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The effect of neighbourhood social capital on child injuries: A gender-stratified analysis



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ABSTRACT

We designed a longitudinal retrospective cohort study to analyse the associations between neighbourhood social capital and child injuries. Register data from the Umeå Simsam Lab in Sweden was used to measure child injuries and demographic and socioeconomic factors at individual, household and neighbourhood level. A social capital score from a previous survey was used to measure neighbourhood social capital. We conducted a three-level multilevel negative binomial regression analysis, with children (level 1, $N = 77,193$) nested within households (level 2, $N = 10,465$), and households nested within neighbourhoods (level 3, $N = 49$). The incidence rate of child injuries was lower in high social capital neighbourhoods. When controlling for factors at individual, household and neighbourhood levels, living in a high social capital neighbourhood was protective of injuries among girls, but not among boys. Promoting social capital in local neighbourhoods could be seen as a prevention strategy for injuries among girls.

1. Introduction

Differences in life chances and health between different social groups are dramatic and are seen worldwide, including Sweden (WHO and CSDH, 2008). The Swedish Commission for Equity in Health concludes that inequalities in death risks between different educational groups even seem to have increased during 1995–2010 (SOU 2017:47, *Statens offentliga utredningar The governments official investigations, 2017:47*). Health inequalities to a great extent can be explained by the social determinants of health, i.e. “the conditions in which people are born, grow, live, work and age” (WHO and CSDH, 2008, p. 26). Thus, health inequalities are a result of inequalities in access to resources – circumstances, conditions and environments – between different social groups (SOU 2017:47, *Statens offentliga utredningar The governments official investigations, 2017:47*), and are not inevitable but possible to be reduced through political choices.

Inequalities in access to resources start in early life, since children are affected by the amount of resources available to their parents and their living environments. Alarming, longitudinal studies show that children who start their life in unfavourable conditions are also at high risk of remaining in vulnerable positions throughout their lives (Mörk et al., 2014; WHO and CSDH, 2008). A systematic review of social

health inequalities in Swedish children found that children living in socially unfavourable circumstances also had an increased risk of early risk factors, physical health problems, mental health problems, injuries, and even mortality (Bremberg, 2002). Most of the studies reviewed used parent's socioeconomic position to differentiate children into different groups. On the contrary, Swedish studies on the influence of the living environment on child health inequalities are limited (Ivert, 2012). A review of studies using multilevel techniques to examine the effects of neighbourhood environment on child health outcomes in high-income countries (Sellström and Bremberg, 2006) found no studies from Sweden. This is despite strong evidence suggesting that children's neighbourhood conditions have important and life-long effects on their future well-being (WHO and CSDH, 2008; Minh et al., 2017). The importance of targeting housing and neighbourhood conditions for reducing health inequalities is underlined by the United Nations in the Sustainable Development Goals (United Nations, 2015a,b) and by the WHO (2018b) as well as by the Swedish Commission for Equity in Health (SOU 2017:47, *Statens offentliga utredningar The governments official investigations, 2017:47*).

There are reasons to believe that the living environment is particularly important for the health of children, since children spend more time in their local environment compared to adults. In addition,

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children in general have less individual resources compared to adults, which might make them more dependent on resources in their local environment. Sellström and Bremberg (2004) discuss the factors in the local environment that may influence children's health, and summarize these factors in three main areas: 1) *the socio-economic status* of the residential area, 2) *a good "social climate"* (such as lively civic associations, social cohesion, and access to social support), and 3) access to public and private services in the area. Macintyre et al. (2002) conclude that neighbourhood environments may influence health through the *material infrastructure* (e.g. safe playgrounds and recreations areas) as well as through the *collective social functioning* of the neighbourhood (e.g. culture and norms, community support and the reputation of an area). Further, researches propose that socioeconomic factors at the individual and area level interact to influence health. Stafford and Marmot (2003) in their study about neighbourhood deprivation and health based on the Whitehall II study, found support for the "collective resource model", i.e. that people living in more affluent areas have better health than people living in deprived areas due to more collective resources (both material and social) to draw on. Further, the positive health effects of these collective resources are greater for poorer people since they could be dependent on locally provided resources such as services, social support, and job opportunities. Consequently, investment in collective resources in local areas may reduce health inequalities between different social groups.

Social capital has become a widely used concept for studying place effects on health and is viewed as an attractive 'conceptual tool' for what constitutes 'health-enabling' living environments (Campbell and Gillies, 2001). The individual approach views social capital as "the ability of actors to secure benefits by virtue of membership in social networks or other social structures" (Portes, 1998, p.6) and does not evidently refer to the place and health debate. In contrast, the collective approach views social capital as something characterizing local areas by levels of social participation, trust and reciprocity norms (Kawachi and Berkman, 2000; Putnam, 1993, 2000; Szreter and Woolcock, 2004). This conceptualization clearly relates to the ideas of a place effect on health. Putnam (1993, p. 167) defines social capital as "features of social organizations, such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions". So far, Swedish research on social capital and health has been dominated by studies among adults, rather than children (e.g. Engström et al., 2008; Eriksson et al., 2011; Sundquist and Yang, 2007). A Dutch study (Drukker et al., 2003) found that children living in more socially affluent neighbourhoods in terms of socio-economic conditions and social capital had better self-rated health and quality of life compared to children living in more unfavourable areas. A comparative study between Canada and the Netherlands (Drukker et al., 2005) similarly found that children in both countries who lived in areas with low socio-economic deprivation and high levels of social capital, rated their health better than children living in socially deprived areas. Elgar et al. (2010) found that neighbourhood social capital reduced household socioeconomic differences in health among children in Canada – a result that support the collective resource model described by Stafford and Marmot (2003). A literature review (Vyncke et al., 2013) of studies conducted between 1990 and 2011 in Western countries (of which none from Sweden) similarly concluded that neighbourhood social capital can play a role in explaining inequalities in child health.

Studies based on adults from several countries, such as the US (Kim et al., 2006), UK (Snelgrove et al., 2009) the Netherlands (Mohnen et al., 2011), as well as Sweden (Engström et al., 2008; Eriksson et al., 2011; Sundquist and Yang, 2007) have found a positive effect on health from living in a high social capital area. However, studies from various contexts also indicate that these positive associations differ between population subgroups, not least between men and women. Stafford et al. (2005) studied gender differences in the link between neighbourhood environment and health in the UK and found that neighbourhood integration, trust and tolerance was positively associated

with good self-rated health among women but not among men. An association between living in a high social capital neighbourhood and good self-rated health for women but not for men was equally found in a study from Sweden (Eriksson et al., 2011). Likewise, Kavanagh et al. (2006), in their study from Australia, found that neighbourhood safety (an aspect of social capital) was protective for women's self-rated health but not for men's.

Neighbourhood social capital and neighbourhood deprivation are clearly context-bounded and their effects on health for different groups may therefore differ in various contexts. A recent systematic review of systematic reviews of social capital and health conclude that "evidence on how various aspects of SC affect different health outcomes for different actors remains unclear", (Ehsan et al., 2019). This makes it hard to draw context-specific conclusions and policy recommendations based on current research. There is an urgent need for Swedish studies assessing the neighbourhood effects on child health in general, and on the association between neighbourhood social capital and child health in particular. This current paper attempts to fill this gap of knowledge. Given what is known about differences in the associations between neighbourhood social capital and health between men and women in various contexts, a particular attention needs to be given to assess potential gender differences in the effect of neighbourhood social capital and health among children.

Despite the fact that Sweden has one of the lowest child injury death rates in the world (WHO/UNICEF, 2008), it is still a public health concern. Injury is the main cause of mortality and the most common cause of hospitalization for children in Sweden. Approximately 170,000 children (9% of all children, 0–17 years) annually seek emergency care due to injuries (The National Board of Health and Welfare, 2017). An association between family socioeconomic position and child injuries has been found in that children living in families with lower socioeconomic positions are more at risk (Räddningsverket Swedish Rescue Service Agency, SRSA, 2007; Laflamme, 2005). So far, little is known about the association between the living environment and child injuries in Sweden, and the need for studies investigating the role of housing and living conditions for inequalities in child injuries has been highlighted (Laflamme, 2005). Neighbourhood social capital constitutes a useful concept for studying how aspects of the living environment may help explain inequalities in child injuries.

The overall aim of this study was to analyse the associations between neighbourhood social capital and child injuries in the Northern Swedish context. In particular, we wanted to investigate the following research questions:

- Does the incidence rate of injuries among boys and girls vary between neighbourhoods with different levels of social capital?
- What is the association between neighbourhood social capital and injuries for boys and girls after controlling for individual, household and neighbourhood demographic and socio-economic conditions?

2. Methods and material

2.1. Study setting and population

This study was carried out in Umeå Municipality in Northern Sweden. Sweden has a population of approximately 10 million, and the country is divided into 290 local municipalities. Umeå municipality has a population of approximately 125,000 people (2017/2018) which places it as the 11th biggest municipality in the country. Further, Umeå is one of the fastest growing municipalities in Northern Sweden, thus having a strong influence on the whole region. The municipality hosts one of the largest universities in Sweden which influences the socio-demographic characteristics of the area with a comparably young population (average age of 38) and with a high educational level. The municipality encompasses both rural and urban areas, with rural villages of different sizes and urban neighbourhoods (Umeå Municipality,

2018a). Most urban neighbourhoods contain mixed settlements with both rental- and freehold apartments, and detached houses, although some neighbourhoods are dominated of either or. There are more than 40 municipal primary schools in the municipality, and schools are mainly chosen based on geographical proximity, since the policy is that no child should have more than 3 km to school (Umeå municipality, 2018b; 2018c). There are only a few private primary schools; hence, most children attend municipal primary schools (Umeå Municipality, 2018d).

2.2. Study design and main hypotheses

This study has a longitudinal retrospective cohort design. The cohort consisted of all children aged 0–12 years who lived in Umeå Municipality at any time during 2006–2010. On average, there were about 8000 boys and 7500 girls in this age group during each year. We limited our analysis to children aged 0–12 years old since we believe that younger children spend more time in their neighbourhood why this environment may be more important for younger children, as supported by others (Forrest and Kearns, 2001; Vyncke et al., 2013).

Our main hypothesis was that the risk of injuries among boys and girls would be lower in neighbourhoods where social capital is high. Given our conceptualization of neighbourhood social capital (see below), it is not unlikely that these neighbourhood characteristics could have an immediate impact on the likelihood of being injured, without any time delay. Our study, thus, relies on the assumption that neighbourhood social capital might have an immediate influence on the risk of child injuries.

2.3. Data sources

We utilized a combination of survey and register data from individuals living in Umeå Municipality during 2006–2010. Through a unique individual personal number generally used in Sweden, individual-level data from several sources were linked together. The Umeå SIMSAM Lab database contains a wide range of health and population register data, including geographical coordinates of where each individual lives, hence we could aggregate individual- and household-level data to neighbourhood-level data (Lindgren et al., 2016). We used neighbourhood social capital data from a survey conducted in Umeå municipality in 2006–2007 (see below). We limited our analysis to child injuries and sociodemographic and socioeconomic factors from the Umeå SIMSAM database from 2006 to 2010, to obtain a proper temporal relationship between the social capital survey and the other measures. We assumed that neighbourhood social capital is quite stable in the same neighbourhood over a five-year period, at least in areas with stable political and sociodemographic features as in Umeå Municipality. This assumption is supported by research stressing the importance of long traditions and history for social capital to develop (Putnam, 1993, 2000).

2.4. Definition of neighbourhood and measurement of neighbourhood social capital

Neighbourhoods were defined as the residential environment where children interact on a daily basis, i.e. where they go to school, play and use the services available in the area. This implies a specific geographical area with a locally used name and geographical borders. We utilized a residential subdivision that was used in a previously conducted social capital survey (Eriksson et al., 2011). This residential subdivision followed officially recognised neighbourhoods, as defined by the municipality as well as by people in general based on local knowledge (i.e. by defined neighbourhood and village names). The geographical borders of each neighbourhood was identified using maps of the municipal area. Postcode sectors in these geographical areas were

then identified and used to link survey responses to each neighbourhood (since we had information on postcode for each survey respondent). Since postcode sectors are small administrative units, several geographically close postcode sectors were merged to fit the geographical borders of the larger neighbourhood areas. In total, 49 geographic neighbourhood areas were identified (constructed out of 122 postcode sectors). Sixteen of these 49 neighbourhoods were described by the municipality as rural villages, while four were described as suburbs and 29 as urban neighbourhoods. The average number of populations in each neighbourhood was 2250 people, with median of 1978 people, 10th percentile of 729 people and 90th percentile of 4070 people. Overall, the rural villages had less population, and were characterised by a somewhat older population, lower educational level, higher employment rate, and more homogenous settlements (mainly detached houses).

The survey questionnaire was theoretically informed and designed to measure different forms of social capital. The following items were used to create an index for neighbourhood specific social capital.

- “Is it common in this neighbourhood that neighbours talk to each other?” (Yes, very common; Yes, rather common; No, rather uncommon; No, very uncommon; No opinion)
- “In my neighbourhood people are ready to help each other.” (About enough; Too much; Too little; No opinion)
- “In my neighbourhood one is expected to be involved in issues that concern this place.” (About enough; Too much; Too little; No opinion)
- “In my neighbourhood people care for each other.” (About enough; Too much; Too little; No opinion).
- “Did you vote in the 2006 election?” (Yes; No)
- “During the last 12 months, have you participated in any social events?” (Yes; No)
- “Do you feel that you can trust people in general?” (Yes; No)

Responses from 5900 survey participants were used to derive the neighbourhood social capital score for each of these neighbourhoods. The individual responses to these questions were recoded in the dataset so that low values signified low, and high values signified high on each specific neighbourhood social capital indicator. We conducted principal component analysis to reduce the dimension of these seven correlated questions into smaller number of uncorrelated components (Vyas and Kumaranayake, 2006; Fabrigar et al., 1999). We retained the first two components with an Eigen value greater than one and accounted for 48% of the total observed variance in the data. We used the cut-off of 0.3 or greater for factor loading to consider an item as relevant to each of the component. With this criterion, the first four items which reflects place-related collective social capital were considered to load very high in the first component; while the remaining three items loaded higher in the second component. We generated composite scores in continuous scale for each of the component. In the subsequent analyses, we used the first component as a proxy of neighbourhood social capital.

The individual-level composite scores were then aggregated to the neighbourhood-level and resulted in average composite score of neighbourhood social capital for each of the 49 neighbourhoods. Neighbourhoods with high composite score represent neighbourhood with high social capital, and vice versa. We ranked the 49 neighbourhoods based on their composite scores and divided them into three groups of neighbourhoods with low, medium and high social capital level. As the number of injuries were quite small in some of the neighbourhoods, we did not group the neighbourhood into quintiles, which is a common practice, to allow us to have sufficient power in detecting differences in the level of injuries between neighbourhoods with different levels of social capital. We also analysed the socio-demographic and socioeconomic characteristics of neighbourhoods with different levels of social capital.

2.5. Measurement of child injuries

To measure child injuries, we utilized data from the Injury database in the Umeå SIMSAM Lab, containing information from the injury register, maintained by the Emergency Department at Umeå University Hospital. This register collects data from patients who had visited the emergency care unit due to injuries (approximately 230,000 injury cases during 1993–2014). It covers 95% of all injuries needing emergency care in the region, since the University Hospital is the only emergency care hospital in the region. Data contains information about the type of injury and the location where the injury took place, and is based on a survey filled out by the patient or a relative when admitted to emergency care.

We used data from all injury events (any kind of injury) taking place in the *living environment (indoor and outdoor at home) and/or at school* for children aged 0–12 living in Umeå municipality during 2006–2010. The category “outdoor at home” included injuries that took place in playgrounds, walkways, courtyards and other unspecified places in the residential area, thus covering the broader living environment. We included injuries at school since most children in Umeå Municipality go to municipal schools located in their immediate local environment, which falls within the definition of neighbourhood in this study. Children exposed to injuries taking place elsewhere or injuries related to sport activities were not included in the analyses.

2.6. Measurement of sociodemographic variables on individual level

We controlled for two potential confounding factors at individual level; age and country of birth. We grouped the children into those 0–6 years old and 7–12 years old, since children’s “activity patterns” in the living environment, and thus their risk of injury, might differ with age. We also took into account whether children were born in Sweden or elsewhere.

2.7. Measurement of sociodemographic and socioeconomic variables at household level

In generating the household-level variables, we included all individuals who lived in Umeå Municipality during 2006–2010 (ranging from 111,221 in 2006 to 115,472 in 2010). Households were defined as individuals sharing the same family identification number in the Swedish population register, i.e. a maximum of two generations of people having a relationship with each other (through marriage, registered partnership, or as biological parent, adoptive parent or guardian) and being registered in the same property. Based on the available data, we constructed the following household-level variables to control for potential confounding at this level:

- Households with at least one adult with higher education (at least a three-year post-secondary education).
- Households with at least one adult born outside Sweden.
- Households with at least one adult receiving unemployment benefit during the last year.
- Households with a single parent.
- Equalized disposable household income, generated as weighted disposable household income (with a weight of 1 for household head, 0.5 for other adults and 0.3 for each child in the household).

This municipality-wide household data was later merged with the children aged 0–12 individual-level data; hence, we could characterize households where the children lived during 2006–2010.

2.8. Measurement of sociodemographic and socioeconomic variables on neighbourhood level

When constructing the sociodemographic and socioeconomic profiles of the 49 defined neighbourhoods, we included data from all households in each of the neighbourhoods, irrespective of whether the households had children aged 0–12 years. The household-level variables were later aggregated at neighbourhood level to derive neighbourhood-level variables, which included:

- Proportion of households in the neighbourhood with at least one adult with higher education.
- Proportion of households in the neighbourhood with at least one adult born outside Sweden.
- Proportion of households in the neighbourhood with at least one adult that had received unemployment benefit during the last year.
- Proportion of single-parent households in the neighbourhood.
- Median equalized disposable household income of all households in each neighbourhood.

2.9. Statistical analyses

First, we reported the total number of child injuries that occurred in the living environment in each year over the study period. We also identified how many unique children were injured and how many of them who experienced multiple injury events during the same year. Next, we estimated the incidence rate of all injury events per 1000 children among boys and girls in Umeå municipality during 2006–2010. As injury can be a repeated event in children, we estimated the total time for children with multiple injuries in the same year. In the next step, we estimated the incidence rate of all injury events per 1000 children in each year during 2006–2010 among all children who lived in neighbourhoods with different levels of social capital in Umeå Municipality. Then, we characterized neighbourhoods with different levels of social capital by their sociodemographic and socioeconomic profiles. To compare the characteristics across neighbourhoods with different level of social capital, we used Anova to test differences in the average proportion of neighbourhoods with a specific characteristic and Kruskal Wallis to test the distribution of equalised income. As three of the neighbourhood variables proved to be strongly correlated with neighbourhood social capital we excluded these variables from the further analyses in order not to induce collinearity in the regression analyses.

Finally, we analysed the association between neighbourhood social capital and child injuries for boys and girls, controlling for potential confounding factors at individual, household and neighbourhood levels. As our main unit of analysis was children, we linked the individual child data with data from the household and neighbourhood where they lived. We used multilevel negative binomial regression to estimate the count of injuries experienced by the children in the same year (Moghimbeigi et al., 2008). We used a three-level model, with children (level 1, N = 77,193 in 5 years) nested within households (level 2, N = 10,465), and households nested within neighbourhoods (level 3, N = 49). In the first model, we controlled for individual-level variables. In the next model, we controlled for individual- and household-level variables simultaneously. In the full model, we adjusted for individual, household, and neighbourhood-level variables. We did not include an offset in the models, since injuries were counted for the same 1-year period at a time for all the children.

Table 1
Injuries among children aged 0–12 years old in Umeå municipality during 2006–2010.

	2006	2007	2008	2009	2010
Children (n)	15,178	15,112	15,321	15,654	16,002
All types of injuries					
Children with injuries (n)	1516	1536	1549	1513	1621
Injury events (n)	1651	1685	1704	1658	1764
Injury events per child (n)					
1 injury event	1395	1400	1411	1383	1492
2 injury events	109	127	123	116	118
3 injury events	10	6	13	13	8
4 injury events	2	2	2	1	3
5 injury events	0	1	0	0	0
Proportion of injured children who experienced more than 1 event per year	8.0%	8.9%	8.9%	8.6%	8.0%
Injuries that occurred in the living environment					
Children with injuries (n)	1022	1059	975	977	1064
Injury events (n)	1088	1135	1035	1036	1120

3. Results

3.1. Descriptive statistics

During the five years of observation, a total of 8462 injury events were observed among 7735 unique children. Less than 10% of the children who had injuries experienced more than one event in the same year. Of all injury events, 5414 events (i.e. 64% of all injury events) among 5097 children occurred in the living environment. About 6–7% of all children experienced any injury in their living environment annually during the study period. See [Table 1](#) for numbers of children and injuries in each year.

The incidence of child injuries in the living environment for boys and girls during the study period is shown in [Table 2](#). During the five years of observation (2006–2010), the incidence of injury was consistently higher among boys compared to girls. The incidence for boys ranged between 74.0 and 84.5 per 1000 boys during the study period, while the corresponding numbers for girls ranged between 61.0 and 70.2 per 1000 girls.

The sociodemographic and socioeconomic characteristics of neighbourhoods with different levels of social capital are shown in [Table 3](#). On average, 25.5% of households across the neighbourhoods had at least one adult with higher education, 9.8% of the households had at least one adult born outside Sweden, 11.4% of the households had at least one adult who had received unemployment benefit and 6.8% of the households were single-parent households. There were no differences in the proportion of households with at least one adult with higher education and the proportion of single-parent households among neighbourhoods with a different level of social capital. However, neighbourhoods with a high-level of social capital had fewer households with at least one adult with a foreign background and who had

Table 2
Incidence of child injuries in the living environments by year and sex in Umeå Municipality.

Year	Boys			Girls		
	Person-time	Injury events (n)	Incidence rate (per 1000)	Person-time	Injury events (n)	Incidence rate (per 1000)
2006	7518	614	81.7	7134	474	66.4
2007	7432	628	84.5	7166	503	70.2
2008	7522	594	79.0	7228	441	61.0
2009	7679	568	74.0	7403	468	63.2
2010	7833	621	79.3	7576	499	65.9
Total	38,766	3025	78.0	37155	2385	64.2

received unemployment benefit. Further, the annual median household income across the neighbourhoods was 190,778 Swedish SEK (approximately 21,074 US dollars), and was considerably lower in neighbourhoods with low-level of neighbourhood social capital compared to those with high-level of neighbourhood social capital. Therefore, we did not include these variables as neighbourhood factors in the subsequent regression models in order to avoid problems with collinearity of these variables with neighbourhood social capital variable in the analysis.

3.2. Incidence of child injuries among boys and girls living in neighbourhoods with different levels of social capital

During the five years of observations (except for year 2008 among boys), the incidence rate of child injuries in the living environment was higher among boys and girls who lived in neighbourhoods with a low level of social capital compared to their counterparts who lived in high social capital neighbourhoods. Overall, the 5-year incidence rate of injury ranged from 74.4 per 1000 boys in high social capital neighbourhoods to 80.5 per 1000 boys in low social capital neighbourhoods. The corresponding numbers among girls ranged from 59.3 per 1000 girls in high social capital neighbourhoods to 70.1 per 1000 girls in low social capital neighbourhoods ([Fig. 1](#)).

As our data structure is nested, i.e. individuals within households within neighbourhoods, and, since we observed differences in incidence rate of injuries ([Fig. 1](#)) and some of the neighbourhood characteristics varied between neighbourhoods with different level of social capital ([Table 3](#)), we conducted multilevel analysis which resulted in fixed effects and random effects.

3.3. Variance of injuries within neighbourhoods and households - random effects

As shown in [Table 4](#), we observed a small variance partition coefficient (VPCs) at neighbourhood level (0.04% among boys and 0.06% among girls), indicating very small portions of the variance in the count of injury among children could be attributed to differences between neighbourhoods. The VPCs at household level were considerably larger (8% among boys and 11% among girls). The VPC at neighbourhood level in the model adjusting for individual, household and neighbourhood-level variables were considerably smaller compared to the model without any adjustment (See Model 1 in the [Supplementary Table 1](#) for boys and [Supplementary Table 2](#) for girl). These indicate some of the variables adjusted for explain part of the variation observed in the simpler model. The higher level-2 VPC for the households-within-neighbourhood levels indicated a larger proportion of the variance in the count of injury among children that can be attributed to differences between households. However, as shown in [Fig. 1](#), when grouping neighbourhoods based on their social capital levels, child injuries did cluster with lower incidence in high social capital neighbourhoods.

Table 3
Characteristics of neighbourhoods with different levels of social capital in 2006.

Neighbourhood characteristics	All	Neighbourhood level of social capital			Statistical test
		Low	Medium	High	
Proportion of households with at least one adult with higher education, % (SD*)	25.5 (7.1)	24.8 (7.8)	26.2 (7.9)	25.4 (5.7)	0.16 (0.855) #
Proportion of households with at least one adult born outside Sweden, % (SD*)	9.8 (4.8)	13.2 (5.3)	9.6 (3.9)	6.4 (1.9)	12.14 (< 0.001) #
Proportion of households with at least one adult that had received any unemployment benefit, % (SD*)	11.4 (2)	12.8 (2.0)	10.8 (1.3)	10.4 (1.8)	9.29 (< 0.001) #
Proportion of single-parent households, % (SD*)	6.8 (2.8)	6.1 (3.6)	7.5 (2.8)	6.8 (1.4)	1.03 (0.364) #
Equalized disposable household income of all households (median and interquartile range, SEK)	190,778 (172,559–199,318)	160, 235 (136,073–177,145)	193, 986 (185,682–199,731)	200,633 (192,121–210,292)	21.74 (< 0.001) ##

Note: * Standard Deviation, # F-test for Anova, ## X2 test for Kruskal Wallis.

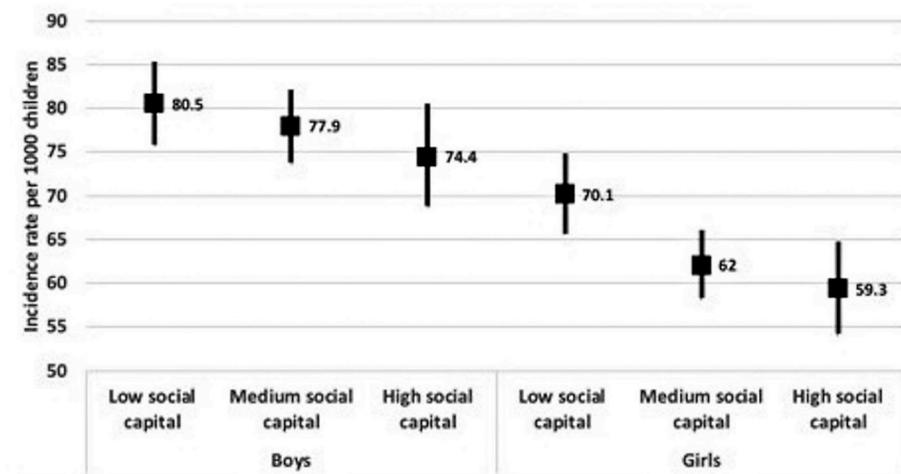


Fig. 1. Incidence rate of injuries among boys and girls 0–12 years old given per neighbourhood social capital level in Umeå Municipality during 2006–2010.

3.4. Associations between neighbourhood social capital and child injuries for boys and girls – fixed effects

As shown in Table 4, we observed an association between neighbourhood social capital and child injuries among girls, but not among boys. Living in a neighbourhood with high level of social capital was associated with a lower risk of injuries among girls (Incidence Rate Ratio/IRR 0.873; 95%CI 0.767; 0.994). The risk of injures was 13% lower for girls living in high social capital neighbourhoods compared to girls living in low social capital neighbourhoods. No protective effect of living in a high social capital neighbourhood was observed among boys after controlling for factors at all levels (IRR 0.961; 95%CI 0.861; 1.072). In addition, there was no protective effect as regards injuries for boys and girls who lived in neighbourhoods with a medium-level of social capital compared to their counterparts who lived in neighbourhoods with low social capital (p > 0.05).

In addition, Table 4 shows that boys aged 6–12 years were at lower risk of injury compared to younger boys aged 0–5 years with IRR of 0.891 (95%CI = 0.828–0.959). The same pattern was not observed among girls (p > 0.05). We also observed that girls who were not born in Sweden had an IRR of 0.718 (95%CI = 0.562–0.916), which implies a population average 28.5% reduction in the count of injuries compared to girls born in Sweden, after adjusting for other factors. Among both boys and girls, the risk of injury was lower if they lived in a household which had at least one adult with higher education compared to those with no adult with higher education (IRR 0.859, 95%CI 0.795; 0.928 among boys and IRR 0.869, 95%CI 0.794; 0.952 among girls), when adjusted for other individual, household, and neighbourhood-level

characteristics. The other household and neighbourhood-level characteristics were not associated with injuries in our models.

4. Discussion

4.1. Incidence of injuries in the living environment among boys and girls

The incidence of child injuries in the living environment ranged between 74.4 and 80.5 per 1000 for boys and between 59.3 and 70.1 per 1000 for girls. Our results likely underestimate the true prevalence of injuries, as many more, especially those with minor injuries, did not seek help or seek help from primary health care and hence do not exist the hospital-based injury database that we use in this study. The Swedish National Board of Health and Welfare (2017) reported that in 2016, a total of 149 per 1000 boys and 125 per 1000 girls aged 0–12 visited emergency care due to any injury. As the latter measures include all injuries, and not only those occurring in the living environment, our results correlate well with the national measures. Further, the same report states that one third of all injuries among Swedish children take place at home and approximately 12% occur outdoor in playgrounds, which also corresponds well to our findings.

Globally, injuries are more common among children growing up in families with low socioeconomic position (Laflamme, 2005; Räddningsverket Swedish Rescue Service Agency, SRSA, 2007; WHO/UNICEF, 2008; WHO, 2018a). Studies show that there are various socioeconomic factors related to child injury risks; including economic factors (income) as well as social (educational level) and family structure (single parent, etc.) (Towner et al., 2005). Our results did not

Table 4
Factors associated with injuries among boys and girls in Umeå Municipality in multi-level binomial regression model.

Variables	Boys IRR (CI 95%)	Girls IRR (CI 95%)
FIXED EFFECTS		
Neighbourhood social capital (Ref: Low)		
Medium	1.018 (0.930; 1.115)	0.934 (0.840; 1.040)
High	0.961 (0.861; 1.072)	0.873 (0.767;0.994)
Year of event (Ref: 2006)		
2007	1.064 (0.954; 1.187)	1.003 (0.882; 1.140)
2008	1.019 (0.913; 1.138)	0.983 (0.864; 1.119)
2009	0.960 (0.859; 1.073)	0.971 (0.853; 1.106)
2010	1.027 (0.920; 1.147)	1.014 (0.891; 1.154)
Individual level		
Age groups (Ref: 0–5 years)		
6–12 years	0.891 (0.828;0.959)	0.981 (0.899; 1.069)
Not born in Sweden (Ref: Swedish)	0.995 (0.800; 1.236)	0.718 (0.562;0.916)
Household level		
Households with at least one adult with higher education (Ref: No adult with higher education)	0.859 (0.795;0.928)	0.869 (0.794;0.952)
Households with at least one adult born outside Sweden (Ref: All adults were Swedish)	0.966 (0.868; 1.075)	1.018 (0.901; 1.150)
Households with at least one adult having received unemployment benefits (Ref: No adult received unemployment benefits)	1.028 (0.927; 1.140)	0.959 (0.849; 1.085)
Households with single parent (Ref: Not single parent households)	1.086 (0.975; 1.209)	1.067 (0.940; 1.211)
Equalized median household income	1.000 (1.000; 1.000)	1.000 (1.000; 1.000)
Neighbourhood level		
Proportion of households with at least one adult with higher education	1.002 (0.996; 1.007)	0.998 (0.991; 1.005)
Proportion of households with single parent	1.011 (0.995; 1.027)	1.008 (0.990; 1.027)
Constant (IRR)	0.147 (0.114; 0.189)	0.132 (0.099; 0.177)
RANDOM EFFECTS		
Neighbourhood variance (SE)	0.001 (0.003)	0.002 (0.005)
Household-level variance (SE)	0.286 (0.046)	0.407 (0.063)
VPC at neighbourhood level	0.04%	0.06%
VPC at household level	8.00%	11.00%
Overdispersion (SE)	5.334 (0.094)	7.016 (0.126)

Note: All the models were estimated using pql2 estimation methods in runmlwin command in Stata. IRR: Incidence Rate Ratio. VPC: Variance partition coefficient. SE: Standard Errors.

confirm an increased risk of injury among children living in household with low-income or single parents. However, children living in households with no adult with higher education had a 13–14% higher risk of injury compared to children living in households with at least one adult with higher education. One possible explanation for this pattern is that educational level is likely to influence parents' risk perception and safety practices (Soubhi et al., 2004). Reimers and Laflamme (2005), in their study of child injuries in Stockholm, found that injuries due to burns and poisoning were over-represented in areas with less well-educated people, and discuss the importance of parental level of awareness and consciousness.

In line with other studies (Mytton et al., 2009; Soubhi et al., 2004; Vafaei et al., 2015; WHO/UNICEF, 2008) our results reveal differences in injury risk between boys and girls, with boys being more at risk. National figures from Sweden show that boys (0–17 years) are over-represented in emergency care, hospitalization as well as deaths due to injuries compared to girls (The National Board of Health and Welfare, 2015). Studies have found how children's play patterns tend to be gendered, with e.g. rough-and-tumble play being more typical of boys than of girls in many cultural settings. In addition, boys tend to play farther away from home, outdoors, and away from direct adult supervision (Edwards et al., 2001). These gendered play patterns might be one explanation for boys being more at risk of injury compared to girls, at least for the age group of focus in our study. Studies also propose that boys are expected to engage more in risk-taking and exploration of their surroundings compared to girls (Morrongiello et al., 2010). Thus, different expectations of how boys and girls should behave in public spaces such as the neighbourhood could make boys more at risk of being injured. A study of gender differences in children's risk appraisals (Hillier and Morrongiello, 1998) further found boys to rate injury risk lower than girls, thus potentially influencing a higher risk-taking behaviour among boys compared to girls.

4.2. Clustering of injuries at neighbourhood level and the association between neighbourhood social capital and child injuries

Less than 1% of the variance in child injuries were due to differences between neighbourhoods, while around 8% of injuries among boys and approximately 11% of injuries among girls could be explained by factors at household level. This is not unexpected, given the strong relation between child injuries and family socioeconomic position found in many studies globally (Laflamme, 2005; Mytton et al., 2009; Soubhi et al., 2004; WHO/UNICEF, 2008). A review of the effects of neighbourhood factors on child and adolescent outcomes from the USA similarly found neighbourhood effects to be small to moderate (Leventhal and Brooks-Gunn, 2000). However, our study still supports the hypothesis on the contextual influences on child injuries, since child incidence of injuries differed across neighbourhoods based on their social capital levels, with a lower incidence of injuries in high social capital neighbourhoods. Eriksson et al. (2012) used data from the Swedish Health Behaviour in School-aged Children survey to investigate the importance of family, school and neighbourhood social capital for health complaints and well-being. Similarly to our results, they (Eriksson et al., 2012) found the strongest association between family context and health, but also that social capital in all contexts mattered and that contributions from each context seemed to be additive.

Social capital is used as a conceptual tool for exploring how psychosocial factors, such as the social climate in a neighbourhood may explain health inequalities, in addition to (or beyond) behavioural factors and material factors (e.g. physical environment and exposure to hazardous environments). In line with other studies (Sellström and Bremberg, 2004; Macintyre et al., 2002), our results support that the neighbourhood environment may influence health through the social climate. The incidence rate of child injuries were lower in neighbourhoods high in social capital, i.e. in neighbourhoods where neighbours talk to each other, are willing to help each other, care for each other

and where one is expected to be involved in local issues. For girls, this association remained after controlling for factors at the individual, household, and neighbourhood levels. A study based on data from Stockholm County similarly found that the risk of traffic injuries was higher in areas characterised by low social integration (Reimers and Laflamme, 2005).

Several pathways between place-specific social capital and health have been proposed, such as collective socialisation, informal social control and collective efficacy (Kawachi et al., 2008). The “collective resource model” described by Stafford and Marmot (2003), could also be used as an explanation; i.e. areas high in social capital generate more collective social resources, such as services, job opportunities and social support, which may have positive influences on people's health. Eriksson and Emmelin (2016) additionally discuss the effects of social influence and social control as possible pathways. A place high in social capital is believed to enable social influence and social control amongst people, which in turn may impact on the (health-related) behaviours of the population in the area. As social human beings, we behave in the same way as we see others behaving. Social control implies (among other things) “knowing thy neighbour”, and thus looking after each other. A neighbourhood with strong helping out norms and where social interactions and social control is high, may result in high level of “collective responsibility” for children's safety (Soubhi et al., 2004). Vafaei et al. (2015) similarly discuss the link between neighbourhood social capital and child injuries in terms of health risk behaviours and community resources: “A main pathway that links social capital and injuries, conceptually, is health risk behaviours. Community (school or neighbourhood) resources affiliated with higher levels of social capital include improved levels of health literacy, safer norms and attitudes, and increased political support for social and public health reforms, all of which may play a preventive role in injury-related health behaviours” (Vafaei et al., 2015, p. 389). Further, Leventhal and Brooks-Gunn (2000) propose three specific mechanisms through which neighbourhoods might influence children and youth: (i) availability of institutional resources such as social and recreational activities, (ii) characteristics of existing social relations such as social support, and (iii) norms and collective efficacy. With regards to norms, they specifically bring up the importance of shared values of mutual trust, safety and the willingness to intervene for the common good.

4.3. The gendered effect of neighbourhood social capital on child injuries

It is hard to find any reasonable explanations for why social interactions, care and support in a neighbourhood should be less important and protective for boys than girls. Previous studies, based on adults, about the association between neighbourhood social capital and health from Sweden (Eriksson et al., 2011) the UK (Stafford et al., 2005) and Australia (Kavanagh et al., 2006) have similarly found a gendered pattern in that living in high social capital neighbourhoods increased the odds of good self-rated health for women but not for men. Eriksson et al. (2011) discussed how these results could possibly be explained by gendered expectations on women to spend more time in the neighbourhood (due to expectations to be mainly responsible in the domestic sphere), thus also being more influenced by that environment. Another possible explanation to these gender differences could be linked to the interactions between neighbourhood- and individual factors. According to the collective resource model (Stafford and Marmot, 2003), people with less resources are more dependent, and might thus benefit more from living in areas with more collective resources (e.g. social capital). In most countries, including Sweden, women in general have less economic resources (lower income) than men (Almqvist, 2016). The beneficial (health) effects of living in areas with more collective resources might therefore be greater for women than men since women in general may be more dependent on these collective resources.

It is not self-evident that the same explanations are valid in this current study of children. Rather, we believe that the gendered results

in this study are due to different expectations on girls and boys with regards to risk-taking behaviour, as well as collective norms and perceptions about and boy's and girl's vulnerability in public spaces. A study of differences in children's risk-taking behaviour and injuries found that parents had a greater expectation of risky play behaviour by sons than daughters even for children as young as 2 years of age (Morrongiello et al., 2010). These gendered expectations on boys to behave in a riskier way may be valid also on a collective level such as in a neighbourhood, which might result in less attention (and protection) given to boys compared to girls, despite the existence of helping out norms. Qualitative research have also found how girls more than boys describe parents as being protective and looking out for them in public spaces (Morrow, 2006). It is likely that the perception of girls being more vulnerable in public spaces is valid also on a collective, neighbourhood level, resulting in more protection of girls even in high social capital areas. Similar to our results, Vafaei et al. (2015) found a gendered effect of place-specific social capital on child injuries in their study from Canada. However, contrary to our study, Vafaei et al. (2015) found a protective effect for girls living in low social capital areas. They Vafaei et al. (2015) discuss how possible lower perceived levels of safety in low social capital areas might cause girls to stay at home, thus limiting the risk of injuries. Other studies confirm higher levels of perceived safety in neighbourhood where people care for and look after each other (Baum et al., 2009; Ziersch et al., 2005). However, how lower levels of safety influence children's behaviour and outdoor activities probably differ by context.

Clearly, neighbourhood social capital might operate differently for different social groups and in different cultural contexts, as also concluded by Ehsan et al. (2019). These diverse mechanisms need to be considered if social capital is to be used for health-promoting and injury prevention purposes. Qualitative studies can give valuable insights into the “how” and “why” questions about the links between social capital and health, including child injuries. Our ongoing qualitative study about children's perspectives on health promoting living environments (forthcoming), might shed further light on how and why the social climate in a neighbourhood may have different health effects for boys and girls.

4.4. Methodological strengths and limitations

A major strength of this study is the longitudinal retrospective cohort design with individual level data on child injuries as well as sociodemographic and socioeconomic factors at an individual, household and neighbourhood level, enriched by survey data of high-quality measuring neighbourhood social capital. The study is only possible due to the personal identification number of every person in Sweden, including links between children and their parents, as well as geographical coordinates for every person's place of living. The large number of injuries over the five-year study period contributes to adequate statistical power to confidently respond to our research questions. The possibility to control for individual, household and neighbourhood-level factors in the same year as when injuries happened ensures that we control for some potential confounders of injuries among children, yet of course the residual confounding cannot be excluded. Also, the longitudinal nature of the data allows us to estimate the follow-up time for each individual, and hence, the incidence rate, more precisely. Using a validated and context specific construct to measure neighbourhood social capital, in combination with register data to measure the health outcome is another strength in our study that avoided the risk for same-source bias (Diez-Roux, 2007).

The results in this study need to be interpreted carefully in light of the following limitations. In the Swedish population registers to which we had access, it is not possible to identify unmarried couples that live together as a family, possibly with children, but without a common child. Statistics Sweden estimates that there are about 500,000 people in Sweden who are cohabiting but cannot be categorised as a family in

the database. Nor is information on children's risk behaviours and parents' risk perceptions of injury available; hence, it was not possible to control for this. More so, we lacked data on child comorbidity which is a potential confounder in this study. It is likely that medical conditions (such as e.g. severe asthma) influence children's activity patterns and thus injury risk. Also, exploration into different types of injury and their causes might give more insight into the mechanisms on how social climate influences child injuries, which could be explored in future studies.

In this study, we focused on child injuries among boys and girls in the ages of 0–12 years, while most Swedish national figures on child injuries are based on data from children 0–17 years. Injury patterns in younger children differ from injuries among teenagers in many ways. One major difference is that non-accidental injuries are much more common among teenagers (i.e. 13+) compared to children 0–12 years (The National Board of Health and Welfare, 2015). Furthermore, there are gender differences in non-accidental injuries, with injuries due to violence being somewhat more common among boys and self-inflicted injuries being much more common among girls (The National Board of Health and Welfare, 2015). It is important to note that we could not detect any potential gender differences in non-accidental injuries due to our selected age group. Among children 0–12 years in our study, there were only 38 cases (i.e. less than 0.5%) of non-accidental injuries (i.e. violence related injuries and self-inflicted injuries) during the whole period 2006–2010, of which only one with self-inflicted injury. These figures would probably have looked very different should we have included teenagers (13–17 years old) in our data.

In this study, we did not specifically address the question whether neighbourhood social capital has a mediating or moderating role between socio-economic deprivation and child health (injury). Thus we cannot answer whether a possible relation between neighbourhood socio-economic deprivation and child health injuries can be explained by low level of social capital. Neither can we answer if social capital is especially beneficial (protective) in more socio-economically deprived neighbourhoods, or the reverse, social capital may reinforce the positive effects of living in a socio-economically affluent neighbourhood. However, we did test the correlation between neighbourhood social capital and different neighbourhood socioeconomic indicators. Interestingly, we found that some indicators (income and unemployment benefit) were correlated with neighbourhood social capital, while others (educational level) were not. This indicates a complex interaction between neighbourhood SES and neighbourhood social capital in our research setting, which requires more detailed analyses in further studies.

5. Conclusions

Neighbourhood social capital was found to be protective of child injuries among girls, while not for boys. This means that in a neighbourhood where neighbours talk to each other, help and support each other and where one is expected to be involved, girls are less likely to be injured. This could be understood as such a climate making people act in a way that is protective of girls, thus preventing injuries happening to girls. Facilitating social capital in local neighbourhoods could be seen as a prevention strategy for child injuries. The lack of protective effect for boys might possibly be explained by gendered expectations on boys to engage more in risk-taking and a lack of protectiveness of these expected behaviours, but this needs further exploration to be properly understood.

Declarations of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.healthplace.2019.102205>.

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