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Socio-economic inequalities in injury incidence in the Netherlands

ED van Beeck[1], Frank van Lenthe[1], Hidde Toet[2], Paul den Hertog[2], Margriet van Baar[3]

[1]Department of Public Health, Erasmus MC, University Medical Centre Rotterdam, The Netherlands; [2]Consumer Safety Institute, Amsterdam, The Netherlands; [3]Julius Centre, University Medical Centre Utrecht, The Netherlands

Correspondence to: Eduard van Beeck , Department of Public Health, Erasmus MC, University Medical Centre Rotterdam, PO Box 2040, 3000 CA Rotterdam, Netherlands. E-mail: e.vanbeeck@erasmusmc.nl

Abstract

Background: Interventions to reduce socio-economic inequalities in injury incidence should be tailored to specific priority areas that may be identified by descriptive studies. We aimed to provide an overview of existing socio-economic inequalities in injury incidence in the Netherlands and to assess the potential influence of methodological choices on the relationships found.
Methods: Self-reported medically treated injuries (all injuries versus fractures) were derived from a survey among a random sample of 59 063 persons. Injuries resulting in hospital admissions (all injuries versus fractures) were derived from a prospective cohort study of 18 810 participants, linked to the National Hospital Discharge Register for a follow-up period of 7 years. Logistic regression was used to calculate the odds ratios of self-reported medically treated injuries and fractures by level of education, occupation and income, and of hospital-admitted injuries by level of education and occupation.
Results: Socio-economic inequalities in injury incidence in the Netherlands were dependent on the indicator of non-fatal injury incidence, indicator of socio-economic status (SES) and studied cause of injury. In the majority of specific relations analyzed, injury risks were not or only moderately elevated in lower SES-classes. Analyses focusing on injury with higher severity levels (admitted injuries and/or admitted fractures) revealed the steepest SES gradient with odds ratios of injury of 1.5 or more of the lowest socio-economic (educational) groups compared to persons with higher SES (education). In hospital admitted traffic injuries, we found the most striking difference with a threefold higher risk in the lowest educational groups.
Conclusion: Future descriptive research into socio-economic differences in injury incidence should include all three core indicators of SES and separate analyses on the more severe injuries should be conducted.

Key words: injury, socio-economic status, inequality, incidence

Introduction

Reducing socio-economic health inequalities is an important aim of current public health policies in Europe [1]. This can be achieved by interventions aimed at decreasing the gap between people with high versus low socio-economic status (SES). This gap results from a wide range of health problems, including injuries [2]. Injuries are a major public health problem with large opportunities for prevention. Interventions to reduce socio-economic inequalities in injury incidence should be tailored to specific priority areas, that may be identified by descriptive studies [3].

However, the descriptive literature on socio-economic differences in injury incidence contains some unexplained inconsistencies. A review of 26 studies into this relationship showed higher risks related to lower SES in all studies at an ecological level (n=13), but not in all studies at the individual level (n=13). In the latter group, 8 studies reported a higher injury risk in lower SES, 4 studies found no association and one study showed a higher risk in higher SES [4].

Several methodological issues may contribute to the inconsistent results found in studies at the individual level. A first methodological issue concerns the validity of measures of non-fatal injury incidence. In many studies into socio-economic differences in non-fatal injury, incidence is estimated with the help of health care utilisation measures , such as "all patients seeking medical care at a General Practitioner (GP) office or the Emergency Department (ED)". It is questionable whether these utilisation measures will result in a complete case ascertainment [5]. Moreover, it is known that social factors, including SES, are related to differences in help seeking behaviour and access to care and have an independent effect on attendance rates [6,7]. Some studies do use self-reported injuries as an indicator for injury incidence, but these are most often confined to injuries requiring medical attention. As a result,

these self-reports have similar problems as the aforementioned health care utilisation measures.

It has been advised in the literature to restrict measures of incidence to injuries of moderate to high severity, which are less sensitive to social influences and health service factors. In response to this, several selections of fractures have been proposed, either among admitted or non-admitted injury patients [5,8,9], however, to date this advice has not been implemented in descriptive research that examines socio-economic differences in injury incidence.

A second methodological issue is related to the variety of available SES indicators: education, occupation, and income. It has been shown that the association between SES and injury risk is influenced by the choice of the SES indicator [10]. In health research, an optimal SES indicator cannot be prescribed, but rather the choice depends upon the social group and the health indicator being examined [11].

In the Netherlands, two data sets were available in order to study the existence of socio-economic differences in injury incidence. We have used these data to analyze socio-economic differences in injury incidence by indicator of non-fatal injury (self-reported medically treated injuries, self-reported medically treated fractures, admitted injuries and admitted fractures) and by indicator of SES (education, occupation, income). The aim of our study was to provide an overview of existing socio-economic inequalities in injury incidence in the Netherlands and to assess the potential influence of methodological choices on the relationships found.

Method

Designs and study populations

Secondary data analyses were performed on two different data sets from the Netherlands.

Self-reported medically treated injuries were derived from the survey Accidents in the Netherlands. This survey was part of the Permanent Research in Living Conditions (POLS) by Statistics Netherlands (CBS). A random sample of 59 063 persons was taken from Dutch residents who were included in the Municipal basic administration. In a face-to-face interview persons were questioned whether they had suffered from an injury as result of an accident in the past three months for which medical treatment was necessary. Medical treatment was defined as hospital admission, treatment in an outpatient clinic or ED, by GP, first aid or other professional treatment. In addition, information on socio-economic indicators was obtained.

Injury incidence was based on a total of 1817 injury cases (of which 110 were fractures) with complete data (nominator data). The number of potential injury patients was 59 063, i.e. the total sample (denominator data).

Injuries resulting in hospital admissions were derived from a Dutch prospective cohort study (the GLOBE study) [12], linked to the National Hospital Discharge Register after 7 years of follow up. This cohort study consists of persons between 15 and 74 years of age, living in a relatively well defined coverage area of 5 hospitals. A total of 18 810 subjects were available for record linkage; 572 subjects with injuries resulting in hospital admission were included in the analysis [13], of which a total of 303 admitted fractures were available (nominator data). The denominator consisted of all observed person-years in the GLOBE-study of the 18 810 persons available for record linkage.

Injury classifications

Self-reported medically treated injuries were classified according to an injury classification, as used in the Dutch Injury Information System (Letsel Informatie Systeem (LIS)) [14,15].

Hospital admissions were classified as injury admissions if 1) an external cause being responsible for hospital admission and 2) main diagnosis at discharge is between ICD-9 code 800 and 999, with the exception of ICD-9 codes 905-909 (late consequences of injuries , poisoning, toxic influences, other external causes), 958-959 (complications of trauma and other unspecified injuries) and 996-999 (complications surgical and medical treatment). Several injury categories were investigated: all injuries (see above); traffic injuries (ICD-9 800-848, or 929.0 or 929.1, with several exclusions in hospital admissions (see above)); occupational, home en leisure (OHL) injuries (ICD-9 850-869, 880-888,890-928, 929.2-929.4, 970-999, with exclusions in hospital admissions (see above)).

Socio-economic indicators

Information on education and occupation was available in both datasets. Income data were only available in the set relating to self-reported injuries, since the cohort study (GLOBE) linked to the Hospital Discharge Register did not collect this type of information in its complete study sample . All indicators for SES were individually based (see table 1). We conducted secondary analyses on data that were collected for different purposes by different research groups, which explains why the classification of SES-indicators is different for self-reported injuries and hospital-admitted injuries. (Table 1)

Table 1. Summary of designs and SES indicators used

Outcome	Design	SES indicator: education (E), occupation (O) or income (I)
Self-reported incidence of medically treated injuries	Survey of a random sample of non-institutionalised persons in the Netherlands Individual based	E: Highest completed education main breadwinner: 1=primary education; 2=lower vocational education, 3=lower secondary general education; 4=intermediate vocational or higher secondary general education; 5=higher vocational education or university O: Occupational level main breadwinner: 1=elementary; 2=low, 3=intermediate; 4=high; 5=scientific I: Net household income per year: divided by quintiles
Incidence of injury admitted to hospital	Prospective cohort study with 7 years follow-up, linked with National Hospital Discharge Register Individual based	E: Highest with certificate completed education of respondent: 1=primary education; 2=lower vocational or lower secondary general education; 3=intermediate vocational or higher secondary general education; 4=higher vocational education or university O: Occupation of breadwinner, according to Eriksons-Goldthorpe-Portocarero (EGP) scheme 1=unskilled manual workers, agricultural labourers, 2=skilled manual workers, 3=self employed, 4=routine non-manual employees and lower administrators and professionals, 5=higher administrators and professionals

Eriksons E, Goldthorpe JH. The constantflux. Oxford, Claredon press, 1992

Statistical analysis

Logistic regression was used to calculate odds ratios and confidence intervals for self-reported medically treated injuries and hospital admitted injuries The highest SES-category was used as reference category.

Odds ratios were adjusted for age and sex as potential confounders.

Results

All injuries

In table 2 the odds ratios of all injuries combined are shown for different indicators of injury incidence and SES.(Table 2)

A significantly higher risk for lower SES-categories was found in three out of four injury indicators, except in self-reported fractures The

Table 2. All injuries: odds ratios (OR)[1] for different outcome measures by socio-economic position

Outcome measure	Indicator socio-economic position					
	Education		Occupation		Income	
	N/n	OR (95%CI)	N/n	OR (95%CI)	N/n	OR (95%CI)
Self-reported injuries						
Low	227 /7 919	0.95 (0.81-1.11)	87 /1 707	**1.36 (1.03-1.80)**	274 /7 511	0.84 (0.71-1.00)
	311 /7 863	1.06 (0.91-1.23)	375 /8 046	**1.25 (1.01-1.53)**	288 /7 162	0.91 (0.77-1.08)
	115 /3 161	0.98 (0.79-1.20)	666 /14 877	1.22 (1.00-1.48)	321 /7 167	0.99 (0.84-1.16)
	686 /16 401	1.08 (0.96-1.22)	311 /8 184	1.05 (0.85-1.30)	282 /7 082	0.86 (0.73-1.02)
High	424 /11 194	1.00	126 /3 530	1.00	323 /7 111	1.00
Self-reported fractures						
Low	17 /7 920	0.80 (0.44-1.47)	4 /1 707	0.65 (0.21-2.03)	23 /7 511	1.03 (0.57-1.86)
	15 /7 861	0.71 (0.38-1.34)	27 /8 046	0.95 (0.48-1.87)	21 /7 162	0.90 (0.50-1.63)
	10 /3 161	1.27 (0.62-2.60)	36 /14 877	0.68 (0.35-1.30)	15 /7 167	0.63 (0.33-1.19)
	38 /16 401	0.86 (0.53-1.40)	23 /8 184	0.79 (0.39-1.59)	25 /7 082	1.02 (0.58-1.79)
High	30 /11 194	1.00	12 /3 530	1.00	24 /7 111	1.00
Admitted injuries						
Low			86 /2 653	1.32 (0.91-1.92)	n.a.	
	140 /3 719	**1.65 (1.20-2.26)**	113 /3 681	1.25 (0.88-1.78)		
	235 /6 768	**1.74 (1.30-2.32)**	32 /821	1.53 (0.95-2.44)		
	85 /3 948	1.06 (0.76-1.48)	160 /6 050	1.12 (0.80-1.57)		
High	65/ 3 279	1.00	47 /1 923	1.00		
Admitted fractures						
Low			51 /2 653	1.00 (0.64-1.57)	n.a.	
	86 /3719	**1.56 (1.02-2.37)**	52 /3 681	0.76 (0.50-1.19)		
	140 /6 768	**1.77 (1.20-2.61)**	23 /821	1.49 (0.87-2.55)		
	43 /3 948	1.00 (0.63-1.57)	95 /6 050	0.88 (0.59-1.31)		
High	34 /3 279	1.00	35 /1 923	1.00		

1 OR: adjusted for age, sex.
n.a. Not available

injury risks were moderately increased, with odds ratios varying from 1.25 to 1.77.

These SES-gradients were not consistently found for all studied SES-indicators. In self-reported injuries a SES gradient was found for occupation (not education and income). In admitted injuries and admitted fractures a SES-gradient was found for education (not occupation).

Traffic injuries

In table 3 the odds ratios of traffic injuries are shown for the different indicators of injury incidence and SES. (Table 3)

In traffic injuries a higher risk in lower SES-groups was found only in those with hospital admitted injuries, and only for 1 SES-indicator (education). A relatively steep gradient was found for the relationship between education and admitted traffic injuries. Persons with low education had a more than a three-fold risk of admission due to traffic injuries than those with a high education. Due to the small numbers it was not possible to distinguish between fractures and other traffic injuries.

Occupational, home and leisure (OHL) injuries

In table 4 the odds ratios of occupational, home and leisure (OHL) injuries are shown. In OHL-injuries, an increased injury risk in lower SES-groups was found for both injury indicators. The odds ratios were moderately increased, with 1.3 in self-reported injuries among people with a low occupational level and 1.6 in admitted injuries among people with a low educational level. Due to the small numbers no distinction was possible between fractures and other OHL-injuries. (Table 4)

Discussion

Our study revealed several socio-economic inequalities in injury incidence in the Netherlands. However, the observed relationship is dependent on the indicator of non-fatal injury incidence, SES-indicator and studied cause of

Table 3. Traffic injuries: odds ratios (OR)[1] for different outcome measures by socio-economic position

Outcome measure	Indicator socio-economic position					
	Education	Occupation	Income			
	N/n	OR (95%CI)	N/n	OR (95%CI)	N/n	OR (95%CI)
Self-reported traffic injuries						
Low	33 /7 919	0.95 (0.60-1.50)	10 /1 707	1.34 (0.59-3.03)	36 /7 511	0.85 (0.52-1.40)
	29 /7 863	0.87 (0.54-1.38)	38 /8 046	1.08 (0.58-2.01)	31 /7 162	0.89 (0.54-1.46)
	12 /3 162	0.83 (0.44-1.60)	53 /14 877	0.86 (0.48-1.57)	30 /7 167	0.88 (0.54-1.45)
	54 /16 401	0.77 (0.51-1.14)	27 /8 184	0.82 (0.43-1.58)	24 /7 082	0.71 (0.42-1.21)
High	45 /11 194	1.00	14 /3 530	1.00	33 /7 111	1.00
Admitted traffic injuries						
Low			19 /2 653	1.77 (0.77-4.08)	n.a.	
	20 /3 719	**3.06 (1.18-7.90)**	12 /3 681	0.72 (0.29-1.81)		
	35 /6 768	**3.24 (1.34-7.81)**	3 /821	0.84 (0.22-3.20)		
	11 /3 948	1.56 (0.57-4.25)	18 /6 050	0.77 (0.33-1.78)		
High	6/ 3 279	1.00	8 /1 923	1.00		

1 O): adjusted for age, sex
n.a. Not available

Table 4. Occupational, home and leisure injuries: odds ratios (OR)[1] for different outcome measures by socio-economic position

Outcome measure	Indicator socio-economic position					
	Education	Occupation	Income			
	N/n	OR (95%CI)	N/n	OR (95%CI)	N/n	OR (95%CI
Self-reported non-traffic injuries						
Low	244 /7 919	0.94 (0.80-1.11)	77 /1 707	1.35 (1.00-1.82)	239 /7 511	0.84 (0.70-1.00)
	282 /7 863	1.08 (0.92-1.27)	338 /8 046	**1.27 (1.02-1.57)**	258 /7 162	0.92 (0.77-1.09)
	103 /3 161	0.99 (0.79-1.24)	613 /14 877	**1.26 (1.03-1.55)**	291 /7 167	1.00 (0.85-1.18)
	632 /16 401	1.12 (0.98-1.28)	284 /8 184	1.08 (0.86-1.35)	259 /7 082	0.88 (0.74-1.05)
High	378 /11 194	1.00	113 /3 530	1.00	290 /7 111	1.00
Admitted non-traffic injuries						
Low			60 /2 653	1.08(0.71-1.64)	n.a.	
	109 /3 719	**1.56 (1.09-2.22)**	95 /3 681	1.26 (0.86-1.85)		
	181 /6 768	**1.64 (1.19-2.26)**	24 /821	1.38 (0.82-2.34)		
	67 /3 948	1.05 (0.73-1.52)	126 /6 050	1.06 (0.73-1.53)		
High	53/ 3 279	1.00	39 /1 923	1.00		

1 OR: adjusted for age, sex
n.a. Not available

injury. In the majority of the specific relationships that were analyzed, injury risks were not or only moderately elevated in lower SES-classes. In hospital admitted traffic injuries, we found the most striking difference, with a threefold higher risk, in the lowest educational groups.

In our study, we tried to assess the potential influence of methodological choices on the relationships found. It must be considered, that this assessment was hampered by several limitations. A major issue is the restricted number of cases in our datasets. Therefore, some analyses of subgroups of patients were not possible. SES-gradients in two out of four injury indicators (self-reported fractures and admitted fractures), could be analyzed only for all injury patients, not for any cause-specific injury category. The limited number of fractures in our datasets prevented us from making further selections of specific fracture types as proposed in the literature [5].

Moreover, the core set of three socio-economic indicators was included in only one data set (self-reported injuries). In the other data set, income was not included, since the cohort study (GLOBE) linked to the Hospital Discharge Register did not collect this type of information in its complete study sample. As a result, we could not analyse the SES-gradient of the two datasets within the SES-indicator income. In the literature, it was previously concluded that income/deprivation is the strongest predictor of the social gradient in injury mortality [2].

In spite of the aforementioned limitations, our assessment of methodological choices provides useful directives for future research. We studied four indicators of non-fatal injury incidence, reflecting an increasing injury severity. Our analyses focusing on injury with higher severity levels (admitted injuries and/or admitted fractures) revealed the steepest SES gradient with an odds ratios of injury of 1.5 or more for the lowest socio-economic (educational) groups compared to persons with a higher SES (education). Previous studies have shown comparable results. An analysis of several data systems in the USA found a SES gradient in hospitalised non-fatal injuries in adults, but not for less severe injuries [10]. A UK study reported similar gradients for different levels of injury severity in young children (0-4 years) [16]. Our findings suggest, that studies measuring injury with a low severity threshold may mask existing socio-economic differences in the incidence of injury of moderate to high severity levels. The conduction of separate analyses on the more severe injuries is therefore recommended. We advice the use of selections of injuries previously proposed [5,8,9] in large datasets.

In our analyses, all three core indicators of socio-economic position (education, occupation, income) were included in the data set on self-reported medically treated injuries, and two indicators (education, occupation) were included in the data set on hospital-admitted injuries. We did not find any indication that one of the SES-indicators was more strongly related to injury risk than the others. In self-reported injuries SES-gradients were only found for occupation, whereas in hospital admitted injuries SES-gradients were only found for education. Income was not included in this data set. Our findings are in line with the existing views reported in the literature. Optimal SES-indicators cannot be prescribed across all outcomes [11]. Various measures of SES may summarise different components of overall health risk [17]. A combination of SES-indicators is therefore preferred. Inclusion of income is advisable, since education and occupation may not adequately reflect income and wealth, especially in younger and ethnically diverse populations [18].

In conclusion, we found evidence for socio-economic inequality in injury incidence in the Netherlands. The inequalities were most pronounced in injury of higher severity levels and in particular, in admitted traffic injuries. Future descriptive research into socio-economic differences in injury incidence should include all three core indicators of SES and include separate analyses for those injuries that are more severe.

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