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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.

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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 and 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.

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