TRANSPORT RESEARCH CENTRE


# Do Key Performance Indicators really measure road safety performance?

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# Introduction

- Vision Zero → focus on intermediate **road safety performance indicators** (SPIs/KPIs)

- One criterion of a useful KPI: **"proven association with road crash and injury risks"**
  - There is a general association
  - But: differences in measurement, spatial/temporal aggregation, road types, etc.
  - Combination of KPIs

- **The goal: explore the association KPIs → outcomes**



https://trendlineproject.eu/

# Method

**outcomes** **exposure** **KPIs**

- Model form: $\boldsymbol{Y} = \exp(\beta_0) \cdot \boldsymbol{E}^{\beta_1} \cdot \exp(\sum_{i=2}^{n} \beta_i \boldsymbol{x_i})$
- NB log-link model: $\ln(\boldsymbol{Y}) = \beta_0 + \beta_1 \cdot \ln(\boldsymbol{E}) + \sum_{i=2}^{n} (\beta_i \boldsymbol{x_i})$
- Regression parameters ($\beta_0$, $\beta_1$, $\beta_i$) estimated in IBM SPSS
- Input data:
  - **Outcomes** ← CARE
  - **Exposure** ← Eurostat
  - **KPIs** ← Trendline

# Data

**Outcomes** (fatalities)

- CARE / Eurostat (2023)
- All EU countries
- # Fatally Injured (at 30 days)

**Exposure** (vehicle-kilometres)

- Eurostat / UNECE: only selected countries
- Alternative: VKM from ETSC 19th PIN Report (2022–2024)
- VKM per road types: collected/estimated by national experts (e.g., 30% motorway / 40% rural / 30% urban)

**KPIs**

- Selection from Trendline final results (2023–2024)
- Total + road types (motorway/rural/urban)

Each country:
**39** items

| | | Total | Motorway | Rural | Urban |
|---|---|---|---|---|---|
| Outcomes | | FAT | FAT_M | FAT_R | FAT_U |
| Exposure | | VKM | VKM_M | VKM_R | VKM_U |
| 5 KPIs | **Speed** | speed | speed_M | speed_R | speed_U |
| | **Seatbelts** - total | belts | belts_M | belts_R | belts_U |
| | - driver | belts_driver | belts_driver_M | belts_driver_R | belts_driver_U |
| | - front pass. | belts_front | belts_front_M | belts_front_R | belts_front_U |
| | - rear pass. | belts_rear | belts_rear_M | belts_rear_R | belts_rear_U |
| | **Cycle helmets** | helm_cyc | | helm_cyc_R | helm_cyc_U |
| | **PTW helmets** | helm_ptw | helm_ptw_M | helm_ptw_R | helm_ptw_U |
| | **Distraction** | distr | distr_M | distr_R | distr_U |

## How many countries?

- FAT: 22
- VKM: 18
- KPIs: ≤20

vs “1 in 10+ rule”

7× $\beta_i$ to estimate
→ 70+ countries ☺

# Results

- **Modelling steps** (total / M / R / U):
  - Base model: VKM
  - Variants: VKM + KPIs
    (one by one; signs; sig. ≥80%)

- **VKM scenarios** based on split shares:
  - 0: M / R / U
  - 1: M / R+10% / U–10%
  - 2: M / R–10% / U+10%

- **Final models:**
  - **VKM** + **belts_rear** + **helm_cyc**
  - **Speed** not significant
  - **Distraction** not significant

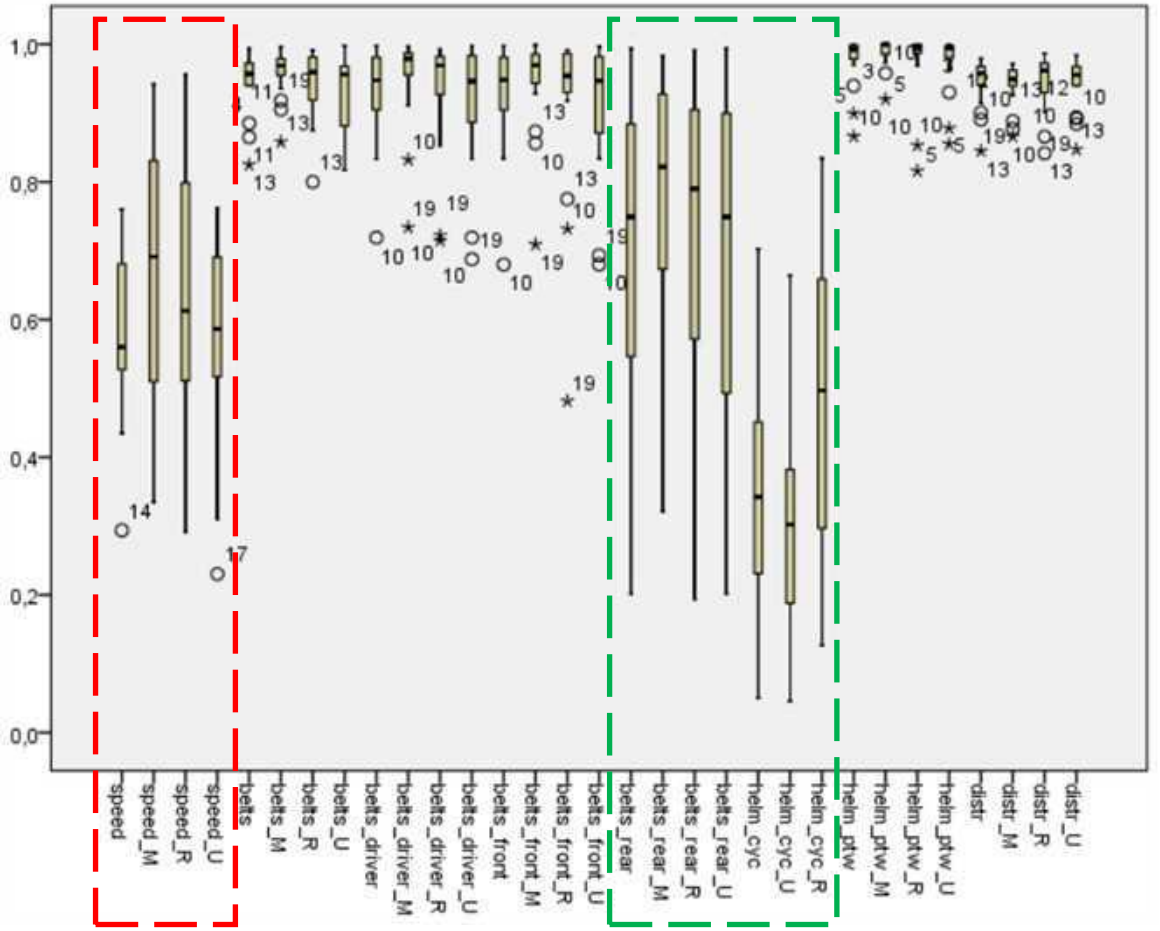
| | | Beta | Sig. | n |
|---|---|---|---|---|
| **Total** | (Intercept) | -3,275 | ,000 | |
| | ln_VKM | ,881 | ,000 | 11 |
| | belts_rear | -,531 | ,112 | |
| **Rural** | (Intercept) | 1,832 | ,002 | |
| | ln_VKM_R | ,909 | ,000 | 13 |
| | helm_cyc_R | -2,147 | ,001 | |
| **Urban** | (Intercept) | 1,292 | ,064 | |
| | ln_VKM_U | ,862 | ,000 | 15 |
| | belts_rear_U | -,619 | ,173 | |
| | helm_cyc_U | -1,524 | ,077 | |

# Lessons learned

- **Not as simple task as expected ☺**
  - Not many countries, missing KPIs
  - Uncertain estimation of VKM shares
  - “Global” approach × group-specific
  - Intercorrelated variables

- **What do the models tell?**
  - Model power:
    - VKM-only models $R^2 \sim 90\%$
    - KPIs improved, e.g., by +4%
  - KPIs with highest variance:
    - **speed** (techniques? free-flow?)
    - **belts_rear**
    - **helm_cyc**

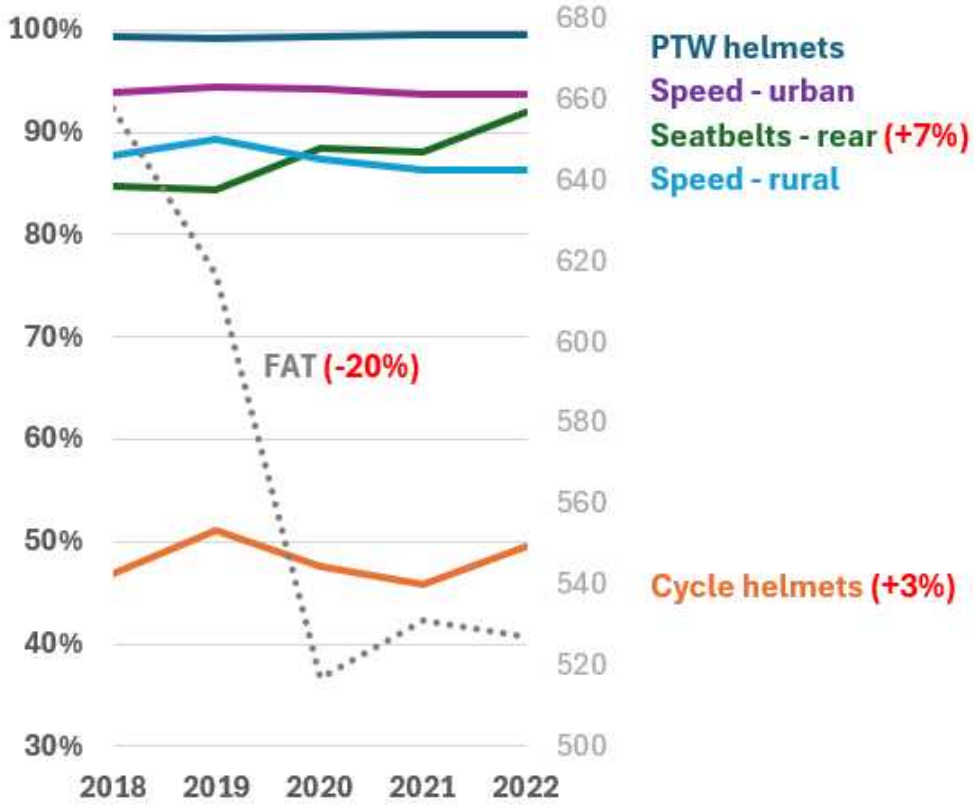
| | FAT | VKM | speed | belts | helm_cyc | helm_ptw | distr |
|---|---|---|---|---|---|---|---|
| FAT | 1 | ,955 | -,021 | -,193 | ,027 | ,024 | -,166 |
| VKM | | 1 | -,067 | -,055 | ,111 | -,695 | -,086 |
| speed | | | 1 | -,235 | ,040 | -,304 | -,245 |
| belts | | | | 1 | ,341 | ,505 | ,554 |
| helm_cyc | | | | | 1 | ,121 | -,154 |
| helm_ptw | | | | | | 1 | ,371 |
| distr | | | | | | | 1 |



# Discussion / Further research

- **Impact of KPIs**
  - +1% KPI → –(1–2)% FAT
  - Belts/helmets reduce severity, not occurrence
  - Only user-related, no road/vehicle KPIs

- **Perspective**
  - One-year comparison × time-series?
  - Czech example: KPIs × FAT changes?




https://www.czrso.cz/nub/post/map

- **Open questions**
  - "Do KPIs really measure road safety performance?" – only partially?
  - Keep on collecting all KPIs? Focus on the low/varying ones? Add new KPIs?
  - Testing "self-reported" KPIs?

ESRA
E-Survey of Road users' Attitudes

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# Thank you for your attention


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*The presentation was produced with the financial support of the Ministry of Transport within the programme of the long-term conceptual development of research institutes.*