

Bicycle helmet use in Sweden during the 1990s and in the future

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SUMMARY

This paper describes how the use of bicycle helmets in Sweden has changed for different categories of cyclists from 1988 to 2002, and it also estimates future trends in voluntary wearing of bicycle helmets up to the year 2010. Observational studies of the use of bicycle helmets were conducted once a year from 1988 to 2002 at 157 sites in 21 cities. The subjects observed were children cycling to school (average n = 5471/year) and in their free time (average n = 2191/year), and adults cycling to workplaces and on public bike paths (average n = 29 368/year). The general trend in helmet use from 1988 to 2002 was determined by linear regression analysis, and the results were also employed to estimate future helmet wearing for the period 2003–2010. Differences in helmet use according to gender and size of city were analysed by chi-square tests. From

1988 to 2002, all categories of cyclists showed an upward trend in helmet use ($p < 0.01$, $p < 0.001$). Helmet wearing increased from about 20 to 35% among children (≤ 10 years) cycling during free time, from approximately 5 to 33% among school children, and from around 2 to 14% in adults. Total average helmet use rose from about 4 to 17%. However, during the last 5 years of the study period (1998–2002), none of the categories of cyclists studied showed an upward trend in helmet wearing. It is estimated that ~30% of cyclists will wear helmets voluntarily by the year 2010, if helmet promotion activities are continued at the same level as previously. The results suggest that Sweden will probably not reach its official goal of 80% helmet use unless a national bicycle helmet law is passed.

Key words: bicycle helmet; observational study; safety promotion

INTRODUCTION

In Sweden, ~45 cyclists are killed each year, which represents ~8% of all traffic fatalities and constitutes an incidence of 0.5 per 100 000 population (SIKA/SCB, 2003). It has been estimated that >20 000 cyclists are injured in Sweden every year, ~30% of whom sustain head injuries, although that rate could be reduced considerably if more cyclists would wear helmets (Björnstig *et al.*, 1992; Attewell *et al.*, 2001; Thompson *et al.*, 2003).

Increased use of bicycle helmets could be achieved by helmet promotion activities or by helmet legislation or both. International experience shows that it is possible to increase helmet use without legislation, albeit not to the same high levels as can be achieved by introducing a mandatory law in combination with information and education (Towner *et al.*, 2002; Coffman, 2003; O'Hare *et al.*, 2003). Nationwide bicycle helmet laws have been enacted in

Australia and New Zealand, which has resulted in an average 80–90% helmet use (Cameron *et al.*, 1994; Povey *et al.*, 1999).

In the middle of the 1990s, Sweden launched a national traffic safety programme, which included, among other things, an official goal to achieve ~80% bicycle helmet use by the year 2000 (Swedish National Road Administration *et al.*, 1994). At the time this programme was initiated, the average rate of bicycle helmet use was ~10%. It was proposed that an 80% wearing rate could be accomplished by implementing a bicycle helmet law, although that was not stipulated as a requirement. Thus far, the method chosen in Sweden has been to use non-compulsory means to induce cyclists to wear helmets. This approach raises at least two questions. First, can it be expected that 80% bicycle helmet use can be achieved by non-compulsory measures, or will it be necessary to introduce a bicycle helmet law? Secondly, what rate of bicycle helmet wearing is likely to be attained in the near future if use is not mandatory?

The aim of this paper is to describe how the use of bicycle helmets by different categories of cyclists in Sweden has changed over the period 1988–2002, and to estimate, on the basis of these data, the future trends in voluntary wearing of helmets up to the year 2010.

METHODS

Study population

Sweden has a population of ~9 million people, with approximately equal proportions of males and females; ~20% of the inhabitants are children (ages 0–17 years) and ~17% are elderly (≥ 65 years) (SCB, 2003). The study population comprised cyclists in Sweden. According to questionnaire survey data, ~80% of the Swedish population aged 15–74 years ride bicycles at least once a year and 40% do so at least once a week (Lekander, 2002). Of the total distance covered by bicycle in Sweden, children (0–14 years) and adults (≥ 15 years), respectively, account for about 16 and 84% (Thulin and Kronberg, 2000).

Measures of helmet use by cyclists

Every September since 1988, the Swedish Road and Transport Research Institute (VTI) has conducted observational studies of bicycle helmet

use in Sweden in a total of 21 cities. During the first 3 years (1988–1990), observations were made at 109 sites and focused on children cycling to school and in their free time, and adults cycling to workplaces. Starting in 1991, the number of sites was increased to 157, because observations made with respect to adult cyclists on public bike paths.

The observations have been made using the same method, for the same sites, and at the same times every year. The criteria used to choose the cities were aimed at achieving, within the limits of available resources, variation with regard to geography and number of inhabitants. The observational sites were selected so that the frequency of cyclists would be as high as possible for each of the categories studied. Each site was monitored once a year for ~2 h in the morning or in the afternoon. Helmet use and gender were recorded for the following three categories of cyclists:

- (1) Children (≤ 10 years of age) riding bicycles in residential areas in their free time. The observer moved around to cover as many courtyards, playgrounds, cycle paths, and similar places as possible.
- (2) Children (6–15 years) riding bicycles to school. The observer stayed at the same site (a school) during the entire monitoring session.
- (3) Adults (≥ 16 years) riding bicycles to workplaces and on public bike paths. The observer stayed at the same site (a workplace or a bike path) during the whole monitoring session.

The proportions of adults using bicycle helmets during the first 3 years (1988–1990) were based on data from workplaces. The corresponding information for 1991–2002 represents a mean for adults cycling to workplaces and on public bike paths.

The average helmet use by all observed cyclists, irrespective of age category, was calculated as a weighted average of helmet wearing by both children and adult cyclists. Helmet use was given the weight 0.16 for children and 0.84 for adults, based on data of exposure to cycling in traffic. The same weights were applied to estimate the number of observations underlying calculation of the average wearing of bicycle helmets.

Temporary dropout was noted for 54 observational sites during the study period 1988–2002. This gives an average dropout rate of 3.4 sites per year, which represent 2.3% of the

Table 1: Number of observations over the period 1988–2002 for different categories of cyclists in Sweden

Year	Children aged ≤10 years (free time)	Children aged 6–15 years (school)	Adults	Total
1988	2125	7979	10 163	20 267
1989	3233	6381	9601	19 215
1990	2636	6584	12 059	21 279
1991	2378	5324	30 704	38 406
1992	2234	4420	28 163	34 817
1993	2469	5063	26 956	34 488
1994	1985	4985	31 829	38 799
1995	2994	5852	35 658	44 504
1996	2073	4750	37 563	44 386
1997	2100	5688	39 609	47 397
1998	1735	4557	32 838	39 130
1999	2029	5735	39 300	47 064
2000	1592	4751	35 905	42 248
2001	1473	4919	33 118	39 510
2002	1812	5081	37 057	43 950
Total	32 868	82 069	440 523	555 460
Average	2191	5471	29 368	37 031

2211 possible observation sessions over the entire study period. In the analyses, mean values were substituted for the data on the missing sites; in other words, the total average change in helmet use (in percentage points) between 2 years of measurement was used in place of the missing values. The number of cyclists that would have been observed at a missing site was estimated by determining the proportion of the total number of observations made at the site in question during the year immediately before and/or after the dropout. On average, the analysis comprised 37 031 observed cyclists per year (Table 1), 605 of which were accounted for by adjusting dropouts.

The general trend in helmet use during the entire study period was analyzed by a linear regression analysis for each category of cyclists. A Kolmogorov–Smirnov test showed that the residuals in the regression analysis were normally distributed.

Differences in helmet use according to gender and size of city was analysed by a Pearson chi-square test for two independent samples ($df = 1$). The cities were divided into two categories, referred to as ‘large’ (three cities with an average population of ~500 000) and ‘small’ (18 cities with an average population of ~80 000).

SPSS 11.0 software was used for statistical analyses, and a p -value < 0.05 was considered to be statistically significant in all cases.

Future use of bicycle helmets up to the year 2010 was estimated based on the results of linear

regression analysis of the observational data for the period 1988–2002, using percentage of helmet wearing as the dependent variable, and the year of observational studies as the independent variable (coded 1–15). Helmet use in future years (2003–2010) was estimated by applying the equation $y_{\text{pred}} = a + bx$, where y_{pred} is the predicted proportion of helmet users, a is the intercept, b is the regression coefficient and x is the year of future observational studies (coded 16–23). A 95% prediction interval is given for the estimated proportion of helmet users in 2010 (Altman, 1991).

RESULTS

The rate of helmet use was higher among children than among adults, both at the beginning and the end of the study period 1988–2002. In general, an increase in helmet wearing was noted for all of the cyclist categories included in the 15 years of observations (Figure 1). More precisely, helmet use rose as follows (approximate values): from 20 to 35% among younger children (≤10 years) cycling in their free time; from 5 to 33% among children cycling to school; and from 2 to 14% in adults cyclists. The total average helmet use increased from approximately 4 to 17%, and the highest relative increase (i.e. about seven-fold) was found for school children and adults.

There was an upward trend in helmet use by all categories of cyclists ($p < 0.01$, $p < 0.001$) during

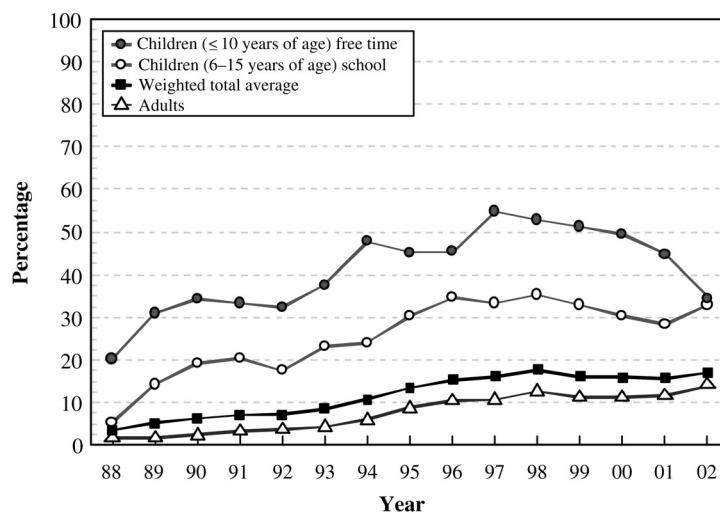


Fig. 1: Observed helmet use in Sweden over the period 1988–2002.

Table 2: Linear regression analysis of trends in bicycle helmet use by different categories of cyclists in Sweden in 1988–2002 and in 1998–2002

Cyclist category	Period					
	1988–2002			1998–2002		
	<i>b</i>	<i>R</i> ²	<i>p</i>	<i>b</i>	<i>R</i> ²	<i>p</i>
Children (≤ 10 years of age): free time	1.53	0.44	<0.01	−4.20	0.81	<0.05
Children (6–15 years of age): schools	1.67	0.70	<0.001	−0.94	0.08	ns
Adults	0.94	0.92	<0.001	0.27	0.00	ns
Weighted total average	1.05	0.88	<0.001	−0.18	0.00	ns

b, non-standardized regression coefficients.

*R*², adjusted *R* square.

ns, not significant.

the entire study period 1988–2002, and the average rate of increase was slightly higher among children than among adult cyclists (Table 2). However, during the last 5 years of the study period (1998–2002), none of the studied categories of bicyclists showed an upward trend in helmet wearing. Instead, there was a downward trend among children (≤ 10 years of age) riding bicycles in their free time ($p < 0.05$), while the level of helmet use remained the same in all other categories studied (Table 2).

From 1998 to 2002, observers subjectively estimated the ages of school children in order to compare helmet use between the younger and older fractions of this group (i.e. 6–12 versus 13–15 years). The average wearing of helmets

during the period was found to be greater among younger school children ($\sim 52\%$, $n = 12\,489$) than among those who were older ($\sim 12\%$, $n = 12\,554$) ($p < 0.001$). The results also indicated a downward trend (from about 60 to 50%) in helmet use among younger school children, whereas the rate of helmet wearing in the group of older school children varied around 12%.

During both the entire study period (1988–2002) and the last 5 years (1998–2002), total average helmet wearing was only marginally higher (about one percentage point) for females compared with males ($p < 0.001$). Among adult cyclists, the rate of helmet use was about the same for men and women, but among younger children (≤ 10 years) cycling in their free

Table 3: Use of bicycle helmets in Sweden during 1988–2002 and 1998–2002, broken down by gender and size of city

Cyclist category	Period							
	1988–2002				1998–2002			
	%	<i>n</i>	χ^2	<i>p</i>	%	<i>n</i>	χ^2	<i>p</i>
Children (≤ 10 years of age) free time								
Male	38.1	19 437	86.31	<0.001	44.9	4976	15.67	<0.001
Female	43.2	13 431			49.2	3665		
Large cities	38.9	8213	7.72	<0.01	38.1	2436	>100	<0.001
Small cities	40.6	24 655			50.1	6205		
Children (6–15 years of age) school								
Male	24.3	44 039	2.72	ns	31.4	13 561	4.40	<0.05
Female	24.8	38 030			32.6	11 482		
Large cities	25.2	14 816	3.68	ns	28.6	4839	31.77	<0.001
Small cities	24.4	67 253			32.8	20 204		
Adults								
Male	8.8	235 979	6.18	<0.05	11.8	93 949	1.43	ns
Female	8.6	204 544			11.9	84 269		
Large cities	14.5	155 485	>100	<0.001	17.4	70 404	<100	<0.001
Small cities	5.5	285 038			8.2	107 814		
Weighted total average								
Male	12.8	203 300	40.06	<0.001	16.1	80 400	28.11	<0.001
Female	13.6	175 934			17.1	71 998		
Large cities	18.4	132 450	>100	<0.001	21.2	59 721	>100	<0.001
Small cities	10.5	246 785			13.8	92 676		

ns, not significant.

χ^2 , Pearson chi-square (df = 1).

time, the rate of helmet wearing was slightly higher for girls than for boys ($p < 0.001$, $p < 0.05$) (Table 3).

For adults, average total helmet use was greater in larger than in smaller cities ($p < 0.001$). The average level of helmet wearing among adults was three times higher in the larger cities during the entire study period and two times higher during the last 5 years ($p < 0.001$). For children, the pattern appears to have been the opposite, especially during the last 5 years, although not as pronounced (Table 3).

In Sweden, average total helmet use has varied between 15 and 20% in recent years, and the level was 17% in 2002. Notwithstanding, average total helmet wearing increased four-fold from 1988 to 2002. If that general trend continues, the average rate of use will be $\sim 30\%$ by the year 2010 (Table 4), which means a level of 50–60% for children and $\sim 20\%$ for adult cyclists. Those rates indicate that, if the official goal of 80% average helmet use in Sweden is to be achieved by, say, 2010, the rate of increase will have to be considerably higher than has previously been observed (Figure 2).

Table 4: Predicted helmet use in Sweden in 2010, based on linear regression of observational data for the period 1988–2002

Cyclist category	Predicted helmet use (%)	PI (%)
Children (≤ 10): free time	64	42–86
Children (6–15): school	51	36–65
Adults	22	18–26
Weighted total average	27	22–32

PI, 95% prediction interval.

DISCUSSION

The VTI observational studies are conducted at the same sites and at the same times every year. However, the sites and times have not been selected at random, and therefore the results cannot be automatically generalized to a Swedish national level or to all times of the year. To make such a generalization would require observational data from a large number of randomly chosen places and times, which was not possible due to limited resources. However, the Swedish National Road Administration (SNRA)

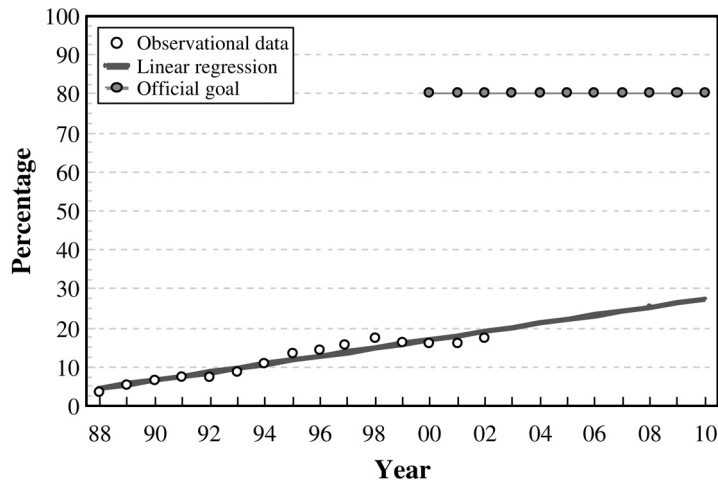


Fig. 2: Estimation of total bicycle helmet use (weighted average) in Sweden for the period 1988–2010, based on observational data for 1988–2002.

conducted supplementary observational studies at randomly selected sites in Sweden from 1995 to 1999, and the results were very similar to the findings of the VTI studies (Lindahl, 1999). Therefore, it can be assumed that the VTI data do adequately represent helmet use in Sweden during the study period.

From 1988 to 2002, average wearing of bicycle helmets increased three- to four-fold in Sweden (from approximately 5 to 15–20%). Systematic attempts to increase the use of bicycle helmets have been made at local, regional and national levels in Sweden since the end of the 1980s. It is reasonable to assume that these helmet promoting activities did contribute to the increased helmet wearing during the study period.

An example of a local helmet initiative in Sweden is the non-compulsory ‘local bicycle helmet law’ introduced in the municipality of Motala in 1996 (Nolén and Lindqvist, 2002). An evaluation showed a positive effect on children’s helmet wearing during the first 6 months after the intervention, but the effect then became weaker and had disappeared after two and a half years. The Motala law also had a significant, but small, long-term effect on helmet use by adults (Nolén and Lindqvist, 2004).

An example of a Swedish regional helmet programme aimed primarily at children is the Skaraborg Bicycle Helmet Program, which was initiated in 1987 (Ekman and Welander, 1998). A study of the influence of this program over

a period of 15 years showed that the incidence of head injuries among young cyclists (aged 0–14 years) decreased more in Skaraborg than in four control areas (Ekman *et al.*, 1997).

Helmet promotion at a national level started in Sweden at the end of the 1980s, with two information campaigns that targeted children (0–15 years) and adults who cycled to work. However, the most intensive period of helmet promotion was 1994–1998, when a National Traffic Safety Program was implemented, which, among other things, prioritized the increased use of bicycle helmets and also included the goal to achieve 80% helmet wearing by the year 2000 (Swedish National Road Administration *et al.*, 1994). Every year during 1995–1998 there were media campaigns about bicycle helmets. Information was given on television and radio, at cinemas, and on posters displayed in the traffic environment. These campaigns were focused chiefly on adult cyclists, and the national actions were coordinated with helmet promotion at the regional and local levels.

At the national level there is also the Swedish Bicycle Helmet Group, which was formed in 1991 after a global call by the World Health Organization (Svanström *et al.*, 2002). The aim of this group is to act as a national forum for exchange of information and cooperation among authorities and organizations, and associations concerned with helmet use by cyclists. Besides disseminating facts about helmet wearing, this

group also arranged national bicycle helmet conferences in 1995 and 1997.

Although it does not have to be any causal relationship between the aforementioned helmet promotion activities and the observed changes in helmet use during the study period, the increasing trend in average helmet use in Sweden 1988–1998 corresponds fairly well with helmet activities conducted at the national level during this period. Furthermore, the downward trend seen after 1998 coincides with the lack of major information campaigns (Figure 3).

The Swedish experience of promoting bicycle helmet use during the 1990s indicates that a substantial increase in average helmet use can be achieved by non-compulsory methods. This is also supported by the systematic helmet promotion activities that were conducted in Victoria, Australia, and New Zealand before the introduction of helmet laws (Wood and Milne, 1988; Scuffham *et al.*, 2000). In Victoria, there was a progressive increase in voluntary helmet use from 5% in 1983 to 31% in 1990 (Cameron *et al.*, 1994). In New Zealand, voluntary use of helmets rose from a few per cent in 1986 to approximately 85% among children, 63% among young people and 46% among adults in 1993 (Scuffham *et al.*, 2000).

Studies have also shown that long-term community-based, multiple-strategy programmes can increase helmet use among children. Two successful examples are the Seattle Bike Helmet

Campaign in the United States and the Montréal Program in Canada. During a period of 5 years, helmet use among children increased in Seattle from about 6 to 40%, and in Montréal from about 1 to 33% (Rivara *et al.*, 1994; Farley *et al.*, 1996).

Research has however shown that to attain a more substantial effect on use of bicycle helmets, the promotion activities have to be combined with a compulsory helmet law that applies to all cyclists (Graitcer *et al.*, 1995; Rivara *et al.*, 1998; Towner *et al.*, 2002; O'Hare *et al.*, 2003). This has, for example, been done in Australia and New Zealand, where 80–90% helmet use has been achieved. Swedish observational data for 1988–2002 predict that average voluntary helmet use will reach 30% by the year 2010, which means that the official goal of 80% will probably not be achieved, unless a national bicycle helmet law is introduced. Although, predictions that are based on linear models of historical data should be interpreted with caution, rather large deviations from the previous general trend in Sweden will have to occur if bicycle helmet use is to come anywhere near a level of 80% by 2010 without a bicycle helmet law. In Victoria, Australia, average helmet use was also ~30% just before the helmet law, therefore it seems realistic that the same rate of voluntary use of bicycle helmets can be achieved in Sweden by 2010. However, this requires that the scope of bicycle helmet promotion activities remains the

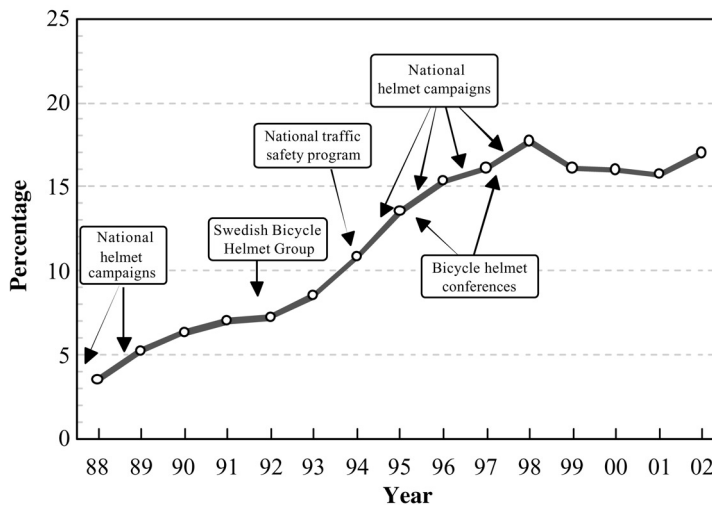


Fig. 3: Observed total bicycle helmet use (weighted average) in Sweden and helmet promotion activities conducted at a national level during the period 1988–2002.

same as in earlier years. If helmet promotion activities are discontinued, as has happened in the past 5 years, it is likely that the rate of helmet use will remain at the present level (15–20%) or may even decrease.

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REFERENCES

- Altman, D. G. (1991) *Practical Statistics for Medical Research*, 2nd edition. Chapman & Hall, London.
- Attewell, R. G., Glase, K. and McFadden, M. (2001) Bicycle helmet efficacy: a meta-analysis. *Accident Analysis and Prevention*, **33**, 345–352.
- Björnstig, U., Öström, M., Eriksson, A. and Sonntag-Öström, E. (1992) Head and face injuries in bicyclists—with special reference to possible effects of helmet use. *Journal of Trauma*, **33**, 887–893.
- Cameron, M. H., Vulcan, A. P., Finch, C. F. and Newstead, S. V. (1994) Mandatory bicycle helmet use following a decade of helmet promotion in Victoria, Australia—an evaluation. *Accident Analysis and Prevention*, **26**, 325–337.
- Coffman, S. (2003) Bicycle injuries and safety helmets in children. Review of research. *Orthopaedic Nursing*, **22**, 9–15.
- Ekman, R., Schelp, L., Welander, G. and Svanström, L. (1997) Can a combination of local, regional and national information substantially increase bicycle-helmet wearing and reduce injuries? Experiences from Sweden. *Accident Analysis and Prevention*, **29**, 321–328.
- Ekman, R. and Welander, G. (1998) The results of 10 years' experience with the Skaraborg bicycle helmet program in Sweden. *International Journal for Consumer and Product Safety*, **5**, 23–39.
- Farley, C., Haddad, S. and Brown, B. (1996) The effects of a 4-year program promoting bicycle helmet use among children in Quebec. *American Journal of Public Health*, **86**, 46–51.
- Graitcer, P. L., Kellermann, A. L. and Christoffel, T. (1995) A review of educational and legislative strategies to promote bicycle helmets. *Injury Prevention*, **1**, 122–129.
- Lekander, T. (2002) Use of bicycle the latest 12 months. Data from Swedish National Road Administration's (SNRA) traffic safety survey 1998–2001. (Personal communication). Borlänge: Swedish National Road Administration.
- Lindahl, E. (1999) *Bicycle Helmet Usage in Urban Areas August-September 1999 (in Swedish)* (No. VV 1999:136). Swedish National Road Administration, Borlänge.
- Nolén, S. and Lindqvist, K. (2002) A local bicycle helmet 'law' in a Swedish municipality—the structure and process of initiation and implementation. *Injury Control and Safety Promotion*, **9**, 89–98.
- Nolén, S. and Lindqvist, K. (2004) A local bicycle helmet 'law' in a Swedish municipality—the effects on helmet use. *Injury Control and Safety Promotion*, **11**, 39–46.
- O'Hare, M., Langford, J., Johnston, I. and Vulcan, P. (2003) *Bicycle Helmet Use and Effectiveness* (Report). Monash University Accident Research Centre, Clayton.
- Povey, L. J., Frith, W. J. and Graham, P. G. (1999) Cycle helmet effectiveness in New Zealand. *Accident Analysis and Prevention*, **31**, 763–770.
- Rivara, F. P., Thompson, D. C., Thompson, R. S., Rogers, L. W., Alexander, B., Felix, D. and Bergman, A. B. (1994) The Seattle Children's Bicycle Helmet Campaign: changes in helmet use and head injury admissions. *Pediatrics*, **93**, 567–569.
- Rivara, F. P., Thompson, D. C., Patterson, M. Q. and Thompson, R. S. (1998) Prevention of bicycle-related injuries: helmets, education, and legislation. *Annual Review of Public Health*, **19**, 293–318.
- SCB (2003) *Population statistics*. Retrieved 2003-06-30, 2003, from <http://www.scb.se/statistik/be0101/be0101eng.asp>.
- Scuffham, P., Alsop, J., Cryer, C. and Langley, J. D. (2000) Head injuries to bicyclists and the New Zealand bicycle helmet law. *Accident Analysis and Prevention*, **32**, 565–573.
- SIKA/SCB (2003) *Road Traffic Injuries 2002* (Official Statistics of Sweden). Swedish Institute for Transport and Communications Analysis. Statistics Sweden, Stockholm, Sweden.
- Svanström, L., Welander, G., Ekman, R. and Schelp, L. (2002) Development of a Swedish bicycle helmet promotion programme—one decade of experiences. *Health Promotion International*, **17**, 161–169.
- Swedish National Road Administration, National Swedish Police Board, and Swedish Association of Local Authorities (1994) *Swedish National Traffic Safety Program 1995–2000 (in Swedish)*. Swedish National Road Administration, National Swedish Police Board, Swedish Association of Local Authorities, Sweden.
- Thompson, D., Rivara, F. and Thompson, R. (2003) Helmets for preventing head and facial injuries in bicyclists (Cochrane Review). *The Cochrane Library*, **1**, 1–27.
- Thulin, H. and Kronberg, H. (2000) *Different age groups of pedestrians and cyclists in different traffic environments—exposure and risks (in Swedish)* (VTI-Meddelande No. 886). Swedish National Road and Transport Research Institute, Linköping.
- Towner, E., Dowsell, T., Burkes, M., Dickinson, H., Towner, J. and Hayes, M. (2002) *Bicycle Helmets—A Review of their Effectiveness: A Critical Review of the Literature*. Department for Transport, London.
- Wood, T. and Milne, P. (1988). Head injuries to pedal cyclists and the promotion of helmet use in Victoria, Australia. *Accident Analysis and Prevention*, **20**, 177–185.