Institute of Transport Economics
Norwegian Centre for Transport Research

Summary

Explaining the decline in traffic fatalities and serious injuries in Norway after 2000

TØI Report 1816/2021
Authors: Rune Elvik, Alena Katharina Høye
Oslo 2021 72 pages Norwegian language

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.

The decline in traffic fatalities and seriously injured road users

The objective of this report is 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. The report is an update of a study published in 2014, covering the period 2000 to 2012.

There are many relevant 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 measure 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.

Factors included in this study

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

1. Changes in traffic volume
2. Road safety measures
3. Road user behaviour
4. Other societal changes

The effect on the number of killed or seriously injured road users of changes in traffic volume have been estimated by fitting a "counterfactual" trend to the numbers. The term counterfactual refers to the fact that the fitted trend shows the effect of traffic growth only, assuming that all other factors are kept constant. 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

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. Children walk and cycle less.

Copyright © Institute of Transport Economics, 2021

Impacts of the factors included in the formal analysis

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 S.1 shows the explanatory contribution of all the factors included in the analysis, according to model 2 above.

According to a trend line, the number of killed or seriously injured road users in Norway declined from a fitted value of 1479 in 2000 to a fitted value of 679 in 2019. This is decline of 800. The factors for which numerical estimates of their contributions could be made, contributed to a decline from 1149 to 679 killed or seriously injured road users. This represents 59 % of the total decline. The remaining decline, from 1479 to 1149, is not explained by the factors included in the analysis.

If model 1 is applied, the factors included explain 64 % of the decline in the number of killed or seriously injured road users. If model 3 is applied, the explanatory share is 54 %. The range from 54 to 64 % is a measure of the uncertainty about how best to estimate the combined contributions of a set of factors to changes in the number of killed or injured road users. It should not be interpreted as a confidence interval in the statistical sense. It reflects the impacts of the choice of model for estimating combined impacts.

Copyright © Institute of Transport Economics 2021,

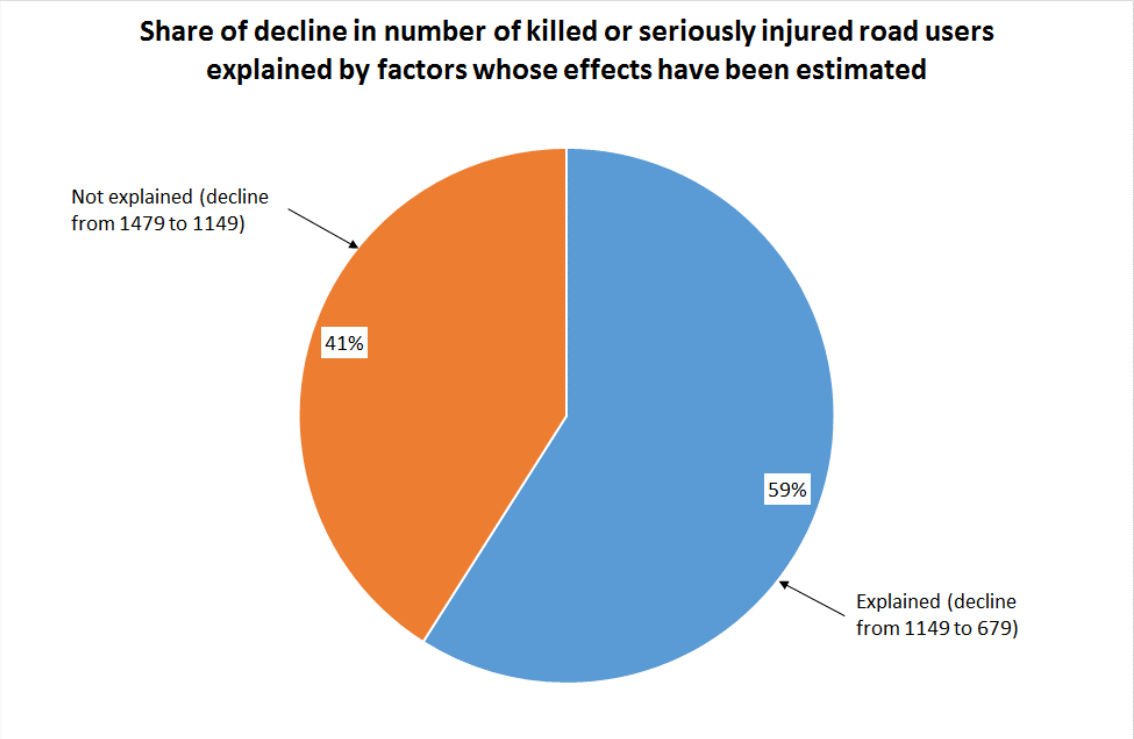

Figure S.1: Contribution of all factors included in the analysis to explaining the decline in the number of killed or seriously injured road users in Norway from 2000 to 2019

Figure S.2 shows the contributions of each factor to the decline in the number of killed or seriously injured road users from 2000 to 2019.

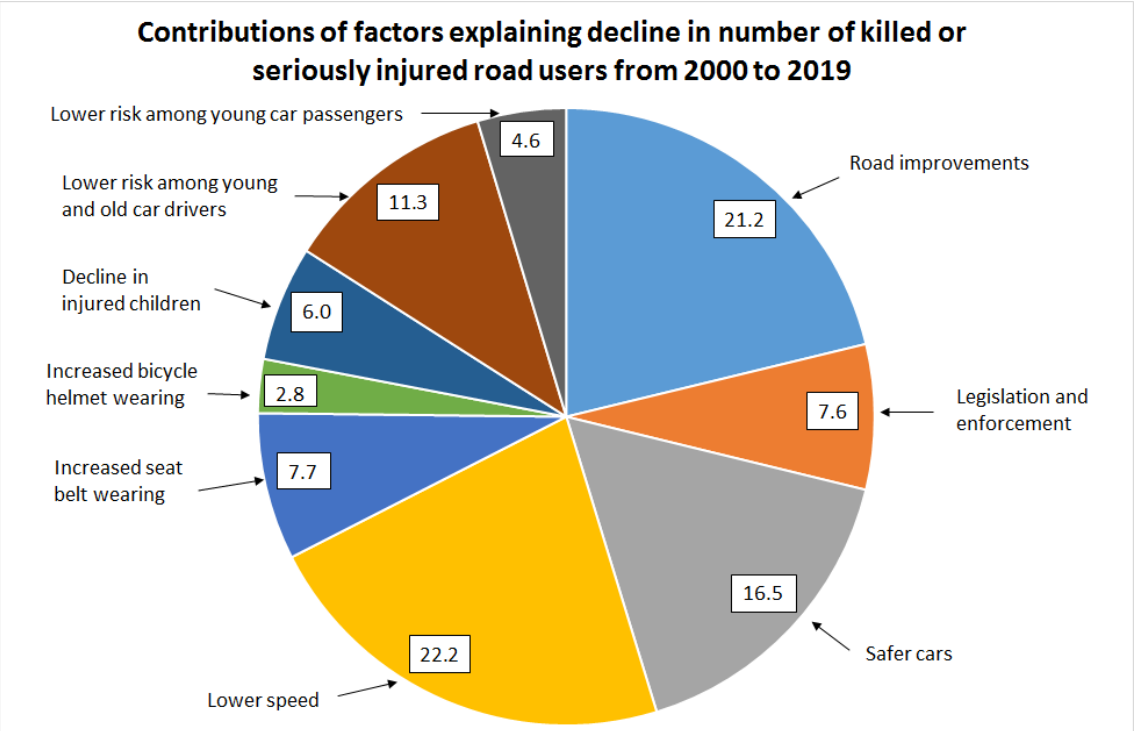

Figure S.2: Contributions of each factor included in the analysis to the decline in the number of killed or seriously injured road users in Norway from 2000 to 2019

Copyright © Institute of Transport Economics, 2021

The sum of the various sectors in Figure S.2 equals 100 %. This corresponds to the 59 % explained sector of Figure S.1.

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.

The estimates are uncertain. The only source of uncertainty that has been quantified is the choice of method for estimating the combined contributions of all factors. As noted above, this produced a range for the explanatory contribution of the factors included ranging from 54 to 64 %. Common statistical methods for estimating uncertainty were not regarded as applicable to the study, as it represents a form of historical reconstruction. The factors included cannot in any meaningful sense be treated as having been "sampled" from a known or theoretical population of factors that could have contributed to a decline in the number of killed or seriously injured road users. In any historical reconstruction, what gets to be included is what one is able to reconstruct in sufficient detail.

Factors not included

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.

Copyright © Institute of Transport Economics 2021,