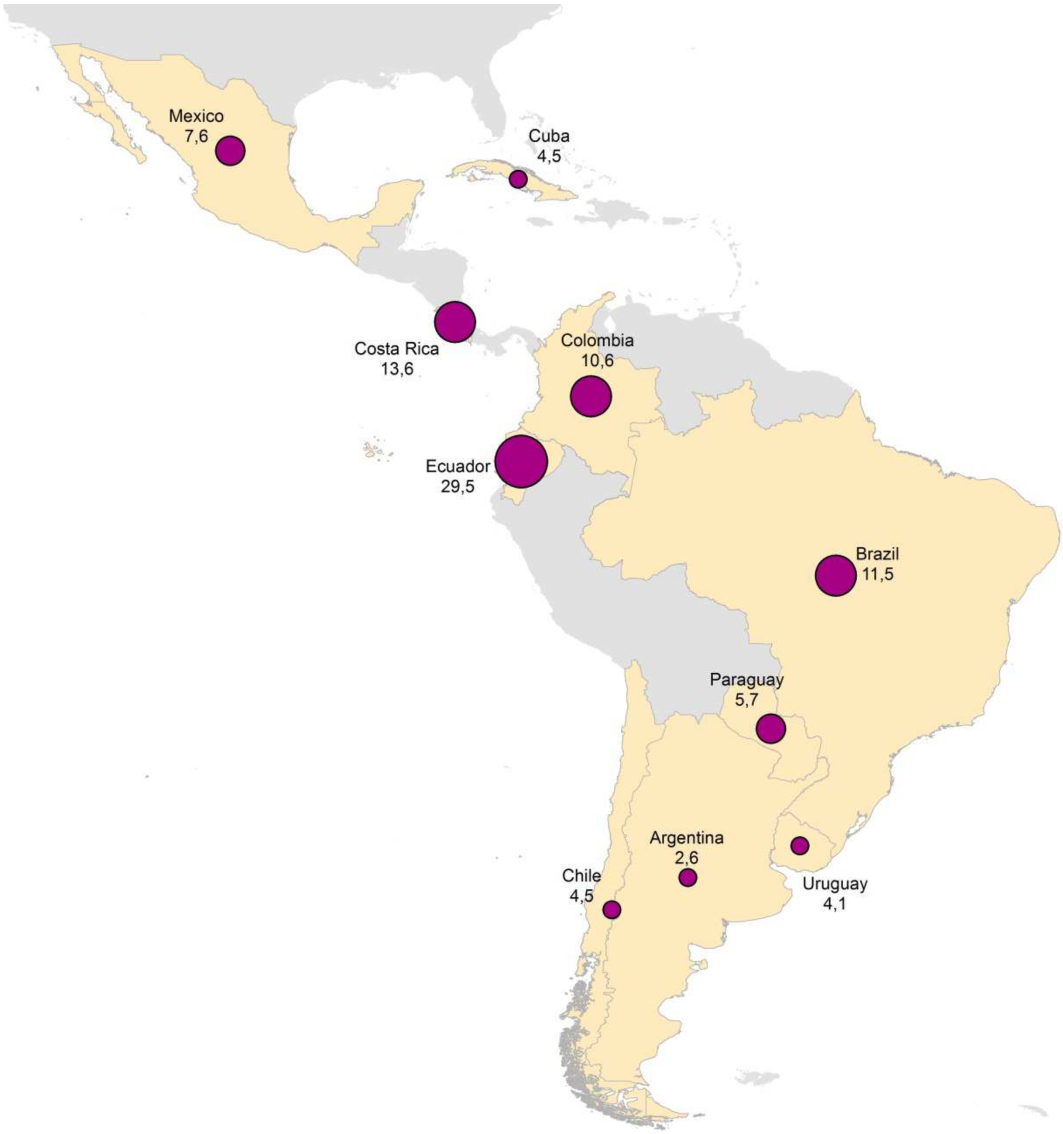

Figure 14 – Road traffic deaths per 100 kilometers of road length (2010)