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Nonfatal childhood injuries and their association with socioeconomic and gender structures: an ecological study of 14 Swedish municipalities (2000–2005)

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Abstract

Background: Injuries are the major cause of death and disability in European children. This study explored socioeconomic and gender structures in association with nonfatal childhood injury rates by sex and age groups in Sweden.

Methods: Six indicators of socioeconomic structure and three indicators of gender structure were combined using principal component analysis. Sex- and age-specific mean annual injury rates of fourteen Swedish municipalities were estimated (2000–2005). The associations were analysed with Pearson's correlation coefficients.

Results: Narrow gender ratio in unskilled occupations and in politics was positively associated with injuries in girls 6–17 years ($r \geq 0.7$) and with fractures in boys 6–12 years of age ($r = 0.5$). Wider income distribution was negatively associated ($r \geq -0.4$) with boys' injuries and positively associated with fractures in girls 13–17 years ($r = 0.5$). Relative wealth and male manager dominance was negatively associated with injuries in children 0–5 years ($r = -0.4$). Relative poverty was not associated with nonfatal childhood injuries.

Conclusions: The strength of the associations between socioeconomic and gender structures and nonfatal childhood injury rates varied by sex, age group and type of injury. Childhood injury preventive interventions should consider the local gender structure, area-level wealth and area-level income distribution, and not only area-level poverty.

Key words: children, injuries, socioeconomic structure, gender structure, ecological study

Introduction

Over one million children around the world die from injuries [1] and injuries are the main cause of death and disabilities in European children [2]. Research findings suggest that injuries have not only biological determinants but also socio-cultural determinants [3]. Furthermore, area level of poverty has shown an effect on childhood injuries independent of individual level of poverty [4-7]. Area level studies have shown positive associations between poverty and fatal childhood injuries [8-13], although the findings are inconclusive regarding nonfatal injuries [14, 15]. Even in Sweden, one of the most egalitarian countries in the world, the occurrence of childhood injuries has an unequal socioeconomic distribution [16-18]. For example, a multilevel study found that children living in the most deprived neighbourhoods had 1.13 (95% CI: 1.1–1.2) times higher odds of being injured than children in the most affluent neighbourhoods after adjustment for sex, household income, parental level of education and immigrant background [7]. Furthermore, Wilkinson's income inequality hypothesis points out that not only the individual level of poverty but also the income distribution at area level influences the health of the population [19]. While the health effects of area level poverty have been widely studied, the effect of income distribution on childhood injuries has received less attention.

Experts in gender theory [20-22] have suggested that gender structure influences the expected social practices of boys and girls. Morrow [23] suggested that children actively construct and reconstruct their gender identities in response to the constraints and norms of their families and nearest key persons. In line with this reasoning, the gender structure of a society may influence the injury risk for boys and girls, respectively, owing to expected gendered social practices. Such gendered practices are, of course, also intertwined with children's biological and developmental phases. Knowledge about the

influence of gender structure in childhood injuries is lacking.

Even if fatal injury rates are relatively low in Sweden, it is still the primary cause of death for children [24]. Furthermore, national Swedish data showed that household incomes increased by an average of 25% between 1995 and 2004, widening the income gap between people with low versus high income [25]. The unique socioeconomic and gender structures in Sweden, together with our interest in finding new knowledge that can contribute to a reduction of childhood injuries, are the main reasons for this study. Thus, this study explored socioeconomic and gender structures in association with the occurrence of nonfatal childhood injuries by sex and age groups in Sweden.

Methods

An ecological approach was selected as the best means to study local socioeconomic and gender structures [3]. The study base was fourteen municipalities located in the southwest of Sweden, in a geographical area with 40% arable land compared with 8% for Sweden as a whole. Swedish municipalities are the smallest spatial, administrative and political structure with a significant degree of autonomy. The average annual (2000–2005) population in these municipalities ranged from 6,000 to 50,000 inhabitants. Twenty-two percent of the inhabitants were children (0-17 years).

Socioeconomic and gender structures

Indicators were searched following our theoretical conception of socioeconomic and gender structures. The available indicators to characterise the local socioeconomic and gender structure (see Table 1) were collected online from Statistics Sweden (www.scb.se) and from the Swedish National Institute of Public Health (www.fhi.se).

The socioeconomic structure was defined as the level of relative income and its distribution in the population. Six indicators were selected.

Table 1. Comparison of the contextual backgrounds of the 14 Swedish municipalities.

Variable	*Average*	*Range*	*Sweden*
Demographic data			
Mean annual total population (per 1000) 2000–2005	18	5–49	8800
Mean annual population density (inhabitants/km^2) 2000–2005	34	17–74	25
Population under 17 years old (%) 2000–2005	22	21–23	20
Population living in the city (%) 2000–2005	68	42–85	80
Socioeconomic data			
Gini coefficient index 2002–2005	0.29	0.27–0.32	0.31
Mean income (per 1000 SEK) 2000–2005	161	147–176	216
Proportion of millionaire (%) 2000–2005	8	6–11	11
Children living in a household with social welfare (%) 2000–2005	6	3–12	18
Low educated people aged 20–64 years (%) 2000–2005	13	8–18	17
Unemployed people aged 20–64 years (%) 2000–2005	17	14–21	17
Gender inequality data			
Sex ratio in leading position at work (m/w) 2001–2005	2.9	1.8–3.8	2.8
Sex ratio in unskilled occupations (m/w) 2001–2005	0.6	0.2–0.9	0.7
Proportion (%) of women members at the municipal council 2002	40	34–46	47
Fatal injury rate in the whole population, 2000–2004			
Mean annual fatal injury rate among females (per 100,000)	35	23–56	33
Mean annual fatal injury rate among males (per 100,000)	62	35–83	74

Average = average value of the 14 municipalities
Range = lowest municipal rate – highest municipal rate among the 14 municipalities;
SEK = Swedish crowns (9.15 Swedish crowns = 1 Euro for years 2000-2005)
Source: Statistics Sweden and the Swedish National Institute of Public Health.

Gini coefficient index, based on household disposable income, was selected, since it indicates the level of income distribution or degree of socioeconomic heterogeneity in a society [19] ("0" means maximum income homogeneity, and "1" means maximum income heterogeneity). *Mean income* was selected, because it reflects the income level of the municipality. *Proportion of millionaires* was included as an indicator of wealth—millionaire being defined as a person having over 1,000,000 Swedish crowns (9.15 Swedish crowns = 1 Euro for years 2000-2005) in properties, financial assets and/or bank deposits. *Proportion of children living in households receiving social welfare benefits* was selected as an indicator of the proportion of children living in relative poverty. We also included the *proportion of unemployed adults* and the *proportion of adults with low education level* (no more than nine years of education) [14]. No good indicator of household expenditure was found and therefore, no such indicator was included in this study.

Most studies have focused on gender as an individual variable, while few studies have explored the association between gender structure and health [26, 27]. Thus, the indicators identified for this study should be regarded as tentative, and constrained by availability of statistics relative to this area. Gender structure was defined as the sex distribution of roles between men and women at home and at work, and in the political arena. Sex distribution at the political level was measured as *the proportion of women in the municipal council* (with an average total of 30 members). The highest level of decision-making in the municipality is the municipal executive committee, but the average number of members is five, which limits its use as a gender indicator. The sex distribution of the labour market was measured as the sex ratio between the proportion of men over the proportion of women in a leading position at work (*manager sex ratio*) and in unskilled occupations (*unskilled sex ratio*). Managerial positions included full-time politicians, judges, directors within the public sector and managers of companies with at least two employees. Unskilled occupations included work positions that do not require any formal education. No good indicator of sex distribution of roles at home was found and therefore, no such indicator was included in this study.

Nonfatal childhood injuries

The database of the Skaraborg Local Injury Surveillance System (SLISS) provided the annual number of nonfatal injuries per municipality for 2000–2005. There are four local public hospitals and 25 primary health care centres (PHCs) included in SLISS. Each municipality in Skaraborg had at least one PHC. The injury information was systematically collected using two instruments: the clinical record completed by the treating physician and a self-administered questionnaire collecting demographic data and information about the event (when, where and how the injury occurred, and the activity at the time of injury).

Injuries were classified according to the European Home and Leisure Accident Surveillance (EHLASS) classification system and the ICD-10 (chapter XX) [1]. All nonfatal injuries registered in SLISS were used to reflect the general health service due to nonfatal injury. Since minor injuries can be treated outside the health system, and given that no evaluation of this issue was carried out, fractures were separately analyzed since they are less affected by dropouts and under-registration [28]. All fractures are treated at hospitals within the studied area.

Each new registered injury episode was used as a single case. Dental fractures and cases registered as 'no-injury found' by the physician were excluded. Injury database management and analysis used anonymous information in accordance with the Swedish legislation for registers.

The injury data were stratified by sex and age (see Table 2); by sex, since earlier studies have shown that childhood injuries [29, 30] are more common in boys; by age (0–5 years, 6–12 years, 13–17 years and 18–24 years), since we assumed differences between the age groups in terms of development and social practices. The annual average municipal populations by sex and age group were obtained from Statistics Sweden, to calculate the sex- and age-specific annual municipal injury and fracture rates.

Statistical analysis

Since we were dealing with small municipalities with relatively low occurrence of injuries, the annual rates were transformed into mean annual rates (2000–2005) to obtain more stable values for analysis. The only exception was the sex distribution in the municipal council, which was only available for the year 2002.

Principal component analysis (PCA) was used to combine the gender and socioeconomic indicators (see correlations between indicators in Table 3). PCA is a mathematical tool used to identify the correlation structure between variables and can be used to construct indices preserving most of the original information [31].

The strength and direction of the associations

Table 2. Mean annual injury and fracture absolute cases, rates by sex and age (with 95% confidence intervals) and specific age sex ratios, over the 14 municipalities and the years 2000–2005.

All nonfatal injuries ¥						
Age	***Girls***			***Boys***		***Sex ratio******
	Cases*	Rate** (95% CI)		Cases*	Rate** (95% CI)	Rate** (95% CI)
0–5 years	931	131 (119-144)		1169	158 (147-169)	1.2 (1.2-1.3)
6–12 years	1589	139 (131-148)		2104	181 (170-192)	1.3 (1.2-1.4)
13–17 years	1032	119 (120-129)		1626	182 (170-194)	1.5 (1.5-1.6)
Fractures ¥¥						
Age	***Girls***			***Boys***		***Sex ratio******
	Cases*	Rate** (95% CI)		Cases*	Rate** (95% CI)	Rate** (95% CI)
0–5 years	79	11 (9-12)		91	12 (11-14)	1.2 (1.1-1.4)
6–12 years	275	23 (21-25)		301	24 (22-27)	1.1 (1.0-1.2)
13–17 years	108	12 (11-13)		304	33 (30-35)	2.7 (2.4-3.1)

¥ All registered episodes of nonfatal injuries, excluding cases coded as "no-injury found";
¥¥ All registered fractures, excluding dental fractures;
*Mean annual absolute number of registered episodes per sex and age (2000-2005);
**Mean annual rate/ 1000 inhabitants per sex and age (2000-2005);
***Mean sex ratio (male rate / female rate).

were analysed using Pearson's correlation coefficient (SPSS version 15.0): "0" means no linear association, and "1" or "-1" means complete linear association between the studied variables. The analyses in this study were based on a small sample (n = 14), therefore, the level of significance will not be acknowledged. Instead, the following sections will account for and discuss linear correlations of -0.4 to 0.4 and stronger (r ≥ 0.4 or ≤ -0.4).

Results

There were 61,585 cases of nonfatal childhood injuries registered in the fourteen municipalities during the years 2000 to 2005, of which 13% were fractures. Boys' injury and fracture rates were higher than girls' (see Table 2).

The PCA identified four data-driven components, representing 84% of the total variation in the data. The variables with factor component loading scores higher than +/-0.6 were used to label the components (see Table 4). Component 1 was labelled *relative poverty*. Component 2 was labelled *relative wealth and male manager dominance*. Component 3 was labelled *narrow gender ratio in unskilled occupations and in politics*, and Component 4 was labelled *wider income distribution*. Pearson's correlations coefficients between the identified components and the sex- and age-specific nonfatal injury rates are presented in Table 5.

Relative poverty

The analyses of the municipal level of *relative poverty* showed only one moderate negative correlation (r=-0.4), and that was with the occurrence of fractures in girls 6–12 years. Otherwise, no strong correlations were found between *relative poverty* and *nonfatal injuries*, irrespective of the nature of the injury, sex or age group.

Relative wealth and male manager dominance

The mixed component reflecting the municipal level of *relative wealth and male manager dominance* showed strong negative correlations (r = -0.4) with the occurrence of *fractures* in girls 0–5 years and with both *all nonfatal injuries* and *fractures* in boys 0–5 years. Otherwise, no strong correlations were found between *relative wealth and male manager dominance* and injuries, irrespective of the nature of the injury, sex or age group.

Narrow gender ratio in unskilled occupations and in politics

Our gender component reflecting the municipal level of *narrow gender ratio in unskilled occupations and in politics* showed positive

Table 3. Pearson's correlation coefficients between the socioeconomic and gender variables.

	Gini coefficient	*% millionaire*	*% poor children*	*Mean-income*	*% low education*	*% unemployed*	*Manager sex ratio*	*Unskilled sex ratio*
% millionaire§	0.35							
% poor children¥	-0.25	-0.02						
Mean income	0.42	0.14	-0.69					
% low education	-0.33	0.02	0.73	-0.67				
% unemployed	-0.09	-0.45	0.53	-0.45	0.49			
Manager sex ratio	0.06	0.49	0.28	-0.30	0.36	0.17		
Unskilled sex ratio	0.12	0.10	-0.29	0.37	0.17	0.15	0.19	
*Women in politics**	-0.05	0.15	-0.24	0.53	-0.37	-0.13	0.24	0.34

Correlations of 0 = no linear association, and correlations of -1 or 1 = strong linear association.
§ Proportion of persons having over 1,000,000 Swedish crowns (9.15 Swedish crowns = 1 Euro for years 2000-2005) in properties, financial assets and/or bank deposits;
¥ Proportion of children living in households receiving social welfare benefits;
* Proportion of women in the Municipal Council.

correlations with the occurrence of *all nonfatal injuries* in girls 6–12 years (r = 0.7; P <0.01), girls 13–17 years (r = 0.8; P <0.01) and boys 13–17 years (r = 0.5). Positive correlations were also observed with the occurrence of fractures in girls 0–12 years (r = 0.5; P <0.05) and in boys 6–12 years (r = 0.6; P <0.05).

Wider income distribution

The income component reflecting the municipal level of *wider income distribution* showed negative correlations (r = between -0.4 and -0.5) with the occurrence of *all nonfatal injuries* in boys of all age groups, while no strong correlation was observed in girls. A positive correlation was observed between *wider income distribution* and *fractures* only among girls 13–17 years (r = 0.5), while no strong correlation was observed with boys' fractures.

Discussion

The findings of this exploratory study suggest that socioeconomic and gender structures were

Table 4. Factor component loadings (Varimax-rotated) and percentage of variance explained by each component. Figures in bold indicate factor component loading scores higher than +/-0.6.

	Relative poverty	*Relative wealth & male manager dominance*	*Narrow sex distribution at work and in politics*	*Wider income distribution*
Mean income	***-0.82***	-0.03	0.42	0.20
% poor children ¥	***0.83***	0.11	-0.22	-0.15
% adults with low education level	***0.89***	0.12	0.06	-0.08
% unemployed adults	***0.75***	-0.38	0.34	0.08
% millionaires	-0.13	***0.91***	-0.04	0.23
Manager sex ratio (m/w)	0.41	***0.75***	0.28	-0.07
Unskilled sex ratio (m/w)	-0.00	0.04	***0.89***	0.14
% women in municipal council	-0.43	0.27	***0.61***	-0.44
Gini coefficient index	-0.24	0.20	0.11	***0.89***
Percentage of variance	***35***	***19***	***18***	***13***

¥ Proportion of children living in households obtaining social welfare benefit.

Table 5. Pearson's correlation coefficients (based on the 14 municipalities) by age, sex, type of injury and component.

		Relative poverty		Relative wealth & male manager dominance		Narrow gender ratio in unskilled occupations and in politics		Wider income distribution	
Sex	*Age*	*Injury*	*Fracture*	*Injury*	*Fracture*	*Injury*	*Fracture*	*Injury*	*Fracture*
Girls	0–5 years	-0.14	-0.08	-0.33	-0.44	0.15	0.53*	-0.35	-0.04
	6–12 years	-0.12	-0.43	-0.04	-0.29	0.74**	0.52	-0.07	0.25
	13–17 years	-0.12	0.11	-0.13	-0.30	0.79**	0.30	-0.24	0.46
Boys	0–5 years	-0.02	0.00	-0.41	-0.44	0.08	-0.03	-0.48	0.16
	6–12 years	-0.02	-0.27	-0.34	-0.29	0.31	0.56*	-0.47	-0.04
	13–17 years	0.13	0.32	-0.34	-0.30	0.49	0.36	-0.44	-0.10

Note: Injury in this table refers to all nonfatal injuries = All registered episodes of nonfatal injuries.
Fractures in this table and study refer to all registered fractures, excluding dental fractures.
Correlations of "0" = no linear association, and correlations of "-1" or "1" = strong linear association.
* P-value ‹ 0.05; ** P-value ‹ 0.01.

associated with the occurrence of nonfatal childhood injuries. The results suggest that communities with *narrow gender ratio in unskilled occupations and in politics* were strongly associated with the occurrence of nonfatal injuries in children 6–17 years. *Wider income distribution* at the municipal level was negatively associated with the occurrence of boys' injuries at all ages, and positively associated with the occurrence of fractures in girls 13–17 years. Moreover, municipal-level *relative wealth and male manager dominance* was negatively associated with the occurrence of both injuries and fractures among children 0–5 years. Finally, it was found that *relative poverty* at the municipal level was negatively associated with the occurrence of fractures in girls 6–12 years. The findings in this study are congruent with previous studies claiming that social environmental factors are associated with the health outcomes of the population [3, 19, 21, 22].

The analyses showed that municipalities with *narrow gender ratio in unskilled occupations and in politics* had higher childhood injury rates than those with female dominance in unskilled occupations and male dominance in politics. Additionally, the associations were stronger in girls than in boys. These associations are in line with earlier studies showing that gender structure can influence children's social practices and health [21-23]. Similar findings have been found in two studies exploring the association between gender structure and adults' health. One study [27] found that the equal participation of men and women in private (home) and in public spheres (managerial working position and politics) was positively associated with lower life expectancy at birth and higher number of compensated days for sick leave and disability pension for both adult men and adult women. Another study [26] found that the risk of sick leave and death was higher among women with 'less traditional roles' in the public sphere than among women with 'more traditional roles'. Both studies explained their findings by women's incorporation of health-damaging behaviours traditionally linked to men, since men's behaviours had fewer changes. Another question of more importance for our study is why differences in gender structures were associated with nonfatal childhood injuries. A hypothesis that may contribute to understanding the mechanisms behind the observed associations in this study is that women's higher participation in municipal governments may promote longer opening hours at sports facilities for female teams, an issue under discussion in Sweden. Such strategies might improve the children's overall health, but also contribute to increased injuries. Unfortunately, we found no good indicator of gender roles at home to complement the indicators from the political and working spheres. Additionally, the sex distribution in the municipal council from 2002 didn't differ from 1998.

Earlier studies [4-6, 8, 10] and also Swedish studies [7, 11, 13, 16-18] found a positive association between poverty and childhood injuries. This study found a similar association only with the occurrence of fractures in girls 6–12 years. The finding could have been identified by chance, and conclusions need to be drawn based on the major finding that relative poverty was not associated with injuries in children. Thus, this study did not support findings from earlier studies associating poverty and childhood injuries. One important consideration relevant to the earlier Swedish studies is the context of the studied population with respect to injury risk and relative poverty. The earlier Swedish studies [7, 11, 13, 16-18] used the neighbourhood level in Stockholm, whilst this study used municipalities in a rural area. Further studies with a larger sample of municipalities could test the validity of our findings.

This study explored socioeconomic structure not only from the absolute low-income perspective but also from the wealth perspective and from the income distribution perspective. One important reason for doing so was that Cubbin and Smith [14] had suggested the use of multiple measurements in the analysis of socioeconomic contexts. Another important reason was that generally wider income inequality has been associated with health problems [19]. Our findings suggest that attention also should be paid to wide income distributions even in egalitarian countries, like Sweden. We found that municipalities with wider income distribution were positively associated with fractures in girls aged 13-17 years and negatively associated with injuries in boys, all ages. It is possible that the opposite trends to those that might have been expected between genders may be due to increased sport opportunities, like horse riding and team sports, or due to specific injury prevention strategies focusing on boys' sports. Further studies are needed regarding income distribution to evaluate possible implications for injury prevention.

Exploration of the indicators of socioeconomic and gender structures suggested an interaction between the socioeconomic structure and the gender structure. This finding is in line with

studies suggesting that area-level studies require a combination of multiple indicators [14]. For this reason, the studied components are a combination of six indicators of socioeconomic structure and three indicators of gender structure. As far as we know, no other study has combined both socioeconomic and gender indicators to study spatial associations with any health problem. Thus, further studies should analyze the interaction between the two contextual structures.

The injury database allowed us to use a wider spectrum of nonfatal injuries, with information collected at both hospital and primary health care clinics. The studied injuries represent all nonfatal injuries for which treatment was sought in this region. Still, the study was limited to fourteen small and neighbouring municipalities, and did not have national coverage, which would have been an advantage. Conducting the study at the municipal level means that these findings cannot be interpreted as family, neighbourhood or individual associations between the socioeconomic and gender structures, and nonfatal injuries. We found it meaningful to use the municipal level, owing to the administrative and political importance of municipalities in Sweden. From a public health science perspective, it has been suggested that levels other than the individual are needed to gain knowledge of how social characteristics at a contextual level influence individual health [3, 14, 19]. This study is a contribution to such research.

The findings should be interpreted with caution since this is an ecological study, based on a small sample of agricultural municipalities and since many of the indicators are explored for the first time. However, the data set is unique and of importance since the number of injuries on which it is based is large and also covers injuries of different severity levels.

In conclusion this study found that components of the socioeconomic and gender structures were associated with the occurrence of nonfatal childhood injuries. The strength varied by sex, age, nature of the injury and type of component studied. Spatial studies on social determinants of childhood injuries should consider the local gender structure, the level of wealth and the level of income distribution, and not only the level of poverty. Our results also confirm the importance of separate analyses by age and sex for better understanding of potential contributors to injury risk for different age groups and genders.

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