Explaining the decline in fatal and serious injuries in Norway 2000-2019

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Abstract

The number of traffic fatalities and seriously injured road users has declined considerably in Norway after the year 2000. According to trend lines fitted to the data series, the number of fatalities declined by 68.6% from 2000 to 2019; the number of seriously injured road users declined by 50.5%, and the number of killed or seriously injured road users (put together) declined by 54.1% from 2000 to 2019. The three most important factors contributing to the decline are highway safety treatments, safer cars and lower mean speed of traffic. Other factors contributing include increased seat belt wearing, speed cameras and section control, and increased bicycle helmet wearing. The factors included in the study explain 59 % the decline in the number of killed or seriously injured road users from 2000 to 2019. This means that other factors, not quantified in this study, have also contributed to the decline.

Keywords

Fatal injury; serious injury; decline; explanation; Norway

The decline in killed or seriously injured road users 2000-2019

From 2000 to 2019, there was a large decline in the number of killed or seriously injured road users in Norway. This is shown in Figure 1.

The objective of the study summarised in this paper was to identify and estimate the effects of factors that have contributed to the decline in the number of killed or seriously injured road users in Norway from 2000 to 2019.

There are many factors

The number of killed or injured road users is influenced by a vast number of factors. It is impossible to list all these factors, let alone estimate their contributions. The most important groups of factors include:

1. Traffic volume and changes over time in traffic volume
2. Economic changes, in particular changes of the business cycle
3. Road safety measures
4. Road user behaviour
5. Reporting of injuries in official accident statistics

All else equal, an increase in traffic volume is associated with an increase in the number of traffic injuries. Economic growth may contribute to an increase in traffic volume, but the business cycle influences how fast traffic grows. It may grow slowly, or not at all, during a recession. Road safety measures contribute to reducing the number of killed or injured road users. Changes in road user behaviour may influence the number of injured road users, contributing either to an increase or to a decline. Some, but not necessarily all, changes in road user behaviour are related to the introduction

of road safety measures. Finally, it has long been known that the police do not report all cases of traffic injury. If the level of reporting changes over time, the recorded number of injured road users may change as a result of this. It is assumed that all cases of fatal injury are reported.

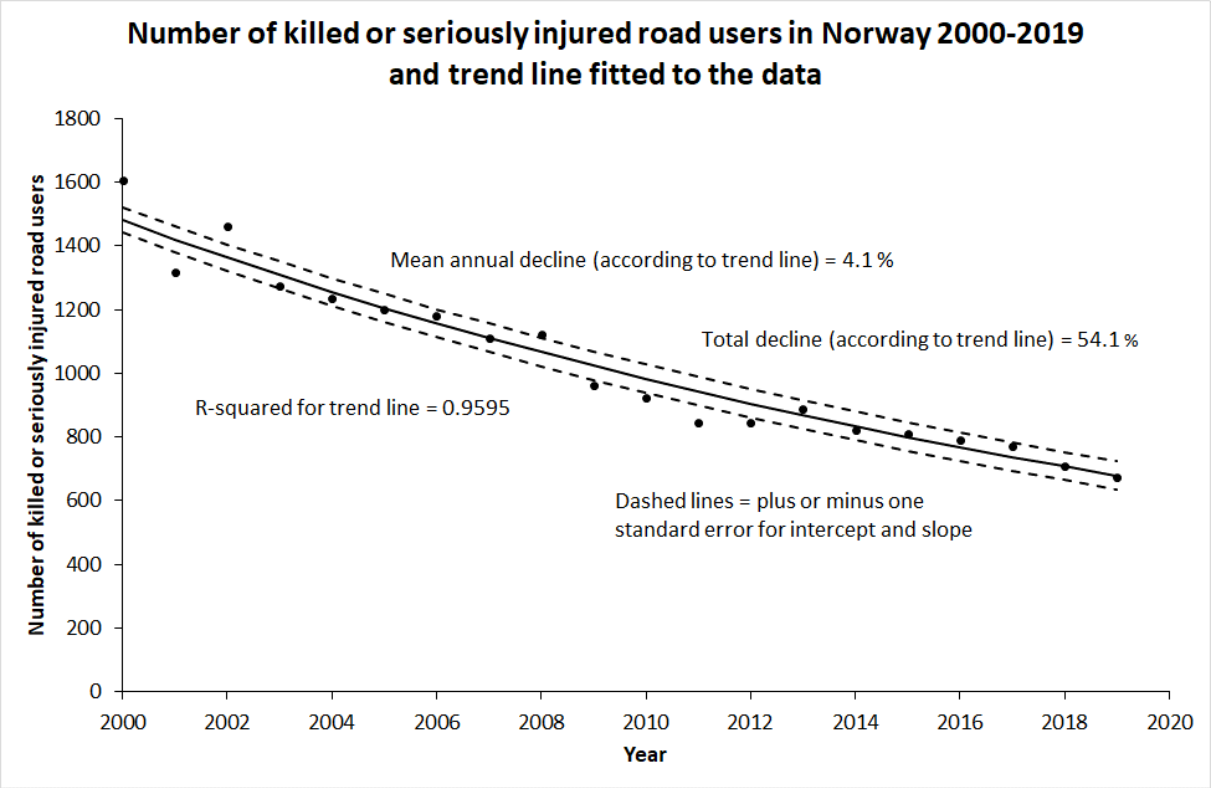

Figure 1: Decline in the number of killed or seriously injured road users in Norway from 2000 to 2019

Factors included in this study

The factors included in this study have been classified into four main groups:

1. Road safety measures
2. Road user behaviour
3. Other societal changes
4. Possible changes in the reporting of serious injuries

The factors that are believed to contribute to reducing the number of killed or seriously injured road users are:

1. Road safety measures
    a. New motorways
    b. New 2+1 roads with median barrier
    c. Median rumble strips
    d. Local safety treatments of roads
    e. Lowering of speed limits in 2001
    f. Increased market penetration of vehicle safety features
    g. Increased use of speed cameras and section control
    h. Per se limits for illicit drugs and prescription drugs; less driving under the influence of drugs
    i. Increased fixed penalties in 2017 and 2018

2. Road user behaviour
    a. Lower mean speed of traffic, in particular after 2006
    b. Increased seat belt wearing
    c. Increased wearing of bicycle helmets
3. Other societal changes
    a. Injury reduction among children
    b. Lower risk to young (18-24) and old (75-+) car drivers
    c. Lower risk to young (18-24) car passengers
4. Possible changes in the reporting of serious injuries

Local safety treatments of roads include minor treatments like upgrading pedestrian crosswalks, establishing cycle lanes, converting junctions to roundabouts, installing guardrails or installing road lighting. The factors listed as other societal changes are likely to partly reflect changes in traffic exposure. Studies made in 1991 (Borger 1991) and 2019 (Lund 2019) indicate that there has been a decline in the reporting of serious injuries in official accident statistics in this period.

Estimating the individual and combined effects of the factors

The impact of a factor on the number of killed or seriously injured road users was estimated by assuming the factor was absent. Effects, in other words, are modelled as factors contributing to a decline in the number of killed or seriously injured road users, implying that in the absence of these factors, the number of killed or seriously injured road users would have been higher than it actually was according to the long-term trend fitted to data.

To estimate the combined effects of several factors, a residual term was estimated for each factor for each year from 2000 to 2019. According to the long-term trend, the expected number of killed or seriously injured road users in, for example 2010, was 982. If no highway safety treatments had been implemented, the number would have been 1059. Thus, the residual term for highway safety treatments for the year 2010 was: 982/1059 = 0.927.

Combined effects were estimated by multiplying residual terms. Three models were used. To explain these models, suppose there are three residual terms: 0.9, 0.8 and 0.7. The first method, the common residual method, estimates the combined effects as follows:

Model 1 (independent effects) = $1 – (0.9 \cdot 0.8 \cdot 0.7) = 1 – 0.504 = 0.496$ (49.6 % reduction)

The second method, referred to as the dominant common residual method, estimates combined effects as follows:

Model 2 (dominant effects) = $1 – [0.9 \cdot 0.8 \cdot 0.7]^{0.7} = 1 – 0.619 = 0.381$ (38.1 % reduction)

The dominant common residuals method is based on the assumption that the most effective factor (0.7) to some extent reduces the effects of less effective factors; it dominates these, so to speak. The most conservative method, is the double dominant common residuals method:

Model 3 (double dominant) = $1 – [0.9 \cdot 0.8 \cdot 0.7]^{(0.7 \cdot 0.8)} = 1 – 0.681 = 0.319$ (31.9 % reduction).

Figure 2 shows the explanatory contribution of all the factors included in the analysis, according to model 2 above.

It is seen that these factors explain the greater part of the decline in the number of killed or seriously injured road users. The largest contribution came from road safety measures.

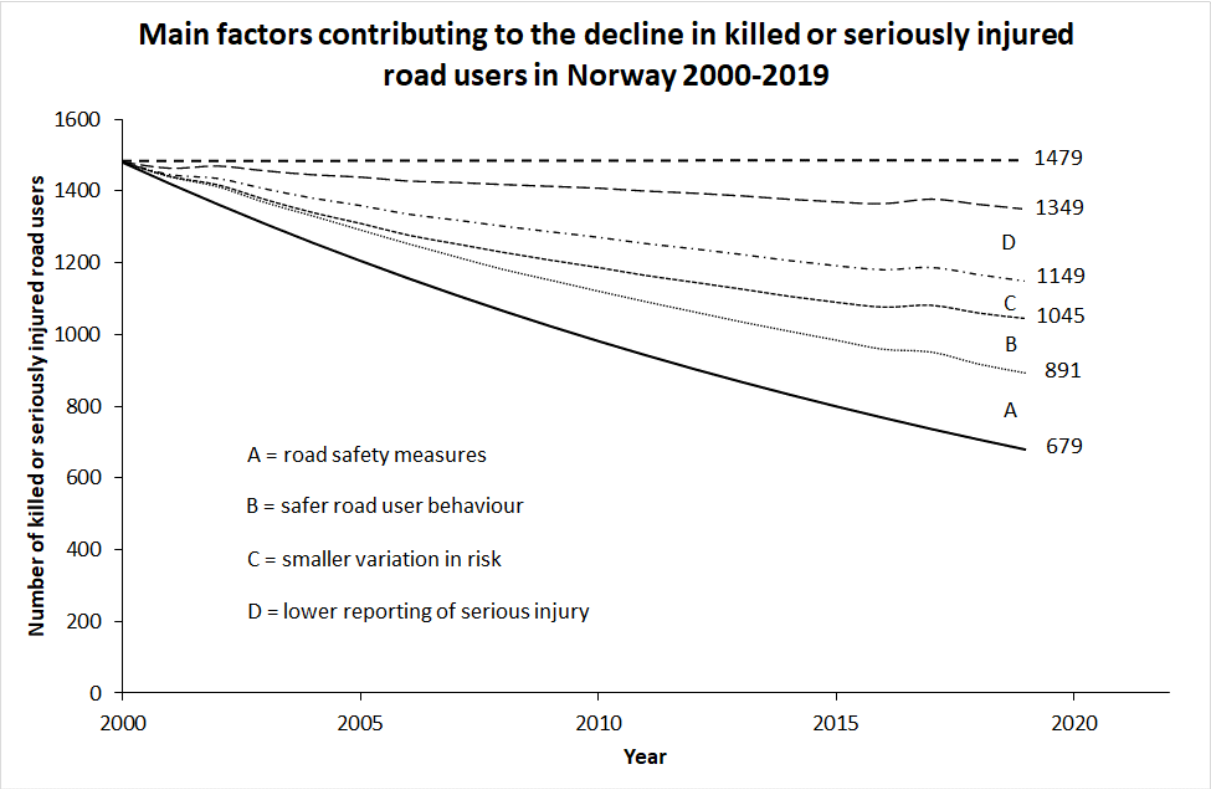

Figure 2: Factors contributing to the decline in the number of killed or seriously road users in Norway from 2000 to 2019

More detailed breakdown of factors contributing to the decline

Figure 3 shows a more detailed breakdown of factors contributing to the decline in the number of killed or seriously injured road users, not including lower reporting.

The tendency for the mean speed of traffic to go down had the largest estimated contribution. The second largest came from road improvements, and the third largest from safer cars. However, no factor made a dominant contribution. The study confirms the fact that a long-term improvement in road safety is the result of a large number of minor contributions by a large number of factors.

Factors not included in the study

The analysis did not include all factors that may have contributed to the decline in the number of killed or injured road users, mainly because sufficient data to reconstruct year-by-year changes in the factors was not available. The omitted factors include, but is not necessarily limited to:

- All safety treatments on municipal roads. Only national roads and county roads were included.
- Extended use of 30 km/h zones on all public roads, including national and county roads
- Increased seat belt wearing among occupants of heavy vehicles
- Reforms of driver training programs and road safety campaigns
- Improvements in emergency service response time and in medical treatment
- Extended use of safety management systems in commercial transport
- Changes in drinking-and-driving. Drugs are included, but not alcohol.

Lack of data was the main reason for not including these factors. This most likely means that the contribution of road safety measures to the decline in the number of killed or seriously injured road users has been underestimated.

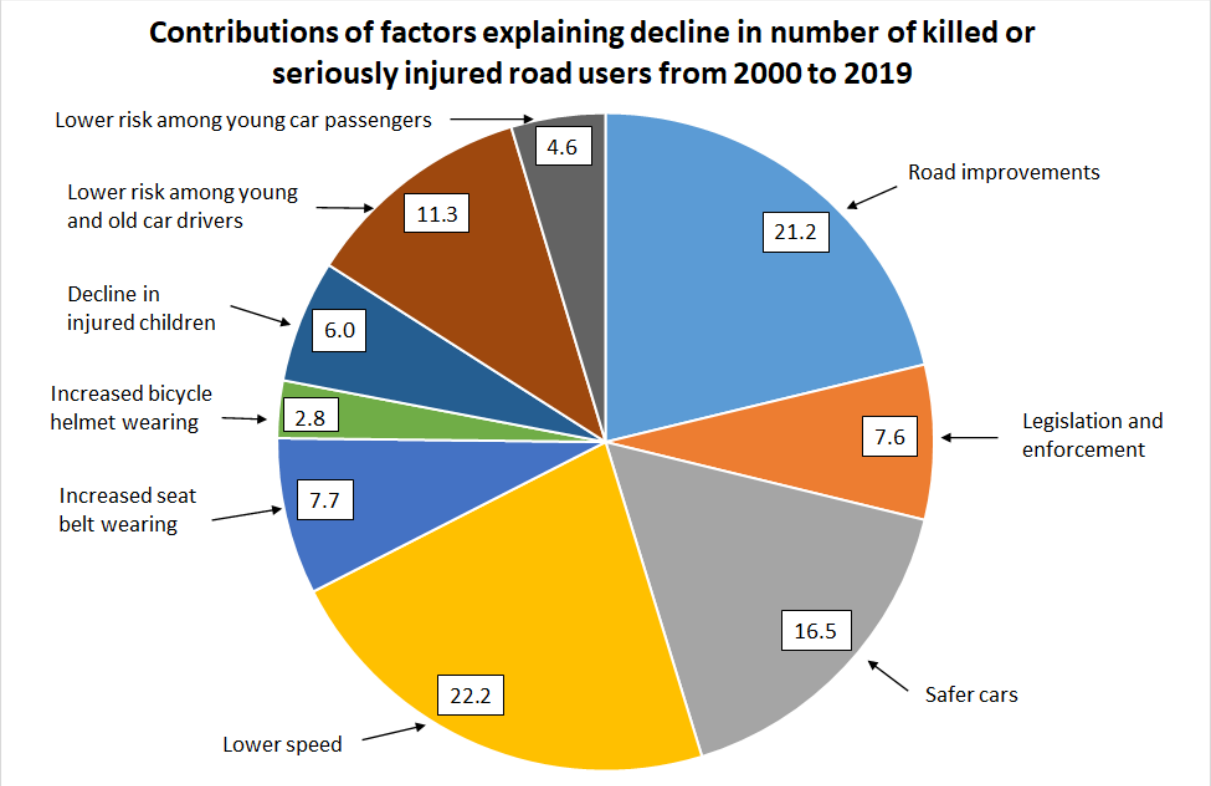

Figure 3: Contributions of various factors to the decline in the number of killed or seriously injured road users in Norway from 2000 to 2019

Limitations of the study

There are two major limitations of the study summarised in this paper:

1. A causal relationship between the factors included and changes in the number of killed or seriously injured road users cannot be established: the estimated contributions only represent a hypothetical counterfactual
2. The estimates cannot be tested empirically: there is no way of running history a second time over with one or more of the factors absent to see what then happened. Prediction of future effects of factors that have not "run their course" is, however, in principle possible.

In other words: these estimates cannot be treated as more than educated guesses, at best.

References

Borger, A. 1991. Underrapportering av trafikkulykker. Notat 975. Oslo, Transportøkonomisk institutt.

Elvik, R. , Høye, A. K. 2021. Hva forklarer nedgangen i antall drepte eller hardt skadde i trafikken etter 2000? Rapport 1816. Oslo, Transportøkonomisk institutt.

Elvik, R., Høye, A. K. 2022. Do we know why the number of traffic fatalities is declining? If not, can we find out? Traffic Safety Research, 2, 000007.

Lund, J. 2019. Helsevesenbasert skaderegistrering som verktøy til å forebygge trafikkulykker. Rapport. Oslo, Trygg Trafikk.