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Effects on road safety of new urban arterial roads

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Abstract

This paper presents an evaluation of the effects on road safety of new urban arterial roads in Oslo, Norway, and a synthesis of evidence from similar studies that have evaluated the safety effects of new urban arterial roads in other cities. A before-and-after study was made of four urban arterial road projects in Oslo. The study controlled for general accident trends in Oslo and for regression-to-the-mean. A statistically non-significant reduction of 9% in the number of injury accidents was found for all four projects combined. The effects on safety of new urban arterial roads were found to vary, depending on whether a new arterial road was built, or an existing arterial road upgraded by means of lane additions and reconstruction of junctions to interchanges. New arterial roads tend to induce more traffic, which tends to offset the benefits of a lower accident rate on the new roads. The results for other cities are very consistent with those for Oslo. For a total of seven cases in which new arterial roads were built, a statistically non-significant reduction of 1% in the number of injury accidents was found. Two cases that involved lane additions and converting at-grade junctions to interchanges resulted in a mean accident reduction of 51%, which was highly significant. On the average, the nine arterial road projects from which evidence was summarised resulted in a net induced traffic of 16%, and a net reduction in accident rate (accidents per million vehicle kilometres) of 18%. These effects almost cancel each other, leading to a very small net change in the expected number of accidents.

Keywords: Arterial road; Urban area; Oslo; Safety effects; Evaluation

1. Introduction

Traffic congestion is a problem in many major cities. Norwegian cities, although comparatively small by international standards, are no exception to this rule. During the last 15 years, major road construction projects have been carried out in the Norwegian cities of Oslo (population 500,000), Bergen (population 230,000), and Trondheim (population 150,000). The main objective of these projects has been to reduce traffic congestion by expanding road capacity. Another objective has been to improve road safety, by providing new urban freeways built according to high design standards.

This paper presents an evaluation of the effects on road safety of four new urban arterial roads in the city of Oslo. In addition, the results of other studies that have evaluated the effects on road safety of new urban arterial roads are summarised.

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2. New urban arterial roads in Oslo

The four new urban arterial roads in Oslo whose effects on road safety have been evaluated are:

1. the Festning tunnel;
2. the Granfoss tunnel;
3. upgrading of Store Ringveg between Sinsen and Storo;
4. the Ekeberg tunnel.

The Festning tunnel was opened in 1990. It is a dual tunnel built under the central business district of Oslo, designed as a six-lane urban freeway. The length of the tunnel and the adjacent roads is 3.3 km. Annual average daily traffic (AADT) in 1998 was about 87,000. The old arterial road consisted of a pair of one-way city streets with mixed traffic and many signalised junctions.

The Granfoss tunnel was opened in 1992. It consists, for most of the distance, of a dual road tunnel. There are four travel lanes and freeway geometric standards. Length is 4.1 km and AADT in 1998 was about 23,000. The old main road system consisted of a pair of two-lane roads, passing

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mostly through residential areas, and having a number of signalised junctions.

Store Ringveg between Sinsen and Storo was opened in 1994. This project consisted of constructing two new interchanges, widening the road from four to six lanes, and moving a tramline from the road to a separate track alongside it. The interchanges replaced a major signalised junction and a congested roundabout. The length of the upgraded section is about 2.3 km. AADT in 1998 was about 46,000. The road remained open to traffic during the period in which it was being upgraded.

The Ekeberg tunnel was opened in 1995. It is a six-lane dual road tunnel of freeway standard. The length is about 2 km. The previous main road was a narrow four-lane road, passing close to a residential area and having a major signalised junction. AADT in the tunnel was about 75,000 in 1998.

Speed limits on the new urban arterial roads is 70 or 80 km/h. The most common speed limit on the old main roads was 50 km/h. The new arterial roads do not have access roads to abutting properties, nor do these roads have any at-grade junctions. By contrast, the old main roads had numerous minor access roads, as well as a number of signalised junctions serving fairly large traffic volumes (generally in the range of 25,000–50,000 entering vehicles per day).

3. Sources of data and design of evaluation study

3.1. Sources of data

Accident data were obtained from statistics kept by highway authorities in the city of Oslo. These statistics are confined to injury accidents. Property-damage-only accidents are not reported in official road accident statistics in Norway. Detailed accident records going back at least 15 years are available for main roads only. For secondary roads, only summary accident data are available.

In addition to accident data, data on traffic volume were collected. These data were mostly based on counts made by highway authorities. Data on traffic volume were incomplete, and estimates had to be made for some years. Details on these estimates are given in the main report (Amundsen and Elvik, 2002).

3.2. Design of evaluation study

The effects on road safety of the new arterial roads were evaluated by means of a before-and-after study (Hauer, 1997). The city of Oslo was used as a comparison group. A separate evaluation was made of the effects of each of the four new arterial roads. Results were then combined into an overall estimate of the effect of all four projects by means of the log odds technique of meta-analysis (Fleiss, 1981; Shadish and Haddock, 1994).

The before-and-after periods covered different years for each project. In general, 4 years of before data and 4 years of after data were used. Table 1 gives a summary of data for each project.

The count of accidents each year for each project was in the range of 10–40. This means that year-to-year changes in the number of accidents were strongly influenced by random fluctuations. In view of this fact, the evaluation was based on the total number of accidents for all years before and all years after. The years during which construction was in progress were omitted from the study.

Table 1
Data for four new urban arterial roads in Oslo

Project	Years		Road or area	Number of injury accidents		Million vehicle kilometres of travel		Accident rate (accidents/million vehicle km)	
	Before	After		Before	After	Before	After	Before	After
Festning tunnel	1986–1989	1995–1998	Old	117	14	297.10	52.95	0.39	0.26
			New		125		371.95		0.34
			Total	117	139	297.10	424.90	0.39	0.33
			Rest of Oslo	4441	4443	11,344.20	11,570.30	0.39	0.38
Granfoss tunnel	1986–1989	1994–1997	Old	73	29	198.01	81.76	0.37	0.36
			New		34		127.65		0.27
			Total	73	63	198.01	209.41	0.37	0.38
			Rest of Oslo	4485	4414	11,443.30	11,414.59	0.39	0.39
Sinsen-Storo	1988–1991	1995–1998	Old	70	35	118.37	147.00	0.59	0.24
			New	N.A.	N.A.				
			Total	70	35	118.37	147.00	0.59	0.24
			Rest of Oslo	4418	4547	11,436.43	11,848.20	0.39	0.38
Ekeberg tunnel	1991–1994	1996–1999	Old	40	11	159.58	13.72	0.25	0.80
			New		28		190.75		0.15
			Total	40	39	159.58	204.47	0.25	0.19
			Rest of Oslo	4392	4587	10,799.62	12,076.53	0.41	0.38