

Neighborhood Influences on Child Injury Risk¹

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Comment on This Article

Abstract

Childhood injuries are the leading cause of mortality and morbidity in developed nations, and there are wide disparities between children from rich and poor backgrounds. Recent developments in regression modeling have enabled researchers to begin disentangling influences at the child, the household, the local neighborhood and the larger area levels, all of which contribute to determining and maintaining these social inequalities in childhood injury.

We describe recent research on neighborhood influences on injury risk with a focus on children, and provide a detailed critique of the three large population-based studies carried out by our groups in the UK and U.S. These studies demonstrate that residence in neighborhoods characterized by high levels of poverty and poor quality housing is associated with an elevated risk of child injuries independent of any risks attributable to individual household characteristics.

Future work in this area will need to collect more detailed household socioeconomic data and improve the characterization of neighborhoods. Despite these deficiencies, there is sufficient evidence to support neighborhood interventions to reduce child injury risk. These include improvements in housing quality, community development, neighborhood-based approaches to changing social and cultural behavior and attitudes of adults and children, and greater social heterogeneity in neighborhoods. These would reduce, but not replace, the need to narrow the social and economic disparities between rich and poor if we are to reduce inequalities in child injury.

Keywords: *injuries, neighborhood effects, inequality*

Introduction

Injury is one of the most common causes of death, serious morbidity and acquired disability in childhood. A recent estimate of the burden of mortality and disability in Europe, for example, suggested that around 20 percent of both deaths and loss of disability-adjusted life years among 0-19 year-olds were caused by injuries (Valent et al. 2004). If only children over the age of one year are considered, around 40 percent of deaths and perhaps 30 percent of acquired disability is related to injuries (UNICEF 2001). Equivalent and equally concerning figures are available for the U.S., where more lives of people aged 1-34 years are lost to injury than all other causes combined (Segui-Gomez and MacKenzie 2003). These headline figures represent the most severe end of the spectrum; for every death, it has been estimated there may be 45 hospital episodes, over 600 doctor consultations and 5000 – 6000 minor injuries (BMA 2001).

It is self evident that the environment influences injury risk; injury is the result of a collision (either literally or metaphorically) between the child and their environment (Haddon 1980). The environment in this context is not just the physical environment, but also includes the social circumstances in which the child lives.

Scholarly understanding of the social influences on childhood injury risk is relatively unsophisticated. We know about some of the general epidemiological associations such as that between social deprivation and increased risk, but we do not know how these operate. This paper describes an expanding sphere of work which examines the influences of neighborhood characteristics on childhood injury risk. This is of interest for three reasons. First, there is a much larger body of research which shows that neighborhood and area-based factors—so-called ecological or neighborhood effects—influence many aspects of health from infancy through old age. Second, the policies of many governments of developed countries for tackling poverty and related health problems target deprived areas and neighborhoods in addition to (and in some cases rather than) being directed at alleviating family poverty. Third, sophisticated statistical modeling techniques have recently been developed which allow a parceling out of influences at different levels of aggregation—often called multilevel modeling.

In this paper we focus mainly on studies of unintentional injuries from Europe and North America, although we acknowledge that the overall burden of childhood injury falls disproportionately on less developed countries. Moreover, the definition and ascertainment of childhood injury, and the distinction between intentional and unintentional injury, is a subject of considerable theoretical debate and empirical difficulty (see, for example, Stewart-Brown et al. 1986; Walsh and Jarvis 1992; Overpeck and McLoughlin 1999; Cohen et al. 2003). Studies which use hospital admissions or attendances may be biased as social factors influence access to health care and whether or not children are admitted to the hospital. The difficulties of determining intent have implications for policy, as the priorities for and approaches to preventing intentional injury will not be the same as those for unintentional injury. These caveats need to be borne in mind in interpreting the studies we describe below.

Social Inequalities in Childhood Injury: Household or Neighborhood Risks?

In developed countries, the outcomes of death and disability from childhood injury generally seem to be slowly improving, but inequalities between children from rich and poor backgrounds are widening (Roberts and Power 1996; Scholer et al. 1999). There is a social gradient in most types and causes of injury in childhood; this is particularly steep for certain causes such as house fires and pedestrian injuries (Roberts 1997). There is no doubt that some of this gradient is related to the social circumstances and risk factors associated with family poverty (see, for example, Agran et al. 1998; Delgado et al. 2002; Engstrom et al. 2002). However, much of the evidence on social inequalities in injury risk comes from ecological studies which compare injury rates between rich and poor areas rather than between rich and poor families (for examples from different countries see Jolly et al. 1993; Faelker et al. 2000; Pomerantz et al. 2001; Hippisley-Cox et al. 2002). It is assumed that differences between areas reflect the characteristics of families that live there. In other words, the higher rates of childhood injury in deprived areas are thought to be due to elevated risks in poor families. These have been described as compositional factors because they relate to the composition of the inhabitants of areas.

Inevitably, the question arises whether these studies are observing differences in the risk of injury related to the area itself, rather than the inhabitants. These area characteristics are called contextual factors and theoretically affect the whole neighborhood regardless of the social circumstances of individual inhabitants. They are particularly relevant in the case of unintentional injuries if only for the simple reason that these occur in a *place* as well as to a *person*.

Possible types of risk factors and the levels at which they operate are described in Table 1. Although these risk factors may operate independently of each other, more often than not they are likely to interact. Thus, for example, access to safe play facilities in a neighborhood may have more of an effect on poor families as they may not have a car and the resources to transport their children elsewhere to find safe play.

Table 1. Risk factors which might underlie social inequalities in childhood injury and the level at which they operate

Household	Local neighborhood	Larger area such as district, city, and state ¹⁴
Family income / poverty ¹ Provision of household safety features eg smoke alarms ² Parental educational status ³ Number of adults in household / lone parents	Housing characteristics ⁸ Factors related to school such as sports activities, facilities and extra-curricular activities ⁹ Access to day care ¹⁰ Road traffic hazards ¹¹	Injury prevention policies ¹⁵ Family support programs (especially for preschool children) ¹⁶ Traffic legislation eg on cycle helmets, speed limits ¹⁷

<p>4</p> <p>Number of children in family / crowding ⁵</p> <p>Parenting abilities and experience ⁶</p> <p>Parent or caretakers use of alcohol, drugs and smoking ⁷</p> <p>Upkeep of the house in terms of maintenance and safety</p>	<p>Local access to unprotected hazardous sites eg building site</p> <p>Playground facilities ¹²</p> <p>Neighborhood attitudes to supervision and safety</p> <p>Local children's culture, activities and peer relations</p> <p>Level of social and community cohesiveness¹³</p>	<p>Transport policy ¹⁸</p> <p>Policies and programs to combat poverty ¹⁹</p> <p>Building regulations</p> <p>Policies on sale of alcohol to young people</p> <p>Risks associated with climate eg swimming pools, heating requirements</p>
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Notes: This table is indicative and the references are not systematic but a guide to further reading.

1. Many studies but see especially Durkin et al. 1994; Roberts and Power 1996; Agran et al. 1998; Engstrom et al. 2002.
2. See Mallonee et al 1996, although DiGuseppi et al. 2002 show they may not be effective
3. Agran et al. 1998; Delgado et al. 2002
4. Wadsworth et al. 1983; Haynes et al. 2003
5. Many studies but see Agran et al. 1998; Reading et al. 1999; Delgado et al. 2002; Haynes et al 2003
6. Carter and Jones 1993; Scholer et al. 1997; Soubhi et al. 2004
7. Bijur et al. 1992
8. Alwash and McCarthy 1988; Shenassa et al. 2004
9. Grimmer et al. 2000
10. Poor evidence; see for example Zoritch et al. 2000; Toroyan et al. 2003
11. Meuller et al. 1990
12. Sibert et al. 1999
13. Soubhi et al. 2004
14. For an overview of international differences in injury rates see for example UNICEF 2001 and Peden et al. 2004
15. Guyer et al. 1989; Farley et al. 2003; Sellstrom 2003
16. Roberts and Pless 1995; Roberts et al. 1996
17. Parkin et al. 2003
18. Roberts and Crombie 1995; Stevenson et al. 1996; DiGuseppi et al. 1997; DiGuseppi et al. 1998
19. Roberts and Pless 1995

The influences acting at the level of local neighborhoods include aspects of the physical environment such as quality of the housing stock, road safety features and the access to hazardous sites, but are not restricted to this. They may also reflect socially- and culturally-determined attitudes and practices such as those relating to supervision, independence and appropriate play activities for children. Adverse contextual conditions are often associated with concentrations of poverty, although there is no *a priori* reason why they need to be.

Defining neighborhoods is not straightforward because it is partly subjective and the scale at which the neighborhood factors listed in Table 1 operate may vary. The boundaries between different cultural influences are particularly difficult to define. At the higher levels of aggregation there is abundant evidence of systematic variations between states and countries (see, for example, UNICEF 2001) which presumably reflect differences in policy and legislation. Evidence of variations between cities and large districts is sparse but there is some work showing lower rates of preschool childhood injury in cities that have implemented safety interventions (Sellstrom et al. 2003).

Multilevel Modeling

Disentangling the effect of neighborhood and household factors on injury risk requires an innovative analytic approach. Multilevel modeling is a type of regression which allows the effects of explanatory variables operating at different levels of aggregation to be measured in the same model. In conventional regression the individual data points are all assumed to vary independently of each other. Consequently, this method is not able to cope with observations that may be correlated in clusters or groups (such as the injury events occurring in neighborhoods in a data set covering a wide area). Thus with this method we can model the effects of individual characteristics on the risk of injury to individual children or the effect of collective characteristics on injury rates in groups of children, but not both.

Multilevel models overcome these problems by enabling variance at different levels to be accounted for in the same regression model (Goldstein 1995; Duncan et al. 1998; O'Campo 2003). This means that effects which operate at different levels, say for example at the level of individuals, at small neighborhoods, and at larger aggregated areas, can be distinguished statistically, enabling us to identify specific neighborhood effects and characteristics which have an influence on injury risk independent of effects which operate at other levels. The range of opportunities and the potential pitfalls and drawbacks of multilevel modeling have been well-described in the articles by Duncan et al. (1998) and O'Campo (2003).

Neighborhood Influences on Childhood Injury

Despite the recent proliferation of multilevel studies on health outcomes, a relatively small number have considered injuries. This is surprising considering the obvious environmental contribution to injury causation. The effect of place is arguably more direct and obvious than in many other health outcomes that have been studied such as heart disease, smoking behavior, long-standing illness, etc.

Three published studies have used multilevel modeling to investigate risk factors for injuries to adults in the U.S. and Spain (Cubbin et al. 2000; Borrell et al. 2003; Ferrando et al. 2005). Each detected both individual and place effects on injury risk, with personal influences the stronger of the two. The place characteristics which had an effect on mortality were mainly those reflecting socioeconomic circumstances. However, the relevance of these large adult studies to injury risk in children and young people is unclear as there are differences in the mechanisms of injury between adults and children.

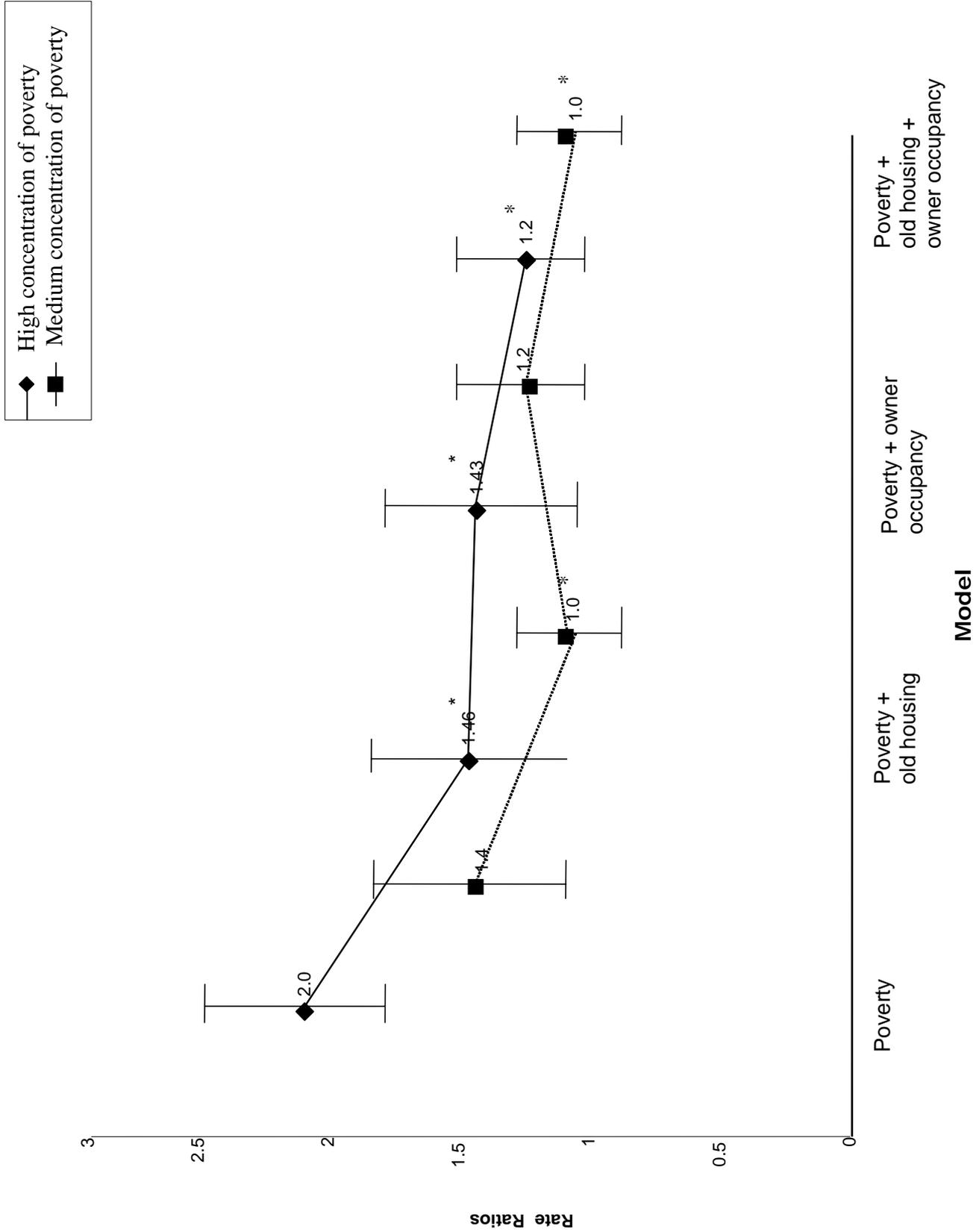
Below, we describe the four studies—two from the U.S. and two from the UK—that have investigated socioeconomic risk factors associated with childhood injury using multilevel modeling methods. In addition, we comment on a Canadian study which compares individual, household and neighborhood predictors of childhood injury using standard logistic regression.

One multilevel study from Baltimore in the U.S. (O'Campo et al. 2000) was on a small number of families with children aged 1 to 4 years (N=288) and used minor injury producing events (for example, falling down stairs, nearly being hit by a vehicle, etc.) as outcomes. A larger U.S. study from Illinois (Shenassa et al. 2004) used ten years of hospital discharges for burns and fall injuries in children 6 years of age or younger and produced data on 11,735 children. Two studies from Norwich, UK used attendances for injury at hospital accident and emergency departments (equivalent to an emergency room in the U.S.); one on children aged 0 to 4 years described data on 3,851 children (Reading et al. 1999), and a second on children aged 5-14 years from 3,526 children (Haynes et al. 2003).

The two U.S. studies (O'Campo et al. 2000; Shenassa et al. 2004) showed individual and family influences on injuries and also independent effects at the neighborhood level. In the study by O'Campo et al., the neighborhood characteristics were defined by census tracts—i.e., areas with an average of approximately 1500 households. Shenassa et al. used ZIP codes to define neighborhoods which resulted in an average of around 3500 households per neighborhood for Illinois in 1990. Both studies identified the important mediating effect of neighborhood housing conditions. The study from Baltimore was limited by small numbers but showed that the strongest explanatory variable at the neighborhood level was the number of housing violations, a direct measure of housing conditions. This was independent of other individual factors and had a stronger effect than either neighborhood average income or neighborhood crime rate, neither of which contributed significantly to the model for predicting injury-producing events.

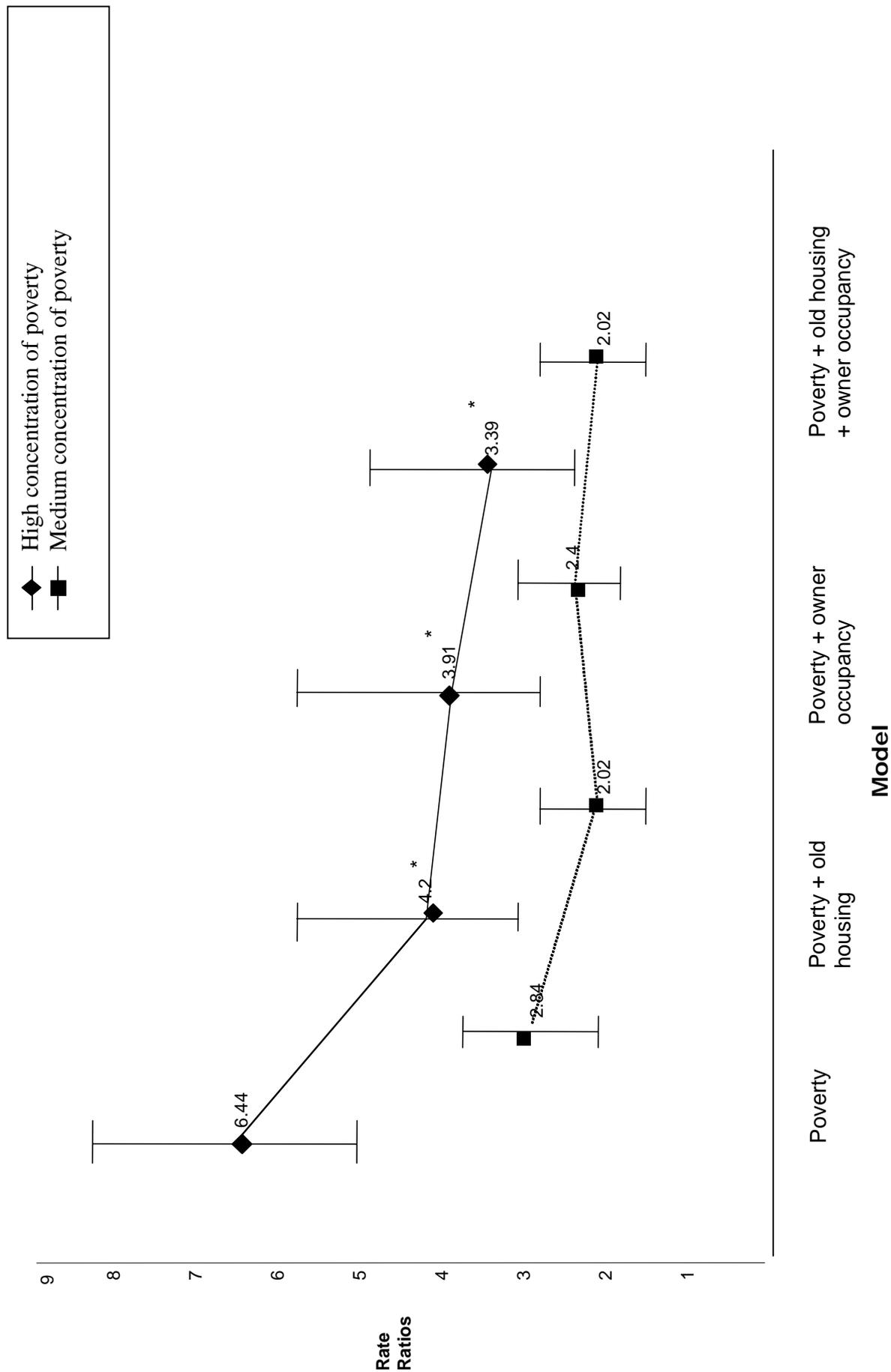
The study from Illinois carried out a more detailed statistical analysis. Two measures of housing quality—percentage of housing built before 1950 and percentage of owner-occupants—both contributed to explaining injury admissions, in addition to neighborhood concentration of poverty and neighborhood proportion of minority residents. More importantly, the study showed that the association between neighborhood poverty and injury rates was mediated by housing variables. Thus, when housing variables were added into the model, the effect of the poverty and minority variables to explain injury rates were significantly reduced (see Figure 1). The mediation of the link between neighborhood characteristics and childhood injury needs to be replicated in more detailed studies, because, if confirmed, it suggests a possible means of intervention to reduce social disparities in injury. We shall return to this point later in the paper.

Figure 1a. Sequential multilevel models for falls (Shenassa et al. 2004)



* The estimate is significantly different from that of the crude model.

Figure 1b. Sequential multilevel models for burns (Shenassa et al. 2004)



* The estimate is significantly different from that of the crude model.

The two UK studies from Norwich (Reading et al. 1999; Haynes et al. 2003) gave broadly comparable results to the U.S. studies. The neighborhoods in the UK studies were socially homogeneous aggregations of census enumeration districts (average size 150 households) to produce areas of around 2500 households. As with the other studies, neighborhood social characteristics contributed to the model independently of the individual variables. A variety of neighborhood factors were tested in these models including a measure of neighborhood deprivation (the Townsend deprivation score (Townsend et al. 1988)), housing characteristics, percentage of lone parent households, variables reflecting concentrations of poverty, measures of social cohesion within neighborhoods, measures of the population structure in neighborhoods, and a measure of access to safe play amenities. Neighborhood deprivation was associated with significantly increased odds of injury for both preschool and school-age groups of children, despite their differences in mechanisms and types of injury. Several of the other neighborhood measures were associated with injury risk—for example, the concentration of local authority housing—but they varied collinearly with the deprivation score and none of them contributed independently to the final multilevel model. However, this does raise the question of what exactly is being measured by a deprivation score. It is probably a surrogate measure for a combination of the factors identified in Table 1.

The final study we review is a large national study from Canada in which individual, household and neighborhood predictors of child injury were examined using standard logistic regression (Soubhi et al. 2004). Although this method gives an inaccurate estimation of the strength of neighborhood effects, we have included the study because it explores the risk factors at different levels in greater detail than other studies. Around 9,000 families were studied with children at different ages. Individual child predictors included measures of temperament and behavior; household measures included various indicators of socioeconomic status as well as parenting style and family functioning; neighborhoods were characterized by measures of deprivation, problems and social cohesion. The neighborhoods used were small in comparison to other studies, consisting of a few hundred households each. Neighborhood characteristics did contribute to injury risk although different characteristics seemed to operate at different ages. In children aged less than four years, neighborhood problems and poverty levels increased the risk of injury and social cohesion reduced the risk; in older children aged 4 to 11 years, neighborhood poverty also increased the risk. An unexpected finding was that neighborhoods with a higher proportion of households headed by a single female appeared to confer a degree of protection—a finding which has not been found in any other study. The weakness of this study is that the apparent neighborhood effects may in fact be proxies for household-level factors.

What Is a Neighborhood? The Effect of Scale

The many studies on area-level effects on child health have generally defined areas using administrative areas such as census tracts or larger areas such as counties in the U.S., and census wards and larger local authority districts in the UK. The reason for this is that data are available and published for these areas, usually by whichever national organization publishes census information. However, this presupposes that these census areas have some validity as neighborhoods. After all, there is no particular reason why the boundaries of real life neighborhoods should coincide with the arbitrary census boundaries.

Neighborhoods have different meanings to different people, and any contextual influences on health outcomes such as injury may operate at a larger or smaller scale than the areas we use for convenience in these analyses.

The consequences of this are that we may either underestimate contextual neighborhood influences, or alternatively, the neighborhood effects we identify may simply be an artifact of the way we draw the boundaries. This is a variation of a well-described methodological problem in spatial geography called the "modifiable area unit problem" (Openshaw 1984). In brief, this states that as there is a potentially infinite number of ways of defining boundaries of areas (or neighborhoods), then any relationship between variables at an ecological level is theoretically possible depending on the number of areas chosen and the way boundaries are drawn. At its extreme, this leads to a nihilistic attitude towards any attempt at disentangling area based influence; however, the problem disappears if the boundaries between areas are defined by changes in physical conditions or social circumstances directly bearing on the topic of study, rather than by administrative convenience or chance.

We have carried out some exploratory work on this issue with respect to childhood injuries (Haynes et al. 1999). In the UK until recently, the most basic census area consisted of around 150-200 households, and these were built up into census wards with around 1500 households. The boundaries of wards are drawn for electoral and administrative convenience and not necessarily to reflect socially cohesive communities. We defined alternative areas of similar size as wards but with more homogeneous characteristics in terms of population structure and concentration of poverty. There was a much tighter ecological relationship between social characteristics and childhood injuries at the level of these alternative areas than at the level of wards. Our subsequent multilevel modeling studies used these areas as our basic neighborhood units (Reading et al. 1999; Haynes et al. 2003). We were able to show that contextual area effects operated at the level of these larger areas rather than at the level of the much smaller basic census areas. Since 2003, UK census information has been made available in a hierarchy of homogeneous small area building blocks, which will make similar work much easier in the future (Cockings and Martin 2005).

This work only scratches the surface. There is no way of knowing whether the areas we used identified communities even though they were socially homogeneous. A study from Canada contradicts our findings by showing that defining homogeneous "natural" neighborhoods has no advantages over using standard census areas in measuring neighborhood effects on health (Ross et al. 2004). Much more work is required on the way neighborhoods are defined. This includes the effects of different scales and whether there are hierarchies or overlapping sets of neighborhoods all exerting effects. Theoretical work on ways of separating out compositional measures (e.g., concentration of poverty, crime rate, ethnic composition), contextual measures (e.g., access to facilities, environmental characteristics) and measures of collective social functioning (see Macintyre et al. 2002) is also needed. These latter effects we have previously described as socio-cultural, and in the context of childhood injuries might include neighborhood norms for supervision of children, attitudes to acceptable childhood behavior and exposure to risk. They might also include aspects of children's socio-cultural environment, for example, whether children in the neighborhood customarily play on hazardous sites, hang around in gangs, or use

sports facilities. There is some evidence that these types of attitudes and behavior may vary between different types of neighborhood (Soori and Bhopal 2002). It seems to us that these are potentially relevant as they might provide a plausible mechanism of how neighborhood factors affect injury risk in addition to, or alternative to, characteristics of the physical environment.

What Do These Studies Tell Us about the Neighborhood Influences on Socioeconomic Differences in Childhood Injury?

Taken together, these studies all point to there being demonstrable neighborhood influences on injury risk and rates of injury in children. In general, they show that the risks of injury are greater in poor and deprived neighborhoods independent of personal characteristics. Thus, children from poorer families and households are at higher risk of injury, but children living in poor neighborhoods are also at higher risk regardless of their particular household circumstances.

But this is only half the story. All the UK, Canadian and U.S. studies have shown that poverty and material deprivation do not fully explain the neighborhood effects. There are some poor neighborhoods with consistently higher injury rates than others with similar poverty levels; likewise, there are comparable affluent areas which consistently confer different levels of risk for injury. The study from Illinois (Shenassa et al. 2004) suggests this may be related to housing quality but this was not confirmed in the studies from the UK which, despite including a range of housing and other environmental characteristics in the models, were not able to explain the residual neighborhood variation in injury risk. We are confident that there are stable neighborhood effects which were consistent over our two studies. Figure 2 shows a scattergram of standardized injury rates (along the Y-axis) with deprivation scores (along the X-axis) for the two age groups we studied. We have connected the values for the same neighborhoods with lines—many of these points lie very close together including five pairs which virtually overlie each other.

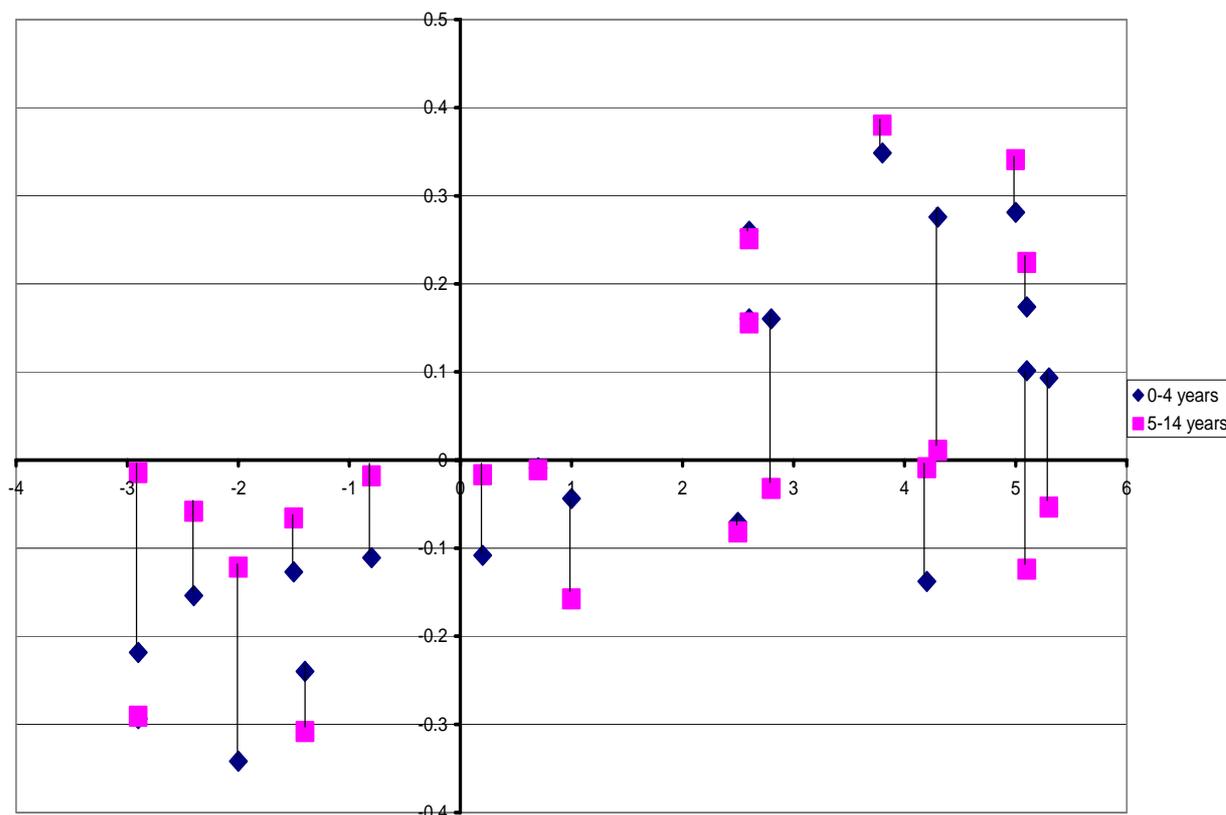
What More Needs to Be Known?

There are weaknesses in all the studies discussed so far. Perhaps the greatest is the lack of detailed socioeconomic data at the individual and household level. To our knowledge, so far no study has had good quality and reliable data on household socioeconomic status to compare with the neighborhood socioeconomic data. The study from Baltimore had data on employment status of the adult respondent, their age and length of stay in the neighborhood (O'Campo et al. 2000). The Illinois study had only basic demographic data on the child (Shenassa et al. 2004). The Norwich studies had lone parent status, maternal age, and number of children in the family (Reading et al. 1999; Haynes et al. 2003).

How, therefore, can we claim that area social characteristics have an independent effect over and above household social factors when we have insufficient information on the latter? The use of multilevel models helps because it enables us to determine that there is variance at the level of neighborhoods independent of any individual level variance, and that introducing the

neighborhood level explanatory factors reduces the area variance, but not the individual variance. However, this is unlikely to fully convince even enthusiasts for multilevel modeling.

Figure 2. Scattergram of injury rates by deprivation for 21 neighborhoods in Norwich, UK



Note: X-axis values are deprivation as measured by the Townsend score—ranging from -2.9 (affluent) to 5.3 (deprived). Y axis values are injury rates for 0-4 year olds and 5-14 year olds, both values standardized by subtraction of the mean value and dividing by the mean in order to facilitate comparison.

Future studies need to collect data on individual and household socioeconomic status as well as injury data. This data should reflect different aspects of socioeconomic status, particularly economic measures such as wealth and income which may have a closer relationship with health outcomes than less direct measures such as occupation and educational attainment (Duncan et al. 2002). There is often reticence about including such questions in surveys but there are sensitive ways of constructing these which facilitate reliable answers (Duncan and Petersen 2001).

The practical difficulty remains in obtaining reliable socioeconomic data on sufficiently large numbers of individual families to give reasonable statistical power in any modeling exercise. The Norwich and Illinois studies required data on several thousand injuries in large populations of children in order to have sufficient power to detect both neighborhood and individual effects.

We are currently engaged in addressing this weakness. The Norwich team is working with colleagues in Bristol, UK, analyzing data from a large longitudinal cohort of 14,000 children born in and around Bristol in the early 1990s (the ALSPAC cohort (Golding et al. 2001)). Shenassa's team is working with data from the Project on Human Development in Chicago Neighborhoods (Earls and Buka 1997). This is a population-based, multilevel study of Chicago neighborhoods and their residents, designed to provide information about the role of neighborhood, family, and individual-level factors in the development of social functioning, as well as mental and physical health status. These data will be combined with hospital and census data to provide a more complete picture of individuals, their homes, and their neighborhoods.

Both data sets have detailed measures of family socioeconomic circumstances at different times through childhood. These should enable sophisticated models to be built of household and neighborhood effects on injury risk which compare measures of socioeconomic status, attitudes and behavior towards risk and childcare, and physical environmental characteristics. It should be possible to show at what scale these operate, and whether there are interactions between the effects at different levels. However, it remains to be seen whether there are data on sufficient numbers of children to allow enough statistical power, even in these very large, well-characterized longitudinal cohorts.

What Are the Implications for Prevention?

The goal of all this work is to help the design, implementation and evaluation of injury prevention interventions. There are considerable methodological challenges when considering community-wide interventions and their evaluation (Shenassa 2002; Doll et al. 2003). This may explain why, despite extensive research on accident prevention, there is little evidence on the effectiveness of community-based interventions (Nilsen 2004) nor of interventions to reduce social inequalities in childhood injury (Dowsell and Towner 2002), and health in general (Kawachi, Kennedy and Wilkinson 1999).

Efforts to redress these disparities are nascent and can benefit from improved understanding of pathways between socio-economic status and health. Thus far these remedial efforts have been mostly informed by two influential lines of research, one focusing on the individual and the other on the community. The focus of the individual-level approach has been on individuals' socioeconomic status and its accompanying levels of control and perceived or real stress. This line of work has built on paradigms of "learned helplessness," and "perceived efficacy" put forth by Seligman (1970) and Bandura (1986), respectively. The other line of research initiated by Durkheim (1951), Faris and Dunham (1939) and their students and expanded by Hollingshead and Redlich (1958), Weschler and Pugh (1967), Dohrenwend and Dohrenwend (1969), and others focused on social determinants of health and has led to the contemporary literature on trust, social cohesion, community efficacy, and other related constructs as "fundamental causes" of health. More recent investigations, greatly influenced by the work of Wilson (1996), have been consistent in demonstrating that both individual and social-level determinants exert an independent influence on health.

Attempts to reduce the steep social gradients in childhood injury have in some cases been influenced by these theories and include both measures targeted at socially disadvantaged individuals and measures targeted at deprived areas. This mixture of approaches is largely pragmatic and opportunistic, often building on other initiatives to reduce child health inequalities. For example, in the UK there has been a large governmental investment (both financially and politically) in the Sure Start scheme. This is an early intervention program designed to improve the life chances of babies and young children in disadvantaged neighborhoods and has a particular target of reducing accident rates (DfEE 1999). The rationale for targeting interventions on areas with high levels of deprivation is that it provides the most effective way of reaching the families most in need. Critics of this approach point to the evidence that only a minority of the poorest families live in the most deprived areas (McLoone 2001).

The main feature of all the studies reviewed here is that the concentration of poverty and material deprivation within neighborhoods, regardless of how it was measured, influences injury risk. One way to tackle socioeconomic inequalities from a neighborhood perspective is to make improvements to housing stock and living conditions. Housing may be a fulcrum between individual and social determinants of health (e.g., see Shenassa et al. 2004; Jargowsky 1997; Dunn 2003), so existing resources and policies for home improvement and neighborhood renewal may provide effective strategies for reducing individual and community-level disparities in health. In the longer term, housing policies should aim towards greater social mixing and heterogeneity in neighborhoods. This would improve economic and social capital, both of which may have direct and indirect effects on reducing injuries in children.

Improving the safety, access to facilities and environmental quality of neighborhoods are also promising approaches. Steps need to be taken to make play facilities safe and attractive. Parks in socially deprived areas, for example, should not be littered with used needles, empty cans and bottles. However, the inability of the UK studies to identify any neighborhood-level association with traffic density or access to play and leisure facilities suggests that interventions should additionally be aimed at changing attitudes and cultural behavior. Examples include improving the quality of child care, influencing attitudes toward using home safety equipment and local amenities, encouraging changes in the play preferences of children and young people and strengthening the role of adult surveillance and supervision. We suggest these are all more appropriately tackled at the level of neighborhoods rather than individuals.

The studies we have described provide evidence in favor of neighborhood- and community-based interventions. This is all the more important as politically there is much less enthusiasm for broad social programs to redistribute wealth than for policies that address neighborhood regeneration. This is not only the case in the U.S., but also in the UK, whose left-of-center government has a stated policy of ending child poverty. In the UK, the headline policies have been area-based and facilitative (i.e., helping individuals help themselves out of poverty), while the redistributive elements of fiscal policy have remained implicit and are barely mentioned.

Neighborhood interventions are politically acceptable, likely to improve local living conditions in deprived areas and should reduce social inequalities in child

injuries. However, as long as there are such marked social and economic disparities between individuals, neighborhood interventions are not likely to abolish the strong gradients in injuries between children from rich and poor families. For this to happen, action needs to be taken at individual, neighborhood and societal levels.

Endnote

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