SPEED MANAGEMENT IN SWEDEN:
EVALUATION OF A NEW SPEED LIMIT SYSTEM

Anna Vadeby
Swedish National Road and Transport Research Institute
SE-581 95 LINKÖPING Sweden
E-mail: anna.vadeby@vti.se

Åsa Forsman
Statens väg- och transportforskningsinstitut, VTI
SE-581 95 LINKÖPING Sweden
E-mail: asa.forsman@vti.se

ABSTRACT
Between 2008 and 2011, the Swedish Transport Administration reviewed the speed limits on the state rural road network in Sweden. Guidelines were established for different types of roads, and the long-term vision was that speed limits should be adapted to the safety classification of each road. A new set of speed limits (i.e., 80, 100, and 120 km/h) was introduced on rural roads to complement the previously used limits of 70, 90, and 110 km/h. This study investigated the effects of the new speed limits on the rural road network. To evaluate the speed changes, a before-and-after study was performed. The study was conducted as a sample survey in which vehicle speeds were measured in a random sample of at least 10 sites per road type. Differences in space-mean speed and 85th percentiles (P85) before and after the introduction of new speed limits as well as speed compliance and traffic safety effects were studied.

Survey results indicate that the mean speed of cars increased by 3.5 km/h when the speed limit increased by 10 km/h on motorways and 2+1 roads. Reducing the speed limit by 10 km/h on 2+1 roads and rural roads with a speed limit of 110 km/h reduced the mean speed by 2 km/h. On rural roads where the speed limit was lowered from 90 to 80 km/h, the mean speeds decreased by 3.3 km/h. All changes are significantly different from zero. No significant changes in mean car speeds were found on roads where the speed limits increased from 70 to 80 km/h. For trucks with trailers, the speed limit of 80 km/h applied both before and after the changes if the speed limits on the roads were 80 km/h or above. In general, there have been no significant changes in mean speed for these vehicles.

Regarding P85 levels, these changed by the same amount as did the space-mean speeds. The P85 levels after the introduction of new speed limits were approximately 15 km/h above the space-mean speed level. This indicates that the speed distribution on the roads has not changed, but has only shifted to another level. When effects on traffic safety are studied, the empirical outcome indicates a reduction of more than 50 severe injuries and deaths yearly. The main reduction of traffic deaths occurred on rural roads where the speed limit was reduced from 90 to 80 km/h. These are roads where normally no other traffic safety measures are implemented. It should be noted that the time period after the introduction of the new speed limits is fairly short and a continued follow-up is recommended to obtain more reliable results.
INTRODUCTION

Between 2008 and 2011, the Swedish Transport Administration reviewed the speed limits on the state rural road network in Sweden. Guidelines were established for different types of roads, and the long-term vision was that speed limits should be adapted to the safety classification of each road. A new set of speed limits (i.e., 80, 100, and 120 km/h) was introduced on rural roads to complement the previously used limits of 70, 90, and 110 km/h.

Initially, speed limit changes were introduced on approximately 3500 km of roads, of which approximately 1000 km were assigned an increase and 2500 km a reduction in speed limits. Later, speed limit changes were introduced on approximately 17,000 km of roads, of which 1700 km were assigned an increase and 15,000 a reduction in speed limits. A total of approximately 20,500 km of roads, corresponding to 21% by length of all state roads in Sweden, were assigned new speed limits. The main group of roads with new speed limits was rural two-lane roads, where the speed limit was reduced from 90 to 80 km/h. This group accounted for more than 60% by length of the roads with changed speed limits. It was predominantly roads with a low safety standard and inadequate road shoulders that were selected for the introduction of reduced speed limits, while roads with a good traffic safety standard were selected for increased speed limits. In addition, roads important to local economic activity, transport, and commuting were assigned higher speed limits than were roads less important from a local economic point of view.

Before the speed limit review, the Swedish Transport Administration estimated that a 10 km/h increase or decrease in the speed limit would result in an actual increase or decrease of 4 km/h in passenger vehicle speed. The change in speed for heavy goods vehicles (HGVs) with trailers was estimated to be less (different assumptions were made depending on road type and speed limit). Based on the above assumptions, it was estimated that 13.5 fatalities and 42 serious injuries could be avoided annually on the national road network by means of the speed limit adjustments.

Earlier, Elvik et al. (2004) studied and compiled the results of 51 studies of the relationship between changes in speed limit and changes in mean speed. They found that when the speed limit changes by 10 km/h and no other action, such as increased enforcement, is taken, the mean speed on the road generally changes by approximately 2.5 km/h. Similar results were also obtained by the OECD (2006). If speed limit changes are combined with other measures, such as increased enforcement or speed bumps, the effect tends to be greater.

Son et al. (2009) studied the long-term effects of new speed limits, finding no further change in driving speed once drivers had adjusted to new speed limits. Retting and Teoh (2008), using speed measurements, arrived at inconsistent findings regarding speed changes 10 years after rational speed limits had been imposed. In two US states where speed limits remained constant between 1996 and 2006, large long-term speed increases were observed, but in one state where speed limits were lowered during the study period, large decreases were evident.
1.1 Objective
The aim of this study was to investigate the effects of increased or decreased speed limits on the rural road network in Sweden in terms of mean speed (space-mean speed), 85th percentile (P85), and traffic safety on selected roads.

2 METHOD

2.1 Effects on speed
The effects on speed were mainly evaluated using a sample survey in which vehicle speed was measured in a random sample of road sites. However, the sample survey measured the effects only about one year after the change in speed limits. Therefore, a number of fixed measurement points were also studied to evaluate long-term effects, up to two years after the introduction of new speed limits.

2.1.1 Sample survey
The sample survey was conducted in seven groups of roads of different types and initial speed limits (see Table 1).

Table 1: Road types.

<table>
<thead>
<tr>
<th>Type of road: speed limit change (km/h)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Motorways: 110→120</td>
<td>Motorways where the speed limit increased from 110 to 120 km/h</td>
</tr>
<tr>
<td>2: 2+1 roads: 110→100</td>
<td>A continuous three-lane road with alternating passing lanes and the two directions of travel separated by a median barrier</td>
</tr>
<tr>
<td>3: 2+1 roads: 90→100</td>
<td>Two-lane rural roads</td>
</tr>
<tr>
<td>4: Rural roads: 110→100</td>
<td>Two-lane rural roads</td>
</tr>
<tr>
<td>5: Rural roads: 90→80</td>
<td>Two-lane rural roads</td>
</tr>
<tr>
<td>6: Rural roads: 70→80</td>
<td>Two-lane rural roads</td>
</tr>
<tr>
<td>7: Rural roads: 90→70</td>
<td>Two-lane rural roads</td>
</tr>
</tbody>
</table>

The vehicle types included in the study were cars, trucks with trailers, and trucks without trailers. For trucks with trailers, the maximum overall speed limit is 80 km/h, so the limit of 80 km/h applied both before and after the speed limit changes on roads with limits of 80 km/h or more. As the maximum speed limit of trucks without trailers varies between vehicle types, the results for this group are difficult to interpret and are not included in this paper.

A random sample of measurement sites was drawn separately for each road type. The sample size was 10 in all groups except group 5, in which 22 sites were selected. A systematic sampling method was used to select sites that were broadly distributed geographically (e.g., Cochran, 1977). Speed measurements were made at the selected sites before and after the introduction of new speed limits. The speed limit changes were implemented in two phases: the speed limits on roads in groups one to four (Table 1) were changed in September and October 2008, and the speed limits on roads in groups five to seven were changed in November and December 2009. The measurements at road sites where speeds were changed...
in the first phase were made in week 34 (August) in 2008 and 2009, and the measurements at road sites where speeds were changed in the second phase were made in week 38 (September) in 2009 and 2010 (some substitute measurements were made at a later date). To be considered an acceptable measurement, the speed at each road site had to be measured for at least three whole weekdays, within the period extending from noon Monday to noon Friday. The presented results represent daytime conditions, from 6 am to 8 pm.

The speed of passing vehicles was mainly measured using pneumatic tubes. At a few sites induction loops were used. Speed measurements with pneumatic tubes and induction loops are not strictly comparable since the speed level may differ slightly between the two methods. However, in this study, the main objective was to estimate changes and since the same equipment was used both before and after the speed limit changes at the same road site, the effect of the different methods is expected to be minor. Vehicle speeds in both directions were registered on the two-lane rural roads, whereas the speed on motorways was measured in only one direction, selected randomly. On 2+1 roads, the speed was always measured on a single-lane stretch in one direction.

Based on the sample survey, a number of parameters were estimated. The parameters of interest here are: the space-mean speed, 85th percentile, and proportion of speed violations. Space-mean speed is the average speed of the vehicles travelling on a selected road network during a specified time period (see, e.g., FHWA, 1998, ch. 1) and is calculated as the ratio between total vehicle mileage and total travel time. Space-mean speed is also the relevant measure when calculating effects on emissions and traffic accidents. The 85th percentile is the speed that 15% of the vehicles exceed. The proportion of speed violations is defined as the ratio between the mileage of vehicles exceeding the speed limit and the total vehicle mileage. A detailed description of the parameters, parameter estimates, and confidence intervals can be found in Vadeby and Forsman (2010, 2012).

2.1.2 Other speed measurements

A number of rural road sites in Sweden are continuously monitored by fixed measuring stations. The main purpose of these stations is to measure traffic flow, but speed is also registered. Some of these sites were selected for use in this study either as controls or for studying the long-term effects of the speed limit changes. The fixed measuring stations are also the basis of the Swedish speed index (Forsman and Danielsson, 2010), which describes the general development of mean speed and speed violations on rural roads. The index is based on 83 fixed measuring sites and reflects only general speed changes, not speed level changes due to, for example, changed speed limits or new speed cameras.

Approximately 20 fixed sites were used as control sites in each phase. The selected control sites were situated on roads where the speed limits were not changed. In addition, 11 measurement points were selected for studying long-term effects on rural roads where the speed limits were lowered from 90 to 80 km/h. At these points, the registered speeds one and two years after the speed limit changes were compared with the speeds before the speed limit changes.

The sample survey is designed in a way that allows the results to be generalized to all roads on the studied road network. This generalizability does not apply to the results obtained using the fixed measuring stations, which were selected for another purpose.
2.2 Effects on accidents
The numbers of people killed or severely injured before and after the speed limit changes were compared to evaluate the traffic safety effects. This evaluation was based on the empirical outcome in terms of accidents reported by the police (the Swedish accident database STRADA) on the rural road network. Since the speed changes were introduced on two occasions, in phases 1 and 2, the study periods differ somewhat. The “before” period is the same for both phases, i.e., from 1 January 2003 to 31 July 2008 (the “before” period might be shorter for some road segments, e.g., if the road was new and did not exist when the before period started). The “after” period for phase 1 is two and a half years long, i.e., 1 February 2009–31 July 2011, whereas for phase 2 it is one and a half years long, i.e., 1 February 2010–31 July 2011. As is clear, the “after” period is short relative to the “before” period, especially for phase 2. The results of the empirical study are therefore somewhat uncertain. Each accident during the time period of the study is linked to a specific part of the road and a certain road type (Table 1). The relative change in the empirical outcome is calculated as

$$
\phi = \frac{z_a - z_b}{z_b}
$$

where $z$ is the number of fatalities or severely injured persons and $c$ is the ratio between the traffic volume in the before and after period.

However, the estimated change in outcome does not depend only on the change in speed limit, as much of the change can be attributed to the general traffic safety trend. The estimated change is therefore divided by the corresponding change in a control dataset comprising roads of the same type as the study objects but where the speed limits were left unchanged. Finally, the relative outcome was recalculated as the absolute change in the number of killed and severely injured people.

The decision whether a road was assigned a higher or lower speed limit in the review process was based on the safety performance of the road with respect to physical road design. In addition, roads important to local economic activity, transport, and commuting were assigned higher speed limits than were roads less important from a local economic point of view. The accident record was in general not considered when deciding new speed limits and therefore there was no need to consider regression-to-the-mean effects in the analyses.
3 RESULTS
The following section presents results in terms of the levels and changes of mean speed and 85th percentile (P85) as well as the empirical accident outcome on roads with new speed limits.

3.1 Effects on speed
The locations of the randomly selected measurement points where the speed was measured are shown in Figure 1. The measurement points are distributed throughout Sweden.

![Figure 1: Distribution of speed measurement points in Sweden. Green = phase 1 (August 2008 and 2009); purple = phase 2 (September 2009 and 2010).](image)

The speed measurement results are shown in Table 2. The table shows space-mean speed levels before and after the introduction of new speed limits, as well as the changes, for all studied road types. On motorways with a new speed limit of 120 km/h, the mean speed increased by 3.6 km/h, while on 2+1 roads, the mean speed increased by 3.4 km/h when the speed limit increased from 90 to 100 km/h. Reducing the speed limit by 10 km/h on 2+1 roads...
and rural roads with an initial speed limit of 110 km/h resulted in a decrease in mean speed of approximately 2 km/h. On rural roads where the speed limit was lowered from 90 to 80 km/h, the mean speed decreased by 3.3 km/h. Almost the same reduction (i.e., 3.4 km/h) was found on rural roads where the speed limit was lowered from 90 to 70 km/h. All the above changes are significantly different from zero. No significant changes in mean car speeds were found on roads where the speed limits increased from 70 to 80 km/h.

Originally, 10 measurement points were selected in all groups except group 5, in which 22 points were selected. As can be noted in Table 2, some measurement points were excluded from the analysis. This is because either the road’s speed limit was not changed or the speed data were of poor quality.

Table 2: Space-mean speed of cars. Approximate 95% confidence intervals; n = number of measurement points.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Group</th>
<th>n</th>
<th>Space-mean speed before (km/h)</th>
<th>Space-mean speed after (km/h)</th>
<th>Change, before–after (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1: MW 110→120</td>
<td>10</td>
<td>114.9</td>
<td>118.6</td>
<td>3.6 ± 0.5</td>
</tr>
<tr>
<td>1</td>
<td>2: 2 + 1 110→100</td>
<td>8</td>
<td>102.3</td>
<td>100.0</td>
<td>−2.3 ± 1.0</td>
</tr>
<tr>
<td>1</td>
<td>3: 2+1 90→100</td>
<td>9</td>
<td>93.8</td>
<td>97.2</td>
<td>3.4 ± 0.5</td>
</tr>
<tr>
<td>1</td>
<td>4: Rural 110→100</td>
<td>10</td>
<td>100.1</td>
<td>98.2</td>
<td>−2.0 ± 0.8</td>
</tr>
<tr>
<td>2</td>
<td>5: Rural 90→80</td>
<td>22</td>
<td>88.5</td>
<td>85.2</td>
<td>−3.3 ± 1.0</td>
</tr>
<tr>
<td>2</td>
<td>6: Rural 70→80</td>
<td>10</td>
<td>85.1</td>
<td>85.4</td>
<td>0.3 ± 1.9</td>
</tr>
<tr>
<td>2</td>
<td>7: Rural 90→70</td>
<td>9</td>
<td>83.3</td>
<td>79.9</td>
<td>−3.4 ± 1.1</td>
</tr>
</tbody>
</table>

For trucks with trailers, the speed limit of 80 km/h applied both before and after the changes if the speed limits on the roads were 80 km/h or above. In general, the mean speed of these vehicles did not change significantly. The mean speed of trucks with trailers after the speed limit changes was 83–86 km/h on roads with a speed limit of 100 km/h and above, 80 km/h on rural roads with a new speed limit of 80 km/h and 75 km/h on roads with a new speed limit of 70 km/h.

The percentage of speed violations increased by approximately 20 percentage points when the speed limit was lowered by 10 km/h and decreased by the same amount when the limit was raised 10 km/h. This is because drivers had not completely adapted their driving speeds to the new speed limits. After the new speed limit of 120 km/h was introduced on motorways and of 100 km/h on 2+1 roads, approximately 50% of car drivers exceeded the speed limit. On rural roads where the speed limit decreased from 90 to 80 km/h, almost 70% of the car drivers exceeded the speed limit.

Table 3 shows the levels and changes of P85. In principle, P85 has changed by the same amount as the space-mean speed. The P85 levels after the introduction of the new speed limits are approximately 15 km/h above the space-mean speed. On motorways where the speed limit increased from 110 to 120 km/h, 15% of the car drivers exceeded 132.2 km/h and on rural
roads where the speed limit decreased from 90 to 80 km/h, 15% of car drivers exceeded 99.4 km/h.

The 85th percentile for trucks with trailers did not change significantly for any of the studied road types. After the new speed limits, the P85 for trucks with trailers was approximately 90 km/h on motorways and 2+1 roads, 89 km/h on rural roads with a speed limit of 100 km/h and 87 km/h on rural roads with speed limits of 80 or 70 km/h.

Table 3: Levels and changes of 85th percentiles for cars (P85). Approximate 95% confidence intervals; n = number of measurement points.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Group</th>
<th>n</th>
<th>P85 before (km/h)</th>
<th>P85 after (km/h)</th>
<th>Change, before–after (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1: MW 110→120</td>
<td>10</td>
<td>128.8</td>
<td>132.2</td>
<td>3.3 ± 0.9</td>
</tr>
<tr>
<td>1</td>
<td>2: 2+1 110→100</td>
<td>8</td>
<td>117.2</td>
<td>113.9</td>
<td>–3.3 ± 1.2</td>
</tr>
<tr>
<td>1</td>
<td>3: 2+1 90→100</td>
<td>9</td>
<td>104.7</td>
<td>107.8</td>
<td>3.1 ± 0.7</td>
</tr>
<tr>
<td>1</td>
<td>4: Rural 110→100</td>
<td>10</td>
<td>115.9</td>
<td>113.6</td>
<td>–2.3 ± 1.0</td>
</tr>
<tr>
<td>2</td>
<td>5: Rural 90→80</td>
<td>22</td>
<td>102.4</td>
<td>99.4</td>
<td>–3.0 ± 1.2</td>
</tr>
<tr>
<td>2</td>
<td>6: Rural 70→80</td>
<td>10</td>
<td>102.0</td>
<td>101.3</td>
<td>–0.7 ± 1.7</td>
</tr>
<tr>
<td>2</td>
<td>7: Rural 90→70</td>
<td>9</td>
<td>99.1</td>
<td>95.6</td>
<td>–3.5 ± 2.0</td>
</tr>
</tbody>
</table>

In phase 1, studies of speed measurements made on similar roads where the speed limit did not change indicate no general change in speeds on the national road network during the measurement period (i.e., August 2008–August 2009). For phase 2, the controls indicate a small decrease in mean speed of approximately 1 km/h for cars, but no change for trucks with trailers, during the measurement period (i.e., September 2009–September 2010). The Swedish speed index for rural roads indicates that the general mean speed for all vehicles did not change during the measurement period for phase 1, but indicates a small decrease of 0.6% during the measurement period for phase 2.

Long-term effects were studied using 11 measurement points on rural roads where the speed limit decreased from 90 to 80 km/h. Figure 2 shows the change in mean speed relative to corresponding months in 2009. For both vehicle types, it can be noted that the greatest reductions occurred in January and February, possibly attributable to the extremely snowy winters of 2010 and 2011. During the snow-free period (April–October), the speed reduction averages approximately 3–3.5 km/h for passenger cars and approximately 1–2 km/h for trucks with trailers. It should also be noted that, for passenger cars, the April to October reduction is somewhat larger in 2011 than in 2010.
3.2 Effects on accidents

Table 4 shows empirical results based on accident statistics from the Swedish accident database STRADA. The results were standardized to establish the effect of amended speed limits in relation to parts of the road network where speed limits remained the same.

Table 4: Change in number of fatalities and seriously injured people (FSI) per year.

<table>
<thead>
<tr>
<th>Fatalities</th>
<th>Seriously injured</th>
<th>Total FSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>−30</td>
<td>−26</td>
<td>−56</td>
</tr>
</tbody>
</table>

The results indicate substantial reductions in the number of both fatalities and seriously injured people, which together declined by 56. This can be compared with the total number of fatalities and seriously injured per annum in Sweden, i.e., approximately 300 and 3000, respectively. Lives have predominantly been saved on rural roads where speed limits were reduced from 90 to 80 km/h with more than 70% of saved lives belonging to this group of roads. This is the largest group, representing more than 60% of the total changed road length. On motorways, with new speed limit 120 km/h, an increase of 11 seriously injured could be seen. When analysing the above results, it is important to take into account that the evaluation period after the introduction of new speed limits was brief. To gain more reliable results, it would be advisable to continue to follow up the number of fatalities and seriously injured people.
4 DISCUSSION AND CONCLUSION

The aim of this study was to investigate the effects of new speed limits on Sweden’s rural road network. The effects on actual speed levels were studied using a sample survey. In all, approximately 80 measurement points were selected throughout Sweden using systematic random sampling.

The survey results indicate that the mean car speed increased by 3.5 km/h when the speed limit increased by 10 km/h on motorways and 2+1 roads. Reducing the speed limit by 10 km/h on 2+1 roads and rural roads with a speed limit of 110 km/h resulted in a 2 km/h decrease in mean speed. On rural roads where the speed limit was lowered from 90 to 80 km/h, the mean speed decreased by 3.3 km/h. These results are in line with those of previous studies that indicate a change in mean speed of 2.5 km/h when the speed limit changes by 10 km/h (Elvik et al., 2004). The results are also of the same magnitude as the assumptions made by the Swedish Road Administration before the speed changes were imposed, although the actual changes are somewhat smaller than the assumed level of 4 km/h.

No significant changes in mean car speeds were found on roads where the speed limits increased from 70 to 80 km/h. On these roads, which typically have low traffic flow, the mean speed was already approximately 85 km/h before the speed limit change. On roads where the speed limit decreased from 90 to 70 km/h the mean speed decreased by 3.4 km/h which is also less than could be expected from previous studies. For trucks with trailers, there were generally no significant changes in mean speed. However, for these vehicles, the speed limit of 80 km/h applied both before and after the changes where the speed limits were 80 km/h or above.

One consequence of drivers not completely adapting their driving speeds after the new speed limits were imposed is that speed limit compliance has increased on roads with increased speed limits and decreased on roads with decreased speed limits. The present results indicate that the percentage of speed violations increased by approximately 20 percentage points when the speed limit was lowered by 10 km/h and decreased to the same degree when the limit was raised 10 km/h.

The P85 levels have changed by the same amount as have the space-mean speeds. The P85 levels after the introduction of new speed limits were approximately 15 km/h above the space-mean speeds. This indicates that the speed distribution on the roads has not changed, but only shifted to another level. The P85 for trucks with trailers has not changed significantly for any of the studied road types.

Some minor quality aspects in relation to the sample survey merit discussion. In analysing vehicle speeds, some single measurement points were excluded due to poor data quality or because the speed limit did not change at the measurement point. In general, data from at least three weekdays from Monday to Friday and in the daytime (06.00–19.00) were analysed, but occasionally fewer than three days were used. Since only a few points were excluded and there were rather many measurement points in each group and a fairly large number of vehicles passed each point, this is deemed to have affected the results only marginally. The speed of passing vehicles was almost always measured using pneumatic tubes, but in some cases using induction loops. Speed measurements with pneumatic tubes and induction loops are not strictly comparable since the speed level may differ slightly between the two methods. The estimates of speed levels may have been slightly affected by the use of two different
methods. However, in this study, the main objective was to estimate speed changes and since the same equipment was used both before and after the speed limit changes at the same road site, these estimates were not affected to any significant extent.

Studies of control sites on similar roads where speed limits have not changed indicate no general change in speeds on the Swedish national road network during the measurement period for phase 1 (i.e., August 2008–August 2009). This result is in line with the outcome of the Swedish speed index for rural roads, which indicated that the general mean speed did not change during this time. For phase 2, the controls indicate a small decrease in mean speed of approximately 1 km/h for cars, but no changes for trucks with trailers during the measurement period (i.e., September 2009–September 2010); the speed index indicates a small decrease of 0.6% over the same time period. These results cannot be generalized to the entire national road network, which means that it is difficult to say exactly what impact general changes has on the results on roads with changed speed limits. It could mean that the actual changes detected by the sample survey due to change of speed limit are somewhat smaller than were reported during phase 2, but we cannot exclude the possibility that the new speed limits have affected road user awareness of the speed limit, possibly resulting in an overall reduction.

Long-term effects were studied on rural roads where the speed limit decreased from 90 to 80 km/h. During the snow-free period (April–October), the speed reduction after the new limit was introduced averaged approximately 3–3.5 km/h for passenger cars and approximately 1–2 km/h for trucks with trailers. The speed reduction for passenger cars from April to October was somewhat larger in 2011 than in 2010, indicating a small positive long-term trend, though none of the changes between 2010 and 2011 is significant. As was found by Son et al. (2009), the difference between the changed speeds one and two years after the new speed limit is small.

The obtained mean speed changes may seem small, but even relatively small changes can substantially affect traffic safety. Theoretical calculations made using the Power model (Nilsson, 2004; Elvik, 2009) indicate that reducing mean speeds by 4% leads to a 17% reduction in the number of deaths and nearly a 14% reduction in the number of seriously injured. An empirical study of the change in the number of fatalities and severely injured people also demonstrated that the changed speed limits had a positive effect, reducing the yearly number of fatalities and severely injured by more than 50. Results were corrected for the general road safety trend. When selecting roads for the introduction of new speed limits, the selection criteria was predominantly based on the safety standard of the road and not the accident outcome. Therefore, regression to the mean is not considered in the analyses.

The greatest reduction in traffic deaths occurred on rural roads where the speed limit was reduced from 90 to 80 km/h. This is also the largest road type group with new speed limits: more than 60% by length of roads with changed speed limits belongs to this group. These are roads where normally no other traffic safety measures are implemented. On motorways, with increased speed limit 120 km/h, an increase of 11 seriously injured could be seen. It should be noted that the study period after the introduction of the new speed limits was fairly brief, so continued follow-up is recommended to obtain more reliable results.
5 ACKNOWLEDGEMENT

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REFERENCES


