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# Investigation of factors affecting serious crash injuries in Europe

**Katerina Folla**
Transportation Engineer, PhD Candidate

Together with:
Maria Charalampidi and George Yannis

National Technical University of Athens
Department of Transportation Planning and Engineering

# Background

- Each year, 1,35 million people are killed in road crashes worldwide, while 50 million people are injured
- Over the last years, Europe has presented a relatively better performance due to the targeted road safety policies, however, the serious non-fatal road crashes still constitute a significant public health issue
- The calculation of the total number of serious injuries in road crashes in the EU, as well as the comparative analyses among the EU Member States, were not feasible mainly due to the different definitions used
- In this context, in 2016, the EC published for the first time data on the number of serious injuries, using a common definition for all Member States
- It is estimated, thus, that in 2016, serious injuries were about 135.000 in the EU-28

# Objectives and Methodology

- Objective: Exploring the factors affecting the number of serious injuries in road crashes in the EU

Methodology:

- Socioeconomic and transport indicators are associated with the serious injuries in road crashes in Europe

- Two different definitions were used for the serious injuries:
  - Hospitalized persons
  - MAIS3+

- Two dependent variables were defined:
  - Serious injuries frequency: the annual number of serious injuries in road crashes per million population
  - Crash severity: serious injuries / fatalities

# Data Collection

- Data on road crash fatalities and injuries were collected for 28 EU countries and 3 EFTA countries (IS, NO, CH) for 2016

- Indicators examined:
  - GDP per capita (€)
  - Motorways/total roads (%)
  - Total Annual Traffic Volume (Mio Veh-km)
  - Pass. Cars > 20 years (%)
  - Buses in total vehicle fleet (%)
  - Motorcycles/100.000 population
  - Seat belt use rates (%)
  - Doctors/ population
  - NCAP score=5 stars (%)

- Various European and international data sources were used: European Commission, Eurostat, World Bank, OECD/ IRTAD database, IRF-WRS

# Modelling Process

- Generalized Linear Models were developed
- Different models were developed for each definition of serious injuries used:
  - Hospitalized persons (data available for all examined countries)
  - MAIS3+ (data available for 16 EU countries)
- A set of 2 models were developed per definition:
  - Serious injuries frequency
  - Crash severity

# Hospitalized serious injured persons (1/2)

| | Model 1 (Dependent variable: LN(SI/P)) | | | | Model 2 (Dependent variable: LN(SI/F)) | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Coefficient | Wald Chi-square | Sig. | $e_i$* | Coefficient | Wald Chi-square | Sig. | $e_i$* |
| Intercept | 8.662 | 37.967 | 0.000 | | | | | |
| EuroNCAP score | -0.080 | 23.967 | 0.000 | -15.31 | -0.040 | 3.920 | 0.048 | -6.69 |
| Motorways(%) | 0.154 | 6.319 | 0.012 | 1.25 | 0.155 | 3.947 | 0.047 | 1.00 |
| LN (veh-kms) | 0.119 | 2.089 | 0.148 | 3.78 | 0.356 | 13.376 | 0.000 | 8.38 |
| Motorcycles/population | 0.225 | 5.840 | 0.016 | 1.00 | 0.301 | 6.086 | 0.014 | 1.29 |
| Buses (%) | -0.756 | 3.239 | 0.072 | -1.05 | | | | |
| (Scale) | 0.144 | | | | 0.248 | | | |
| Likelihood ratio | 22.298 | | | | 13.986 | | | |
| df | 5 | | | | 4 | | | |
| p-value | 0.000 | | | | 0.007 | | | |

* $e_i^* = e_i / e_{min}$

# Hospitalized serious injured persons (2/2)

- Both dependent variables:
  - are decreased with an increase in the percentage of passenger cars with Euro NCAP score equal to 5 stars
  - have a positive relationship with the percentage of motorways
  - are increased with the increase of the PTWs in traffic
- The frequency of serious injuries has a negative relationship with the percentage of buses in total vehicle fleet
- The percentage of passenger cars with Euro NCAP score 5 stars has the highest effect on both serious injuries per population and crash severity, followed by the total annual traffic (vehicle-kms travelled)

# MAIS3+ serious injuries (1/2)

| | Model 1 (Dependent variable: LN(SI/P)) | | | | Model 2 (Dependent variable: LN(SI/F)) | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | Coefficient | Wald Chi-square | Sig. | $e_i$* | Coefficient | Wald Chi-square | Sig. | $e_i$* |
| Intercept | -7.346 | 2.374 | 0.123 | | -18.913 | 53.442 | 0.000 | |
| Motorways(%) | 0.036 | 3.091 | 0.127 | 1.00 | 0.046 | 16.863 | 0.000 | 1.00 |
| Buses (%) | -4.458 | 11.808 | 0.003 | -11.26 | -4.305 | 37.415 | 0.000 | -9.27 |
| Pass. Cars > 20 years | 0.088 | 22.206 | 0.079 | 8.27 | 0.092 | 82.561 | 0.000 | 7.32 |
| Doctors/population | -0.045 | 7.980 | 0.000 | -15.45 | -0.054 | 39.096 | 0.000 | -14.23 |
| LN(GDPcap) | 1.419 | 8.611 | 0.005 | 142.73 | 2.188 | 69.555 | 0.002 | 177.0 |
| Seat-belt use (%) | -0.008 | 2.327 | 0.001 | -5.77 | -0.009 | 9.412 | 0.000 | -5.05 |
| (Scale) | 0.070 | | | | 0.021 | | | |
| Likelihood ratio | 14.721 | | | | 28.300 | | | |
| df | 6 | | | | 6 | | | |
| p-value | 0.023 | | | | 0.000 | | | |

* $e_i^* = e_i / e_{min}$

# MAIS3+ serious injuries (2/2)

- Both dependent variables:
  - have a positive relationship with the percentage of motorways
  - are decreased with the increase of buses in traffic
  - are positively associated with the percentage of passenger cars aged more than 20 years
  - show a negative relationship with the number of doctors per population in a country
  - are increased with an increase in GDP per capita
  - are decreased with the increased use of seat belts

- The GDP per capita has the highest effect on both serious injuries per population and crash severity, followed by the number of doctors and the percentage of buses in vehicle fleet

# Conclusions (1/2)

- Despite the road safety progress over the last years in Europe, serious non-fatal road crashes still remain a significant problem
- The renewal of vehicle fleet of a country with vehicles disposing advanced active and passive safety systems could contribute to the reduction of serious injuries
- The increased use of public transport means, can also have a positive effect in the reduction of serious road crashes
- Increase in the use of protective systems (seat belt, helmet, etc.) is the most efficient way to reduce serious injuries in road crashes
- Focus should be given on vulnerable road users (especially motorcyclists) and road types (e.g. motorways) that are associated with higher travelling speeds, leading to more severe road crashes

# Conclusions (2/2)

- The identification of the factors affecting serious crash injuries could support the decision-making process to improve the level of road safety
- Time series data on serious injuries under a common definition should be collected, that could enable further road safety analyses at European level
- Comparable data at further disaggregation levels (by road user type, vehicle type, road type, etc.) are also necessary for the exploration of the problem


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