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IRTAD International Traffic Safety Data and Analysis Group

OECD

Analyses using the European Road Safety Observatory

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Road safety data: collection and analysis

for target setting and monitoring performances and progress

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Background

- Road safety analyses aim to describe and explain road safety outcomes (road accidents and casualties), either in time or in space, as well as to forecast future developments on the basis of existing experience.

- The availability of reliable data is one of the most important conditions for useful road safety analyses.

- Within the development of the European Road Safety Observatory (ERSO), a wealth of road safety related data at European level was gathered, harmonized and made available.

Objectives

- The objective of this paper is to present a comprehensive overview of analyses carried out by using data and knowledge from the European Road Safety Observatory (ERSO).
- These analyses were carried out within the framework of the EC co-funded integrated research project SafetyNet.

Questions in road safety analysis

- **Time series analyses**: description, explanation and forecasting of overall or particular (e.g. motorcyclists') road safety trends.

- **Geographical analyses**: road safety differences between regions, on the basis of attributes of these regions and of external factors (e.g. road safety measures)

- **Accident analyses**: analysis of accident mechanisms in terms of the contribution of road, vehicle, driver and accident characteristics to the accident outcomes.

Dependencies in road safety data

- **Time-related**: series of measurements over time
- **Space-related**: geographical hierarchical data structure
- **Accident-related**: hierarchical accident process (e.g. road users nested into vehicles nested into accidents)
- Most statistical techniques rely on the assumption of independence among observations.
- Advanced statistical techniques are required to handle these dependencies.

Methods

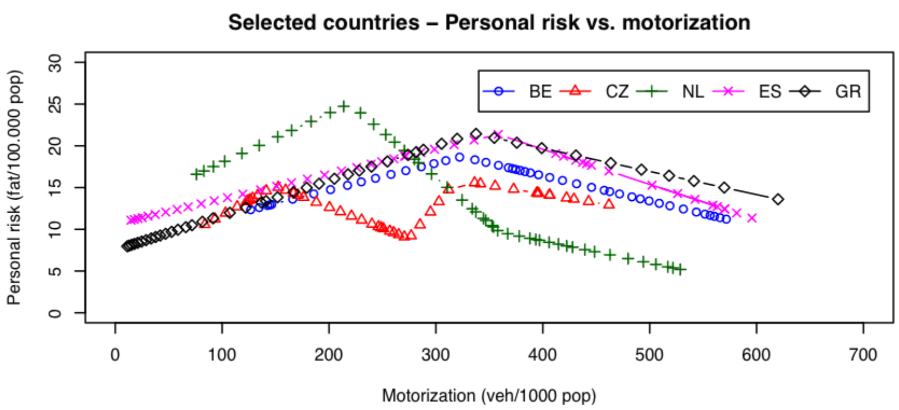
- **Time series analysis:** from extensions of generalized linear models and non-linear models, to dedicated time series analysis methods such as Autoregressive Moving Average (ARMA) models or state-space models
  - serial correlation among observations is explicitly accounted for

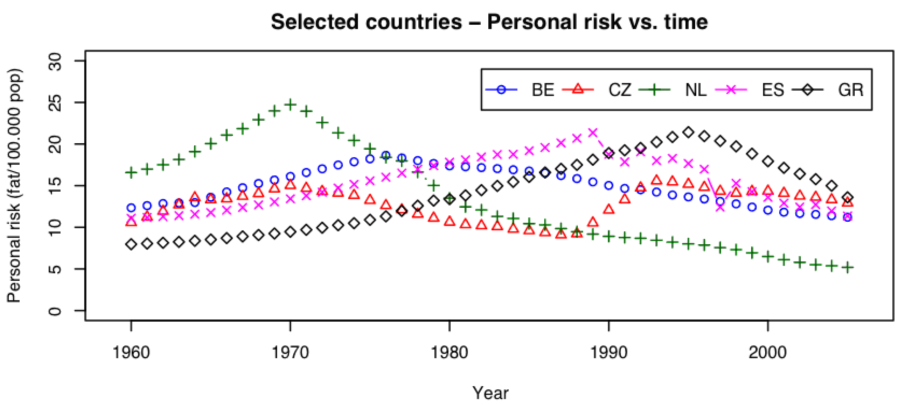
- **Multilevel analysis:** most standard statistical techniques (linear or generalized linear models, multivariate models etc.) may be extended to multilevel forms
  - captures correlations due to some hierarchical grouping of the data
  - easier to apply for geographical analyses than accident analyses

Data

- The development of the **European Road Safety Observatory** has resulted in the collection and harmonization of a wealth of comparable data (macroscopic and in-depth) for 27 European countries.
    - Road accident data of the new Member States (CARE).
    - Estimation of under-reporting in 7 European countries.
    - Risk exposure data (vehicle-kilometres of travel, vehicle fleet, driving licenses, road length etc.) (Eurostat).
    - Road safety performance indicators (alcohol and drugs, speeds, protection systems, DRL, passive safety, roads and trauma)
    - A database of approximately 1300 fatal accidents from 7 European countries
- This data was exploited for addressing key road safety questions

Structural changes in road safety trends





- Different countries reach specific motorization rates in different years.
- Some of the examined countries exhibit their major breakpoint in fatality risk within motorization rate values of 320-370 vehicles per 1000 inh., suggesting that these breaks take place under similar social and economical conditions.
- The range is different for certain subgroups of the examined countries, which show a more complex pattern.

Simultaneous modeling of the three levels of road risk

- A simultaneous analysis of the three levels of road risk, can be very advantageous
  - time series of exposure (e.g. vehicle-kilometres traveled);
  - time series of accident risk (accidents per vehicle-kilometres);
  - time series of accident severity (fatalities per accident).

- Important inter-relations between road safety outcomes and exposure exist and can be optimally accounted for by using multivariate time series analysis.

- Examples for France and the Netherlands

The interest of disaggregation

- When only global figures are used to explain traffic safety changes over time, the resulting models often behave poorly.
- In any country, the total safety figures depend on the related figures of different vehicle groups, road users and road networks.
- Three levels of risk in France: While motorways have a lower accident risk than main rural roads, the severity of motorway accidents is higher compared to main rural roads. Accident risk is generally decreasing, but not so much for motorways, whereas accident severity is generally decreasing, but not so much on rural roads.
- Mobility be age group in the Netherlands: while the number of senior citizens has increased (and will be increasing further), the distance each member of this group travelled with various transport modes changed very little.

The interest of disaggregation

- Examples

- **Three levels of risk in France**: While motorways have a lower accident risk than main rural roads, the severity of motorway accidents is higher compared to main rural roads. Accident risk is generally decreasing, but not so much for motorways, whereas accident severity is generally decreasing, but not so much on rural roads.

- **Mobility be age group in the Netherlands**: while the number of senior citizens has increased (and will be increasing further), the distance each member of this group travelled with various transport modes changed very little.

Explaining the risk

- Another way to obtain a better understanding of the changes in aggregate road safety indicators is to use explanatory variables.
- The influence of a common external factor, the weather, has been studied using time series data from the Athens region in Greece, from France and from the Netherlands.
- The weather factor is useful for road safety monitoring corrected for transitory factors, and could be included in the analysis of short term trends at national level in Europe.

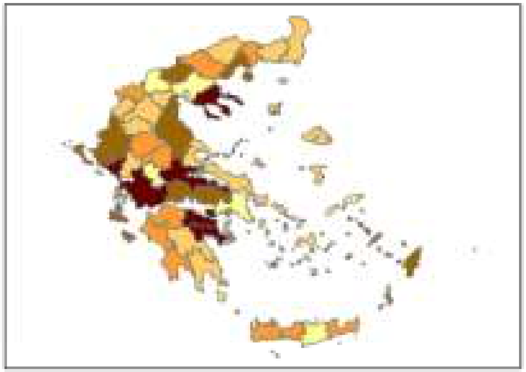
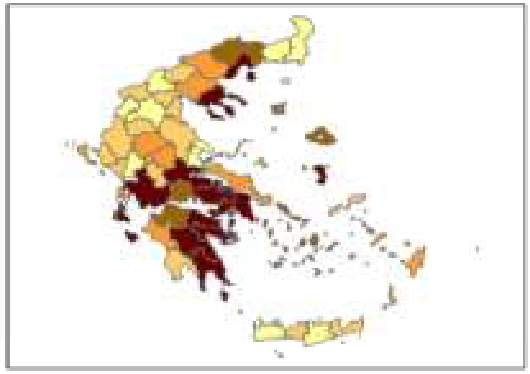
- Changes in weather variables (precipitation, temperature and frost) were significantly correlated with the changes in the numbers of injury accidents and fatalities. However, the strength and even the sign of these correlations depend on the type of road.

Summary of time series analyses

- These analyses reveal the different types of insights that can be obtained on the basis of different levels of analysis,
  – starting from the examination of macroscopic trends,
  – to the combined analysis of different risk levels (exposure, accident risk, and accident severity),
  – to the disaggregation of these risks into different groups of the road traffic system,
  – and eventually by incorporating in the analysis other explanatory risk factors.

Geographical (spatial) analysis

- Using Greek data, it was shown that differences between counties (NUTS-3 level) with respect to the number of accidents or fatalities per inhabitant are, for some part, determined by their location: Neighbouring counties tend to be more similar than counties located far away from each other. These data can be used to create a road safety map for the whole country.

- Spatial modelling can be used to identify borders in road safety (e.g. how broad a road safety measure has to be applied in order to be effective or which areas can be candidate for isolated measures)

Spatial effects of drink-driving and enforcement

- Effects of performance indicators on road safety outcomes at geographical level

- **Belgian roadside survey on drink driving**: Taking into account the geographical dependency of the data (i.e. drivers tested were nested into different sites) it was found that drink-driving on weekend nights exceeds by far that at all other time points. At the individual level, men between 40 and 54 have the highest risk of drink driving.

- **Effects of speeding and alcohol controls in Greece**: both enforcement measures were the most effective in those regions that had the highest accident rate in the first place. Enforcement had a stronger overall effect on the number of fatalities than on the number of accidents.

Road-safety attitudes, behaviours, and accident data

- The accident data from the CARE data base were linked to the SARTRE database
- Attitudes and behaviour were expressed as three principal components:
    - (1) Aggressiveness and Speeding
    - (2) Other Unsafe Behaviour (no seat belt, drink driving etc.)
    - (3) Perceived Control Likelihood.

- A positive attitude towards speeding and aggressiveness was more frequent in age and gender groups that also have a higher number of accidents and fatalities. This statistical relation does not prove that the attitudes shown by young drivers actually caused the accidents. However, it shows that a positive attitude towards speeding and aggressiveness is most typical of the problematic groups.

Summary of geographical analyses

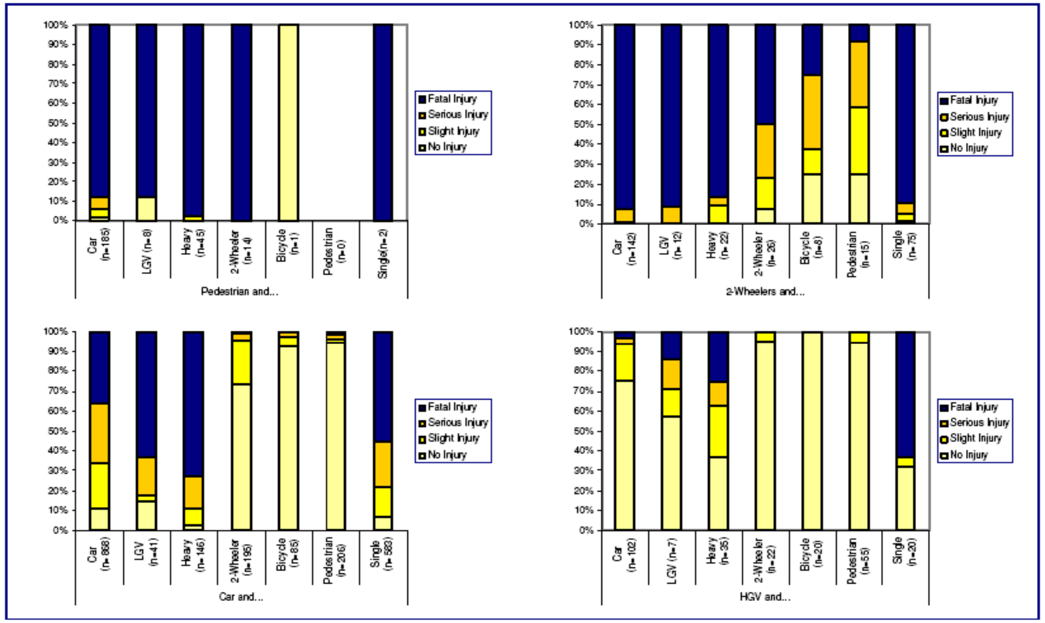
- Geographical structures need to be accounted for, either when analysing regional, national or European data
- Spatial effects may play an important role when examining performance indicators, measures and interventions etc.

Fatal accidents analysis

- In-depth fatal accident investigation data of ERSO for seven European countries were used.
- Comparing survivors and fatalities indicating risk and protection factors for road-users involved in **fatal accidents**, was a particularly complex issue, due to two methodological issues:
  - The accident size effect: the lower the number of road users involved in a fatal accident, the higher the probability of fatality for each road user (given that there was a fatality in every accident contained in the data)
  - The accident opponent effect: the more vulnerable the road user, and the heavier the accident opponent, the higher the fatality risk for that particular road user

Risk and protection factors

- The differences of baseline risk in fatal accidents (accident size, opponent) were taken into account



- “risk factors”: senior road users, drivers who did not react properly to the occurrence of the accident by braking, vehicle age.
- “protection factors”: seatbelt (for car occupants), junctions, front damages.

Summary of fatal accidents analyses

- The in-depth data were proved to offer more detailed information than what is typically available in national or international databases, and also more reliable.

- Each analysis and interpretation of these data needs to take into account that this is a very specific selection of fatal accidents only

Conclusions

- A good insight was provided of what can be accomplished using the data that are - or will be - available through CARE and ERSO.
- As shown on the basis of the various road safety research issues that have been addressed, there are many possibilities for addressing important safety questions by applying appropriate analysis techniques on the CARE and ERSO data.

Conclusions

- SafetyNet has initiated a process in terms of data collection, and this process is certainly not concluded.

- The data made available so far were optimally exploited, however more data, and of improved quality, may provide even more potential for analysis
    - (especially as regards risk exposure data, in-depth data, behavioural data and measures and interventions data).

- CARE and ERSO are currently most useful data sources with comparable information at European level and their further development will eventually enable systematic monitoring of road safety trends and identification of best practices, in order to achieve maximum casualty reduction.