Socioeconomic differences in road traffic injuries during childhood and youth: a closer look at different kinds of road user

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Abstract

***Study objective*—To investigate if there are socioeconomic differences in road traffic injuries among Swedish children and adolescents, and if this applies to the same extent to all categories of road users. To assess the modification effect of gender of child.**

***Design*—A closed population-based cohort study based on the Swedish Population and Housing Census of 1985. Individual census records are linked to Sweden's National Hospital Discharge Register (1987–1994).**

***Setting and subjects*—All children aged 0–15 years in 1985 (approximately 1.5 million subjects) were monitored for five categories of road traffic injuries over eight years, and divided into seven socioeconomic groups on the basis of parental socioeconomic status. Odds ratios and population attributable risks were computed using the children of intermediate and high level salaried employees as reference group.**

***Main results*—The injury risks of pedestrians and bicyclists are 20% to 30% higher among the children of manual workers than those of intermediate and high level salaried employees. Socioeconomic differences are greatest for injuries involving motorised vehicles—that is, moped, motorcycle and car. If all children had the same rate as children in the reference group, the rate for all groups would be 25% lower for moped riders and 37% lower for car drivers.**

***Conclusions*—Socioeconomic differences in road traffic injuries are substantial for both boys and girls. Socioeconomic injury-risk differentials increase when young people use motorised vehicles.**

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Injury is a major cause of death, serious morbidity, and permanent disability among children and adolescents. This period of life involves encounters and confrontations with a series of new situations and environments that entail an increased range of risks. An example of central concern is the road traffic environment, where young people make their debuts—as pedestrian, bicyclist, moped rider, motorcyclist, and car driver, in turn.

In industrialised countries road traffic injuries (RTIs) account for a large proportion of socioeconomic disparities in health, in particular in childhood and youth.[1] The bulk of evidence, gathered above all from ecological studies (see examples in references[1–5]) suggest that young persons living in deprived areas have higher injury rates than those living in more privileged areas.[1 6] But whether these area-based differences also apply to individual socioeconomic status (SES) has not been much investigated.[1] And it is also unclear if socioeconomic disparities are found in all modes of transportation. Moreover, little is known about the extent to which socioeconomic differences are modified by gender of child.

Sweden lacks knowledge about the socioeconomic distribution of RTIs. Nevertheless, scattered evidence, mainly from mortality statistics, reveal that socioeconomic differences with regard to all injuries, and to traffic injuries in particular, are considerable.[7–10]

The study was embarked upon in order to investigate the following questions:
(1) Are there socioeconomic differences in RTIs among Swedish children and adolescents?
(2) Is the magnitude of the socioeconomic difference the same for all categories of road users?
(3) Are socioeconomic differences, for any given type of traffic injury, modified by gender?

Methods

The study population is based on the Swedish Population and Housing Census of 1985, and consists of all children aged 0–15 years living in households with one or two adults (parents or guardians) at that time (approximately 1.5 million subjects). For the census, a household was defined as a person or group of persons, registered in the same municipality, living in the same dwelling. Record linkage, by Swedish personal identification number (which uniquely identifies each permanent resident in Sweden), to Sweden's National Hospital Discharge Register was effected for the years 1987–1994. The census also contains information on ages of children and parents, parental socioeconomic characteristics, country of birth of mother, and area of living.

Socioeconomic groups were defined according to a classification used by Statistics Sweden, which is primarily based on occupation but also takes educational level, type of productive activity, and position at work into account.[11] The SES of the household was used: the statuses of the two parents/guardians were compared, and if these diverged, the SES of the higher of the two was attributed to the household.[12] On this basis, each child was allocated to one of the following socioeconomic groups: intermediate and high level salaried employees; assistant non-manual

Table 1 Injuries during the study period (1987–1994) by traffic category

	Boys		*Girls*		*Total*	
Traffic categories		*%*		*%*		*%*
Pedestrians	990	6	757	12	1 747	8
Bicyclists	7 002	46	4 098	66	11 100	52
Moped users	2 513	16	484	8	2 997	14
Motorcyclists	2 516	16	122	2	2 638	12
Car drivers	2 234	15	740	12	2 974	14
Total number of injuries	15 255		6 201		21 456	
Total number of children	753 221		716 680		1 469 901	

employees; the self employed; farmers; skilled and unskilled workers; and others, for example, students, housewives, persons on sickness and disability pensions and the long term unemployed.

Other variables considered were the mother's age at delivery and age of child. Previous studies show that age of mother at delivery is a risk factor for injuries among children.[13] It has also been shown that childhood mortality differences by social class exist in Sweden.[9]

A total of 1 549 181 children initially fulfilled the age and household composition criteria. During the process of linking members of each household across registers, 9522 children (0.6%) were found to have no matching adult, and were removed from the study population.

In addition, children of mothers outside the age range 20–45 at delivery of child were excluded so as to minimise the number of guardians (other than parents) in the study population. Children with parents/guardians aged over 60 in 1985 were also excluded.

Subjects for whom information on country of birth or place of residence was lacking and children who had died or left the country before the start of the follow up period (1 January 1987) were also excluded.

After the above mentioned exclusions, 1 469 901 (95%) children remained in the study population.

Individual records were then linked to the National Hospital Discharge Register for the period 1987–1994 (when subjects were aged 2–24 years). The traffic categories considered were chosen because they mirror activities from childhood through adolescence (see table 1). These categories are also characterised by active participation on the part of subjects (children and adolescents). Traffic injuries requiring hospitalisation were allocated to five groups of road users: pedestrians (E819H), bicyclists (E819G and E826), and drivers of mopeds (E819J), motorcycles (E819C), and cars (E819A).[14]

Injuries were grouped into these categories on the basis of diagnosis of main condition at first discharge during the study period. This entails that it was only possible for any one child to have just one injury of each type during the entire study period.

A total of 21 456 RTIs were investigated, as divided into the traffic categories mentioned above (see table 1).

Of the total number of injuries, boys account for 71% and girls for 29%. Bicycle related injuries come to 52% (37% of which were to girls, and 63% to boys). Pedestrian injuries are relatively few (8%), and proportions for the other categories are fairly evenly distributed (12–14%). Moped accidents are responsible for 14% of the injuries, but—given the short period that young people are exposed to moped related risk—this is a rather high figure. Boys account for 84% of moped injuries.

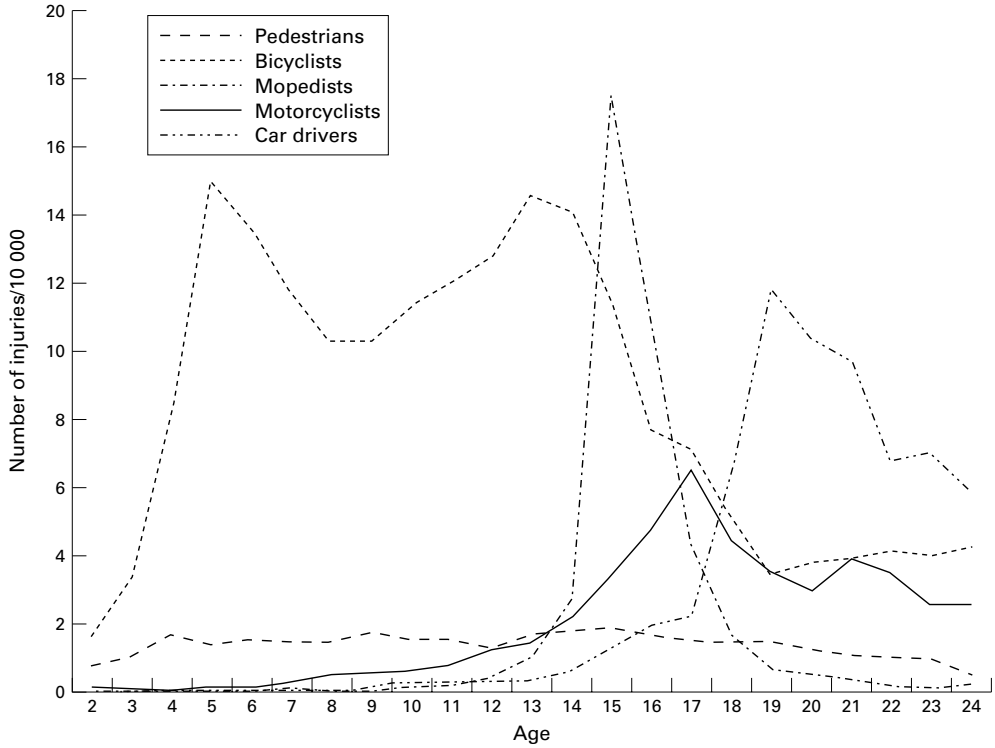

Figure 1 Age distribution of road traffic injuries during the study period 1987–1994 (cumulative incidence).

Table 2 Odds ratios for road traffic injuries among children from different socioeconomic groups and population attributable risks due to socioeconomic differences among children and adolescents 1987–1994 in Sweden

Traffic categories	*Number of persons*	*Number of injuries*	*Rate of injuries (per 10 000 pop)*	*OR (95% CI)*	*Population attributable risk*
Pedestrians					
Intermediate and high level salaried employees	577 974	593	10.3	1.00	
Assistant non-manual employees	203 289	242	11.9	1.14 (0.98, 1.33)	
Self employed	98 010	118	12.0	1.15 (0.94, 1.40)	
Farmers	39 791	32	8.0	0.77 (0.54, 1.10)	
Skilled workers	232 657	291	12.5	1.20 (1.04, 1.38)	
Unskilled workers	235 881	323	13.7	1.30 (1.13, 1.50)	
Unspecified population	82 299	148	18.0	1.72 (1.43, 2.07)	
Total	1 469 901	1 747	11.9		0.14
Bicyclists					
Intermediate and high level salaried employees	577 974	4 024	69.6	1.00	
Assistant non-manual employees	203 289	1 514	74.5	1.18 (1.11, 1.26)	
Self employed	98 010	678	69.2	1.17 (1.08, 1.27)	
Farmers	39 791	218	54.8	0.94 (0.82, 1.08)	
Skilled workers	232 657	1 890	81.2	1.27 (1.20, 1.35)	
Unskilled workers	235 881	1 992	84.4	1.34 (1.26, 1.42)	
Unspecified population	82 299	784	95.3	1.52 (1.41, 1.65)	
Total	1 469 901	11 100	75.5		0.08
Moped users					
Intermediate and high level salaried employees	577 974	886	15.3	1.00	
Assistant non-manual employees	203 289	410	20.2	1.30 (1.16, 1.46)	
Self employed	98 010	243	24.8	1.51 (1.31, 1.75)	
Farmers	39 791	114	28.6	1.85 (1.52, 2.25)	
Skilled workers	232 657	548	23.5	1.60 (1.44, 1.79)	
Unskilled workers	235 881	632	26.8	1.80 (1.62, 2.00)	
Unspecified population	82 299	164	19.9	1.42 (1.20, 1.68)	
Total	1 469 901	2 997	20.4		0.25
Motorcyclists					
Intermediate and high level salaried employees	577 974	657	11.4	1.00	
Assistant non-manual employees	203 289	384	18.9	1.61 (1.42, 1.83)	
Self employed	98 010	328	33.5	2.66 (2.33, 3.04)	
Farmers	39 791	133	33.4	2.80 (2.32, 3.37)	
Skilled workers	232 657	503	21.6	1.95 (1.73, 2.19)	
Unskilled workers	235 881	482	20.4	1.80 (1.59, 2.02)	
Unspecified population	82 299	151	18.4	1.77 (1.48, 2.12)	
Total	1 469 901	2 638	17.9		0.37
Car drivers					
Intermediate and high level salaried employees	577 974	833	14.4	1.00	
Assistant non-manual employees	203 289	410	20.2	1.35 (1.20, 1.52)	
Self employed	98 010	298	30.4	1.84 (1.61, 2.10)	
Farmers	39 791	138	34.7	2.17 (1.81, 2.60)	
Skilled workers	232 657	525	22.6	1.64 (1.47, 1.84)	
Unskilled workers	235 881	593	25.1	1.75 (1.57, 1.95)	
Unspecified population	82 299	177	21.5	1.70 (1.44, 2.00)	
Total	1 469 901	2 974	20.2		0.29

The age distribution, based on cumulative incidence, of injuries during the study period reveals that injury peaks are consistent with ages of debut for use of particular types of vehicles (fig 1). The first major increase for bicycles (around 4–5 years of age) is the time when children start to cycle; the peak (around 12–13 years of age) is when they start to enter new environments with heavier traffic. The age limits for mopeds, motorcycles and cars in Sweden are 15, 16, and 18 years respectively.

Odds ratios (ORs) with 95% confidence intervals (CIs) were used to estimate the effect of parental SES on traffic injuries, using children with intermediate and high level salaried, employed parents/guardians as the reference group. Multivariate logistic regression analyses were then conducted, with hospital admission attributable to traffic injury as dependent variable for each category of road user. Age of child and age of mother at delivery of child were entered as continuous, independent variables.

Population attributable risks (PARs) were calculated in order to investigate the magnitude of socioeconomic differences by RTI category. The PARs show the reductions in the overall injury rates that would have occurred in the hypothetical case that all persons experienced the rates of the highest socioeconomic group.[15 16] Each PAR was computed on the basis of cumulative incidence for the whole population and for intermediate and high level salaried employees.

To answer the third study question about effect modification of gender, a joint logistic regression analysis including both boys and girls was conducted. An interaction variable, gender and socioeconomic group, was included in these analyses.

Results

Odds ratios for the various socioeconomic groups and types of RTIs are shown in table 2. There are significant differences between children of parents of all the groups considered and those of the reference group (children of intermediate and high level salaried employees).

Children of the self employed and farmers show a significantly greater risk of traffic injuries involving mopeds, motorcycles and cars (OR 1.5–2.8); the risk of being injured in relation to use of a motorcycle is almost three times higher in these groups than in the reference group. ORs for the unspecified group (comprising students, housewives, persons on sickness/disability pensions, and the long term unemployed) are higher in all traffic categories.

The PARs, last column in table 2, show that socioeconomic differences are larger for motor

Table 3 Logistic regression models for road traffic injuries among children from different socioeconomic groups, including effect modification of gender

Traffic categories	*Number of injuries*	*Girls OR (95% CI)*	*Boys OR (95% CI)*
Pedestrians	(n=1747)		
Intermediate and high level salaried employees	593	1.00	1.00
Assistant non-manual employees	242	1.09 (0.88, 1.36)	1.19 (0.97, 1.46)
Self employed	118	1.14 (0.85, 1.52)	1.16 (0.88, 1.52)
Farmers	32	0.57 (0.31, 1.04)	0.95 (0.61, 1.48)
Skilled workers	291	1.01 (0.81, 1.26)	1.36 (1.13, 1.64)
Unskilled workers	323	1.13 (0.91, 1.39)	1.46 (1.21, 1.75)
Unspecified population	148	1.42 (1.06, 1.89)	1.99 (1.57, 2.52)
Bicyclists	(n=11 100)		
Intermediate and high level salaried employees	4024	1.00	1.00
Assistant non-manual employees	1514	1.08 (0.98, 1.20)	1.25 (1.15, 1.35)
Self employed	678	1.17 (1.02, 1.33)	1.17 (1.06, 1.31)
Farmers	218	0.88 (0.70, 1.11)	0.98 (0.82, 1.16)
Skilled workers	1890	1.17 (1.06, 1.28)	1.34 (1.25, 1.45)
Unskilled workers	1992	1.22 (1.11, 1.34)	1.42 (1.32, 1.53)
Unspecified population	784	1.30 (1.41, 1.65)	1.68 (1.52, 1.85)
Moped users	(n=2997)		
Intermediate and high level salaried employees	886	1.00	1.00
Assistant non-manual employees	410	1.14 (0.84, 1.54)	1.34 (1.18, 1.52)
Self employed	243	1.71 (1.22, 2.38)	1.48 (1.26, 1.73)
Farmers	114	2.10 (1.33, 3.32)	1.79 (1.44, 2.22)
Skilled workers	548	1.44 (1.09, 1.89)	1.63 (1.45, 1.84)
Unskilled workers	632	1.75 (1.35, 2.25)	1.82 (1.62, 2.04)
Unspecified population	164	1.74 (1.20, 2.55)	1.36 (1.13, 1.64)
Motorcyclists	(n=2638)		
Intermediate and high level salaried employees	657	1.00	1.00
Assistant non-manual employees	384	0.96 (0.51, 1.81)	1.66 (1.46, 1.89)
Self employed	328	2.29 (1.27, 4.12)	2.70 (2.35, 3.10)
Farmers	133	2.98 (1.39, 6.41)	2.79 (2.30, 3.38)
Skilled workers	503	1.18 (0.66, 2.09)	1.99 (1.76, 2.24)
Unskilled workers	482	1.57 (0.94, 2.63)	1.82 (1.61, 2.06)
Unspecified population	151	1.46 (0.65, 3.27)	1.79 (1.49, 2.15)
Car drivers	(n=2974)		
Intermediate and high level salaried employees	833	1.00	1.00
Assistant non-manual employees	410	1.48 (1.17, 1.88)	1.32 (1.15, 1.51)
Self employed	298	1.66 (1.26, 2.21)	1.90 (1.63, 2.20)
Farmers	138	2.87 (2.06, 3.99)	1.96 (1.58, 2.43)
Skilled workers	525	1.78 (1.43, 2.22)	1.59 (1.40, 1.81)
Unskilled workers	593	1.84 (1.48, 2.28)	1.74 (1.54, 1.96)
Unspecified population	177	2.00 (1.46, 2.74)	1.61 (1.33, 1.94)

vehicle traffic injuries than they are for cyclists and pedestrians. Motor vehicle traffic injuries would fall by 25% for mopeds and 37% for cars if the entire population had the vehicle related injury rate of children in the reference group.

The analysis of gender modification shows that socioeconomic differences remain after including gender as an interaction variable (table 3). The effect of socioeconomic group is modified by gender only in the case of bicycle injuries. For this category of road users, the interaction coefficient for assistant non-manual employees is 1.15 (95% CI 1.02, 1.31), for skilled workers 1.15 (95% CI 1.02, 1.3) and for unskilled workers, 1.17 (95% CI 1.04, 1.31). The male injury rate shows more variation by social class than the female rate.

Discussion

The results show that RTIs are far from randomly distributed across children and adolescents from different socioeconomic groups in Swedish society. This applies to all categories of road users, but most prominently to motorised vehicle drivers. Socioeconomic injury risk differentials increase when young people first come into contact with motorised vehicles (mopeds, motorcycles, or cars). In terms of public health outcome, the potential for improvement for motorised vehicles varies between 25% (for moped) and 37% (for car). This would be achieved by lowering the vehicle specific injury rates of the lower socioeconomic groups to the levels observed in the higher socioeconomic groups.

KEY POINTS

- There are considerable differences in road traffic injuries during childhood and youth between socioeconomic groups; this applies to pedestrians, cyclists, moped riders, motorcyclists and car drivers.
- Socioeconomic injury risk differentials increase when young people come into contact with motorised vehicles.
- Socioeconomic differences exist for both boys and girls; the effect of socioeconomic group is slightly modified by gender, in the case of cycling only.

Interestingly, the effect of parental SES is slightly modified by gender only in the case of bicycle injuries, which is where socioeconomic differences with regard to injury are greater for boys than for girls. Otherwise, socioeconomic differences remain comparable—and substantial—for both girls and boys.

The results can be regarded as representative for the Swedish population, as the dropout rate for the Swedish Population and Housing Census of 1985 was only 0.8%.[17]

A first set of limitations of the study lies in attribution of SES. Each child was assigned the SES of the parent/guardian with the highest status in the household. Parental SES was obtained from the census of 1985, and we have not controlled for changes in SES during the follow up period. Nevertheless, as individual upward and downward mobility between social groups during working life is relatively low in Sweden,[18] the 1985 data can be expected to be fairly reliable.

An attempt to control for personal financial stress was made by using receipt of social benefit as a proxy measure. No significant effect on socioeconomic differences with regard to traffic injuries was found (results not presented here).To draw firm conclusions concerning the confounding effect of restricted financial assets, however, requires more reliable measures, such as disposable income within the family.

Another possible confounder is ethnic background of the household as people from different countries may vary, in among other respects, with regard to care seeking behaviour and access to medical care.[19] In this study this was considered by taking into account mother's country of birth as a proxy for ethnic background. Mothers born in Sweden were used as the reference group, and those from other countries were divided into three categories (Nordic countries, other countries in Europe, and countries outside Europe). When this variable was added in the logistic regression model it did not significantly change the effect of socioeconomic group (results not presented here). It is possible that this measure lacked sensitivity. Other measures that might be considered in further studies are those based on the countries of birth of both parents.

Controlling for degree of urbanisation (results not presented here) did not impact on the

current findings. It might be worth underlining that some researchers have claimed that it is inappropriate to control for factors of this kind, as they are, at least in part, themselves associated with socioeconomic position.[8]

From another viewpoint, the data at hand are concerned with injuries leading to hospitalisation. We had no opportunity to establish whether this type of morbidity is comparable across socioeconomic groups.[19] For example, on the basis of our data, it is impossible to say whether injuries tend to be more serious in lower socioeconomic groups than in higher ones, or the extent to which member of lower SES groups die more frequently from their injuries. In the current material, all injuries required at least one night of hospitalisation. A slight proportion of injuries might have been fatal without us being able to check for that. In the event of greater fatality, without hospitalisation, among deprived groups,[19 20] or of lower propensity to seek care, either differential drop out or differences in lethality might lead to an underestimation of SES related morbidity differences.

In the case of Sweden's Hospital Discharge Register, the drop out rate has been estimated to range between 1% and 2%. For the period under study, the external code was missing in around 3% of cases, and studies of validity have shown that diagnoses in the register might be wrong in about 10%.[21] However, we have no reason to believe that cases of missing information or misclassification show a particular social patterning, which suggests that they are unlikely substantially to affect the presented results.

Finally, we have no information about differential exposures across socioeconomic groups, in terms such as duration, environment at risk, quality of vehicle used, age of vehicle use debut, and type of activity. For example, it has been observed that children from lower socioeconomic groups walk home from school more often than children of higher SES.[22] Information on exposure is obviously of great importance in understanding the mechanisms behind observed socioeconomic differences with regard to injury.

Most studies dealing with social differences in traffic injuries during childhood and adolescence have considered spatial distributions of injuries on the basis of aggregated data, for example, those gathered by census tract.[2–5] All these studies suggest that living in a deprived area is likely to increase the risk of traffic injuries, and—as such—provide meaningful information for preventive purposes. Nevertheless, they can by no means be interpreted to entail that low parental/individual SES is a personal risk factor in itself. Only studies of the kind presented here, and those that combine ecological and individual data,[23] allow such conclusions to be drawn.

This study shows that there are socioeconomic differences in RTIs in childhood and youth in Sweden, and also that these are greater when motorised vehicles are used. The manner in which the magnitude of the differential is influenced by factors such as the social and physical characteristics of a young person's living area remains to be investigated.

An interesting question for future research concerns the extent to which differences in individual risks are modified by differences between the places where people live. Methods of this kind are available,[24–26] and may prove to be of importance for safety research in the future. Another question is whether and to what extent socioeconomic differences vary with age among children and adolescents.[27]

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Conflicts of interest: none.

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