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Traffic safety effects of new speed limits in Sweden

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ABSTRACT

The effects of speed, both positive and negative, make speed a primary target for policy action. Driving speeds affect the risk of being involved in a crash and the injury severity as well as the noise and exhaust emissions. Starting 2008, the Swedish Transport Administration performed a review of the speed limits on the national rural road network. This review resulted in major changes of the speed limits on the rural road network. It was predominantly roads with a low traffic safety standard and unsatisfactory road sides that were selected for reduced speed limits, as well as roads with a good traffic safety record being selected for an increase in speed limits. During 2008 and 2009, speed limit changed on approximately 20,500 km of roads, out of which approximately 2700 km were assigned an increase, and 17,800 km were assigned a reduction in speed limits.

The aim of this study is predominantly to describe and analyse the longterm traffic safety effect of increased, as well as, reduced speed limits, but also to analyse the changes in actual driving speeds due to the changed speed limits. Traffic safety effects are investigated by means of a before and after study with control group and the effects on actual mean speeds are measured by a sampling survey in which speed was measured at randomly selected sites before and after the speed limit changes.

Results show a reduction in fatalities on rural roads with reduced speed limit from 90 to 80 km/h where the number of fatalities decreased by 14 per year, while no significant changes were seen for the seriously injured. On motorways with an increased speed limit to 120 km/h, the number of seriously injured increased by about 15 per year, but no significant changes were seen for the number of deaths. The number of seriously injured increased on all types of motorways, but the worst development was seen for narrow motorways (21.5 m wide). For 2 + 1 roads (a continuous three-lane cross-section with alternating passing lanes and the two directions of travel separated by a median barrier) with decreased speed limit from 110 to 100 km/h, the seriously injured decreased by about 16 per year. As regards the change of mean speeds, a decrease in speed limit with 10 km/h led to a decrease of mean speeds of around 2–3 km/h and an increase of the speed limit with 10 km/h resulted in an increase of mean speed by 3 km/h. In conclusion, the results show that in total about 17 lives per year have been saved on the road network with changed speed limits. For comparison, 397 road users were killed in total during 2008. The number of seriously injured remain in principle unchanged. It should also be noted that the results are obtained for the road network which changed the speed limits during 2008 and 2009, and it is not certain that the results can be generalised to another road network.

1. Introduction

There have been a number of research studies undertaken in the past decades which have all shown a close correlation between speed, crash frequency and severity: The faster you go, the higher risk of a crash and the more severe the crash will be. The Power model (Nilsson, 2004; Elvik and Vaa, 2009) estimates that if the average speed is reduced by 5 percent, the number of fatalities is reduced by 21 percent and the number of seriously injured by about 16 percent. Moreover, driving speeds affect noise and exhaust emissions. Speed management is therefore a very important aspect of transport planning.

In Sweden, starting 2008, the Swedish Transport Administration performed a review of the speed limits on the national rural road network. The long-term vision was that speed limits should be adapted to the safety classification of each road and be in line with the ideas of Vision Zero. A core principle of Vision Zero is that road system design should take into account how much force a body can

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Table 1
Road length (kilometers) with decreased speed limit in Sweden.

Change (km/h)	90 → 70	90 → 80	110 → 80	110 → 90	110 → 100	Total
Phase 1	40	521	–	314	1594	2469
Phase 2	1025	12,337	47	704	1237	15,350

Table 2
Road length (kilometers) with increased speed limit in Sweden.

Change (km/h)	70 → 80	70 → 90	90 → 100	90 → 110	110 → 120	Total
Phase 1	41	1	654	57	261	1014
Phase 2	1175	49	417	12	–	1653

Table 3
Road types where speed measurements were done.

Type of road	Description
1. Motorways, 110 → 120 km/h	Motorways where the speed limit increased from 110 to 120 km/h
2. 2 + 1 roads, 90 → 100 km/h	A continuous three-lane road with alternating passing lanes and the two directions of travel separated by a median barrier
3. 2 + 1 roads, 110 → 100 km/h	A continuous three-lane road with alternating passing lanes and the two directions of travel separated by a median barrier
4. Rural roads, 110 → 100 km/h	Two-lane rural roads
5. Rural roads, 70 → 80 km/h	Two-lane rural roads
6. Rural roads, 90 → 80 km/h	Two-lane rural roads
7. Rural roads, 90 → 70 km/h	Two-lane rural roads

tolerate and still survive. This means for example that the ambition is that a speed limit of 90 km/h or higher only should be allowed on roads with median barriers.

The review of the speed limits resulted in major changes of the speed limits on the rural road network. The main category of roads with new speed limits was rural two-lane roads, where the speed limit was reduced from 90 to 80 km/h. This category accounted for more than 60% by length of the roads with changed speed limits. It was predominantly roads with a low traffic safety standard and unsatisfactory road sides that were selected for reduced speed limits, as well as roads with a good traffic safety record being selected for an increase in speed limits. Moreover, roads important to local economy transport and commuting have been assigned higher speed limits than roads less important from a local economy point of view. During 2008 and 2009, speed limit changed on approximately 20,500 km of roads, out of which approximately 2700 km were assigned an increase, and 17,800 km were assigned a reduction in speed limits.

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.

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.

1.1. Aim

The aim of this study is predominantly to describe and analyse the long-term traffic safety effects of increased, as well as, reduced speed limits but also to analyse the changes in actual driving speeds due to the changed speed limits.

2. Method

The review of the speed limits was conducted in two phases and resulted in the changes shown in Tables 1 and 2. The largest change in phase 1 was a decrease of the speed limit from 110 to 100 km/h on 1594 km road. Phase 2 was dominated by the decrease of speed limits from 90 km/h to 80 km/h on over 12,000 km road.

This paper deals with two different studies, one concerns the change in mean speed och one the change in crashes. The methods for these two studies are described below in 2.1 and 2.2.

2.1. Speeds

The effects of speed limit changes were estimated for seven road types with different initial speed limits (Table 3).

To study the effects on the entire road network and not only at specific road sites, a sampling survey was conducted in which speed was measured at randomly selected sites before and after the speed limit changes. Systematic sampling was used to select sites that were widely distributed geographically. Speed measurements were made before and after introducing new speed limits. The speed limit changes on roads in categories 1–4 (Table 3) were evaluated based on the changes made in phase 1. These changes were conducted in September and October 2008. The speed limit changes in categories 5–7 are based on changes made in phase 2 in November and December 2009. Measurements were made at sites on phase 1 roads in August 2008 and 2009 and on phase 2 roads in September 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 until noon Friday); the presented results represent daytime conditions, from 06.00 to 20.00. The speed of passing vehicles was generally measured using pneumatic tubes stretched across the road. In all, approximately 80 measurement points were selected throughout Sweden. The speeds of all vehicles were considered in the analyses. However, these roads have no congestion, and can be regarded as having free-flow conditions during most of the time.

Table 4
Case and control groups in the traffic safety study.

Case group	Control group
Motorway, 110–120 km/h	Motorway 110 km/h
2 + 1, 90–100 km/h	2 + 1, 90 km/h
2 + 1, 110–100 km/h	2 + 1, 110 km/h
Rural, 110–100 km/h	Rural, 90 km/h
Rural, 70–80 km/h	Rural, 70 km/h
Rural, 90–80 km/h	Rural, 90 km/h
Rural, 90–70 km/h	Rural, 90 km/h

Moreover, the speed differences between all vehicles and free-flow vehicles are small. A detailed description of the method is available in Vadeby and Forsman (2014).

To control for confounding factors approximately 20 fixed sites were used as control sites for speed measurements. The selected control sites were situated on roads where the speed limits were unchanged.

2.2. Crashes

The present study of traffic safety effects is a before and after study with control group where the change in accident and injury outcome on roads with new speed limits is compared with the corresponding change in the control group (roads with unchanged speed limits). The evaluation is based on police recorded accident rates from the accident data base STRADA (Swedish Traffic Accident Data Acquisition) for the 2003–2013 period, combined with information on roads from the National Road Database, NVDB. Only road sections with both a before and after period are included in the analysis. Roads where other measures (i.e. speed cameras) were introduced during the before or after period were excluded from the analyses. So were crashes with pedestrians and bicycles only, track-based vehicles, and game.

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 almost five years long, i.e., 1 February 2009–31 December 2013, whereas for phase 2 it is almost four years long, i.e., 1 February 2010–31 December 2013.

To evaluate the traffic safety effects, the numbers of injury crashes and people killed or seriously injured before and after the new speed limits were compared in a before and after study with a control group. This means that the changes are estimated in a case group (which in this case consists of roads with new speed limits) and in a control group of similar roads. The control groups include all roads in Sweden of the same road category as the case group, with unchanged speed limits. The control groups are considered as rather representative for the case groups since they are similar roads, however they are not an exact match. The before and after study therefore controls for changes in the general traffic safety trend and traffic volumes. The case and control groups studied in this report are presented in Table 4. The reason that roads with 90 km/h is used as a control for highways with altered speed 110–100 km/h is that in principle there are no remaining rural roads with 110 km/h.

The change between the before and after periods is estimated as:

$$\hat{\theta} = ck\frac{\sum Y}{\sum X} \quad (1)$$

where X is the number of observed crashes in the before period, and Y the number in the after period (summarized over all road sections), c corrects for differences in traffic volumes between the before and after period (also covering the difference in length of the time periods) and is the ratio of vehicle-kilometers travelled in the after periods to before periods summed over all sites. The factor k corrects for the changes in the control group and is the ratio of after crashes to before crashes in the comparison group summed over all sites. The traffic safety effect is estimated by $\theta - 1$. Following a first-order Taylor expansion (Lehmann, 2001), the variance is estimated by

$$\mathrm{Var}\left(\hat{\theta}\right) = \left[\mathrm{ck}\frac{\sum Y}{\sum X}\right]^2 \left(\frac{1}{\sum X} + \frac{1}{\sum Y}\right) \quad (2)$$

and a 95% confidence interval (CI) is:

$$CI = \hat{\theta} \pm 1,96 * \sqrt{Var\left(\hat{\theta}\right)} \quad (3)$$

It should be noted that the method does not correct for regression to the mean. Since the selection of roads with new speed limit is based on other criteria than accident outcome, the accident material is large and covers all roads that have received new speed limits and that the before and after periods are relatively long, this should not lead to any substantial limitation. It is also noted that for both the case- and control group the accident outcome in the before period is considered as normal for the respective roads.

3. Results

3.1. Speed

The speed limit changes for all vehicles are presented in Table 5. Speed changes for different vehicle types (cars, HGVís) as well as confidence intervals are presented in Vadeby and Forsman (2014). The changes in mean speed on the control sites were only minor and not significant and therefore no corrections were made in the analyses.

On motorways with a new speed limit of 120 km/h, the mean speeds increased by 3.4 km/h, while on 2 + 1 roads, the mean speed increased by 3.1 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

Table 5
Space-mean speed of all vehicle types. Levels before and after the new speed limits and before–after changes; n = number of measurement points. 95% confidence intervals for the change.

Phase	Road category	n	Space-mean speed, before (km/h)	Space-mean speed, after (km/h)	Change, before–after (km/h)
1	MW, 110–120 km/h	10	111.9	115.3	3.4 ± 0,5
1	2 + 1, 90–100 km/h	9	92.9	95.9	3.1 ± 0,5
1	2 + 1, 110–100 km/h	8	100.5	98.4	−2.1 ± 0,9
1	Rural, 110–100 km/h	10	98.4	96.7	−1.7 ± 0,7
2	Rural, 70–80 km/h	10	84.6	84.8	0.2 ± 1,9
2	Rural, 90–80 km/h	22	87.7	84.7	−3.1 ± 0,9
2	Rural, 90–70 km/h	9	82.6	79.4	−3.1 ± 1,1

Table 6
Empirical change of fatalities and FSI (fatalities and seriously injured) per year based on crashes from STRADA. Results corrected for confounding factors. 95% confidence intervals.

Road category	Relative empirical change (%)		Empirical change (number per year)	
	FSI	Fatalities	FSI	Fatalities
MW, 110–120 km/h	128 ± 61	−20 ± 76	15.5	−0.3
2 + 1, 90–100 km/h	12 ± 34	99 ± 276	2.7	0.4
2 + 1, 110–100 km/h (grade separated)	−38 ± 27	−58 ± 71	−5.1	−0.6
2 + 1, 110–100 km/h	−60 ± 18	−48 ± 65	−12.2	91.0
Rural, 110–100 km/h	5 ± 28	−19 ± 64	1.3	−0.6
Rural, 70–80 km/h	−4 ± 29	44 ± 137	−0.8	0.6
Rural, 90–80 km/h	−7 ± 9	−41 ± 15	−12.6	−14.2
Rural, 90–70 km/h	21 ± 41	2 ± 78	1.8	0.0

Table 7
Empirical change of fatalities and FSI (fatalities and seriously injured) per year for the case and control group.

Case group	Change in case group (%)		Change in control group (%)	
	FSI	Fatalities	FSI	Fatalities
MW, 110–120 km/h	55,5	−56.7	−31,9	−45,8
2 + 1, 90–100 km/h	−2,0	−40,1	−12,7	−70,0
2 + 1, 110–100 km/h (grade separated)	−44,5	−70,8	−10,9	−30,3
2 + 1, 110–100 km/h	−64,5	−63,5	−10,9	−30,3
Rural, 110–100 km/h	−24,1	−35,5	−28,0	−20,6
Rural, 70–80 km/h	−29,2	−1,9	−26,0	−31,9
Rural, 90–80 km/h	−32,9	−53,0	−28,0	−20,6
Rural, 90–70 km/h	−12,7	−18,7	−28,0	−20,6

Table 8
Estimated change of the number of fatalities and FSI (fatalities and seriously injured), according to the Power model and empirical accident statistics from STRADA.

Group	Estimates according to the Power model		Empirical change (number per year)	
	Fatalities	FSI	Fatalities	FSI
MW, 110–120 km/h	0.5	3.0	−0.3	15.5[a]
2 + 1, 90–100 km/h	1.2	6.1	0.4	2.7
2 + 1, 110–100 km/h	−0.6	−3.4	−1.6	−17.3[a]
Rural, 110–100 km/h	−0.7	−2.9	−0.6	1.3
Rural, 70–80 km/h	−0.5	−2.3	0.0	1.8
Rural, 90–80 km/h	−9.7	−44.4	−14.2[a]	−12.6
Rural, 90–70 km/h	0.0	−0.2	0.6	−0.8
Total[b]	−10.9	−47.9	−17.2	−10.1

[a] Significant change.
[b] Includes some roads with other changes of the speed limits.

rural roads with an initial speed limit of 110 km/h resulted in a decrease in mean speed of 2.1 km/h. On rural roads where the speed limit was lowered from 90 to 80 km/h, the mean speed decreased by 3.1 km/h. The same reduction (i.e., 3.1 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.

The changes for private cars were somewhat larger, see Vadeby and Forsman (2014). 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.

3.2. Crashes

Table 6 shows the relative empirical change of fatalities and FSI (fatalities and seriously injured) per year based on crash statistics from STRADA. The results are corrected for confounding factors such as the general traffic safety trend and changes in traffic volumes, see Eq. (1). The recorded number of fatalities and FSI in the case and control groups are reported in Appendix A, Table A1. On roads with raised speed limits, the largest effect of FSI is on motorways with increased speed limit from 110 km/h to 120 km/h. On these roads, the number of FSI increased by 15 per year, while no significant changes could be seen for the number of fatalities (probably due to a very low number of fatalities in the after period). A more detailed look at the data shows that there has been an increase on all types of motorways with increased speed limit to 120 km/h, but that the worst development is seen on narrow motorways with a width of 21.5 m.

On 2 + 1 roads with decreased speed limit from 110 km/h to 100 km/h a decrease of the number of FSI of about 17 per year can be seen. For 2 + 1 roads with increased speed limits from 90 to 100 km/h no significant changes were seen. For rural two lane roads with a decreased speed limit from 90 to 80 km/h, the numbers of fatalities decreased by 14 per year, while no significant changes were seen for the number of FSI. In total, 17 lives per year have been saved on the road network with changed speed limits. The number of seriously injured has not changed significantly.

The changes presented in Table 6 are corrected for differences in traffic volumes between the before and after period (also covering the difference in length of the time periods) as well as for the changes in the control group. In Table 7, the estimated changes per

year (corrected for differences in traffic volumes) in the case and control groups are shown. It can be noted that in the control groups where the speed limits are unchanged, the changes are all negative, indicating the general road safety trend.

3.3. Comparison with the Power model

Table 8 shows a comparison between the empirical outcomes of the changes in the number of fatalities and seriously injured and theoretical calculations by the Power model (Nilsson, 2004; Elvik and Vaa, 2009). The powers used in the Power model was 3.5 for the seriously injured and 4.6 for fatalities.

In Table 8, all estimates for the different groups are shown whether they are significant or not. It is apparent that the number of fatalities is of similar magnitude for both methods, although the empirical results indicate larger effects in total. The major impact in the number of saved lives is mainly found on roads with a reduced speed limit from 90 to 80 km/h. Both methods estimate the greatest reduction on the number of fatalities in this group, although STRADA data provides greater effects (−14.2 fatalities compared to −9.7 for the Power model). The results for the seriously injured differs much more. The empirical outcome according to STRADA shows a minor increase of the seriously injured, while the estimates from the Power model show that the seriously injured are reduced by 37 persons per year. Note that it is FSI including both fatalities and seriously injured that is shown in Table 7. The increase in severe injuries are mainly found on motorways with new speed limit 120 km/h. Both motorways with increased speed limit 120 km/h and 2 + 1 roads with decreased limit 100 km/h show changes in the same direction as expected from the mean speed changes but the STRADA results indicate much greater effects. The largest difference is found for roads with decreased limit to 80 km/h where the STRADA results indicate that there have not been any major changes in the number of seriously injured, but the power model estimates a reduction of 35 people per year. However, we can conclude that all significant changes in the empirical study of accidents is in the same direction as the expected impact according to the power model.

4. Discussion

In this paper the long-term traffic safety effect of increased, as well as, reduced speed limits in Sweden is evaluated. The evaluation is based on accident rates from the accident data base STRADA (Swedish Traffic Accident Data Acquisition) combined with information on roads from the National Road database, NVDB. Actual changes in driving speed as an effect of new speed limits are also described, based on a sample survey.

The results show an extensive reduction in fatalities on rural roads with reduced speed limit from 90 to 80 km/h. On these roads, the fatalities decreased by 41 per cent (14 deaths per year). However, the number of seriously injured did not changed significantly. On motorways with an increased speed limit to 120 km/h, the number of seriously injured increased by about 15 per year, but the number of deaths was in principle unchanged (very few fatalities in the after period). The number of seriously injured increased on all types of motorways, but the worst development was seen for narrow motorways (21.5 m wide). For 2 + 1 roads with decreased speed limit from 110 to 100 km/h, the number seriously injured decreased by about 16 per year.

In conclusion, the results show that about 17 lives per year have been saved in total on the road network with changed speed limits. The number of seriously injured decreased by 7 persons but this result is not significantly different from zero. This can be compared to the estimates made by the Swedish Transport Administration prior to the changes: 13.5 fatalities and 42 serious injuries should be avoided annually on the national road network. Thus, the number of lives saved was even larger than the estimate but the estimated decrease in seriously injured were not fulfilled. Estimates based on the Power model, based on actual mean speed changes, also showed a relatively large decrease in the number of seriously injured. It is difficult to find a plausible explanation for the differences in estimated and observed changes in the number of seriously injured. However, previous research has shown a large variation in the effect of seriously injured in earlier studies which makes it difficult to make accurate estimates (Elvik, 2013). When comparing the two methods, it should also be noted that the mean speeds were measured about 5 years ago and we have no updated knowledge about how mean speeds on these roads have changed in recent years. Research around long-term effects is sparse and show mixed results. Son et al. (2009) studied effects of a speed limit rise from 55 mph to 65 mph. They found no further change in driving speed after an initial rise during the first few months after the speed limit change. Ibrahim et al. (2013) investigated the effect of reducing residential speed limits from 50 km/h to 40 km/h. The first results, a few months after the change of the speed limit, showed a decrease of 4.7 km/h on driving speed. The speeds then increased by 1.6 km/h until the next measurement about a year after the speed limit change. Another discrepancy to consider when comparing the results is that the estimation according to the power model does not take into account the general trend due to improved roads, changed vehicle fleet, changing of travel patterns etc. This might be significant factor when comparing the two methods for a longer period (2003–2013).

The results from the sample survey showed that a decrease in speed limit with 10 km/h led to a decrease of mean speeds of around 2–3 km/h for all vehicles and that an increase of the speed limit with 10 km/h resulted in an increase of mean speed by 3 km/h (except on roads where the speed limit increased from 70 to 80, where no significant change was observed). This can be compared to the estimates made by the Swedish Transport Administration before the speed limit changes, where it was estimated that an increase or decrease of the speed limit of 10 km/h would result in an actual increase or decrease of 4 km/h for passenger vehicles. The change for Heavy Goods Vehicles (HGVs) with or without a trailer, was estimated to be less (different assumptions were made depending on road type and speed limit). The changes in actual mean speeds due to speed limit changes were also about the same size as could be expected from previous international studies, i.e., an average change of approximately 2.5 km/h when the speed limit is changed by 10 km/h (Elvik et al., 2004).

In order to achieve larger effects of speed limit decreases than those obtained here, it is probably necessary to combine the change of speed limits with other measures such as speed cameras. Speed cameras have shown to give good results on rural roads both in Sweden (Swedish Road Administration, 2009) and elsewhere (Elvik et al., 2009). Lately, Soole et al. (2013) also found a growing body of evidence supporting road safety benefits of average speed enforcement.

Some minor quality considerations regarding the methodology used to estimate the traffic safety effects merit discussion. The present study is a before and after study with control group where the change in accident and injury outcome on roads with new speed limits is compared with the corresponding change in the control group (similar roads with unchanged speed limit). Such an experimental setting controls for general traffic safety changes over time and the results therefore reflect the effect of new speed limits. However, the method does not correct for regression to the mean. Since the selection of roads with new speed limit not is based on the accident outcome, the accident material is large and covers all roads that have received new speed limits and that the before and after

periods are relatively long, this should not lead to any substantial limitation. It is also noted that for both the case- and control group the accident outcome in the before period is considered as normal for the respective roads. It can also be noted that the results are obtained for the road network which changed the speed limits during 2008 and 2009, and it is not certain that the results can be generalised to another road network.

There is also a possibility of traffic migration from roads where the speed limits were decreased to other roads and to roads where speed limits have been increased. Here, this possibility is expected to be small since the speed limit changes are made on rural roads with limited opportunities to switch to other routes. Also, migration to roads with higher speed limits may not be bad for the traffic safety if those roads have a higher traffic safety standard.

The analyses of the traffic safety effects are based on police records and therefore, the under-reporting of crashes might be a problem. It is well known that the under-reporting is greater for less severe injuries. However, this study only considers fatalities and seriously injured on the rural road network and the accident statistics in every case group is compared to the same statistics in a control group. There is no reason to believe that the under-reporting of fatalities and seriously injured differ between the case and control group, and the corrected final results should therefore be only marginally affected by the underreporting.

The interim traffic safety target in Sweden for 2020 is that no more than 220 people per year should lose their lives in road traffic accidents and that the number of seriously injured people should not exceed 4100. One major factor to reduce the number of fatalities and seriously injured and reach these targets are lower mean speeds (Berg et al., 2013). One way of achieving lower mean speeds is to decrease the speed limits. The results from this study as regards the change of mean speeds for all vehicles showed that a decrease in speed limit with 10 km/h led to a decrease of mean speeds of around 2–3 km/h. As regards the traffic safety effects, the results show that in total about 17 lives per year have been saved on the road network with changed speed limits. The number of seriously injured remain in principle unchanged.

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Appendix A.

Table A1 reports the recorded number of fatalities and fatalities and seriously injured (FSI) in the case and control groups. It should be noted that both on motorways and 2 + 1 roads there are very low numbers of people killed in the after period. It can also be noted that the before and after period differs in length and direct comparison between the before and after period cannot be made.

Table A1
Recorded number of fatalities and FSI (fatalities and seriously injured) in the case and control groups.

Category	FSI				Fatalities			
	Case		Control		Case		Control	
	Before	After	Before	After	Before	After	Before	After
Motorway, 110–120 km/h	92	132	735	512	15	6	92	51
2 + 1, 110–100 km/h (at grade separated)	41	39	34	58	4	2	3	4
2 + 1, 110–100 km/h	38	37	34	58	5	5	3	4
2 + 1, 90–100 km/h	69	113	22	32	4	4	2	1
Rural, 110–100 km/h	104	113	1443	889	13	12	237	161
Rural, 70–80 km/h	109	70	3059	1803	9	8	378	205
Rural, 90–80 km/h	1224	686	1443	889	209	82	237	161
Rural, 90–70 km/h	95	51	1443	889	20	10	237	161

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