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Decomposing the impact of deprivation on child pedestrian casualties in England

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ABSTRACT

The incidence of child injury due to road traffic accidents appears to be positively associated with socio-economic deprivation. However, the reasons behind this relationship have proven difficult to identify. In this paper, we present results from a cross-sectional analysis using generalized linear regression models of child pedestrian casualties for the wards of England. We find that there are distinct and substantial effects on casualty rates from characteristics associated with area deprivation across diverse environments. These associations exist over and above influences arising from local environmental characteristics. Distinct dimensions of deprivation appear to affect the incidence of pedestrian casualties to varying degrees and sometimes in different directions. The results identify a relationship between income deprivation and the incidence of child pedestrian casualties, but they also show that poverty is only one aspect of deprivation that matters. In particular, we find a consistent positive influence from crime related deprivation.

1. Introduction

The existence of a statistical relationship between socio-economic deprivation and health has frequently been proposed in the literature (e.g. Lancaster and Green, 2002; Cooper, 2002; Lorant et al., 2001; Gould and Duncan, 2000; Diamond et al., 1999; Carstairs and Morris, 1991; Townsend et al., 1988; Jarman, 1983). Specifically, higher levels of deprivation are found to be associated with poor health. Research has sought to test the presence and strength of such associations, but has also frequently addressed issues relating to how deprivation is actually measured and how deprivation indices are constructed.

Recent findings indicate that the incidence of injuries amongst children is particularly influenced by deprivation. Hippisley-Cox et al. (2002) find that children from the most deprived social classes have a mortality rate from injury five times that of children from the least deprived social class, while Roberts and Powers (1996) have shown that the social class gradient is prevalent over the most common mechanisms of injury.

1.1. Deprivation and child pedestrian road traffic accidents

Pedestrian road accidents are a major source of injuries to children. Research on the relationship between child pedestrian casualties and the socio-economic characteristics of victims supports the deprivation hypothesis: children of the lowest social class are approximately four times more likely to be killed on the road than those of the highest social class (see White et al., 2000; Christie, 1995 for reviews of this literature).

The factors that lie behind this observed relationship are multi-faceted and often highly inter-correlated. Although the existing literature does not provide us with an exact or comprehensive understanding, individual level studies of child pedestrian casualties do provide some indication of factors that may be of importance. These include poor housing accommodation and lack of open space for playing at home (Roberts and Pless, 1995), low levels of access to car passenger transport for children (Erskine, 1996), increased exposure to hazardous traffic environments and increased proximity to busy streets (Bagley, 1992; Christie, 1995; Roberts et al., 1995), lower levels of child supervision within households (Christie, 1995), the scarcity of publicly available play spaces (Al-Balbissi et al., 1990), and the tendency of deprived children to play unsupervised close to home (Sharples et al., 1990).

Despite evidence such as this we still do not have a precise understanding of how socioeconomic status affects road accident rates. This is because many of the factors cited in the individ-

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ual studies could be prevalent to equal degrees in both deprived and non-deprived locations. Indeed, for several of the factors cited above we could argue that variation is based at least as much on urban density as it is on deprivation. Thus, we need to be clear about what we are trying to capture when we measure deprivation, and we need to try to make deprivation measures distinct from other prominent influences on the incidence of child casualties.

1.2. Plan of this paper

In this paper we focus on the measurement of deprivation and the construction of the deprivation index in an attempt to shed light on relationships between area deprivation and the incidence of child pedestrian casualties. We decompose the deprivation effect by considering six separate dimensions related respectively to income, employment, health, education, housing and services, and crime. Our principal research question is whether the different dimensions of deprivation affect the incidence of child pedestrian casualties in different ways. If they do, we wish to obtain statistical quantification of the association between each distinct aspect of deprivation and the incidence of child pedestrian casualties in England.

We present results from models derived to explain variation in child pedestrian casualties (CPCs) according to a range of location-specific characteristics, a subset of which are the components of deprivation. It is important to emphasize that our analysis is area based. Unlike the individual studies quoted above, our observations are spatial units, not people or family groups. The deprivation scores characterize the socio-economic profile of 7925 small areas of England. As such we cannot directly determine an association between the incidence of casualty and deprivation at an individual or household level. From a policy perspective, however, a location based model is very useful because it allows us to identify the area-level factors that are associated with casualties. Furthermore, our objective is to disentangle the effect on child casualties of ward characteristics and the dimensions of ward deprivation.

The paper is structured as follows. Section 2 describes the deprivation indices. Section 3 develops an area-level model to examine the incidence of child pedestrian casualties. Section 4 discusses issues of model fit and estimation. Results from cross-sectional negative binomial GLMs are presented in Section 5. Conclusions are given in Section 6.

2. Variation in socio-economic characteristics

2.1. The english indices of deprivation

The Indices of Deprivation, published by the Office for the Deputy Prime Minister (ODPM, 2004), provide a comprehensive source of data on spatial variance in socio-economic conditions for England. The principal conviction underpinning the production of these indices is that there are distinct dimensions of deprivation that can be identified and measured separately. The first stage in the construction of the indices is to gather data describing a diverse range of characteristics of small areas, called Super Output Areas (SOAs), of which there are 32,842 in England. These data are then used to construct a series of indicators that measure spatial variance in some particular attribute. Certain indicators are then combined arithmetically or by using factor analyses to produce seven individual *domain indices* that each describes a separate aspect of deprivation.

2.2. Seven deprivation domain indices

The seven domain indices are as follows.

(i) *Income* (INCSCR): the income domain index measures the proportion of the population in receipt of some form of income 'benefit' from the state. These benefits include income support for the unemployed and for working households below a low income threshold.
(ii) *Employment* (EMPSCR): employment deprivation measures the proportion of the population of working age that are involuntarily excluded from work, including the unemployed, incapacitated, physically disabled, and those unable to undertake work.
(iii) *Housing and services* (HOUSCR): this domain measures 'barriers of access to housing and services'. Barriers to services are principally geographic in nature, for instance, measuring distance to doctors, supermarkets, primary schools, post offices and the like. Barriers to housing include overcrowding, but also the affordability of owner-occupation.
(iv) *Health* (HEASCR): the health domain identifies areas with poor health characteristics including premature death, illness and disability, and emergency admissions to hospital.
(v) *Education* (EDUSCR): the education domain measures spatial variance in education, skills and training deprivation. It makes use of indicators on the performance of children at school, the proportion of students continuing education after 16, secondary school absence rates, the proportion of under-21s not entering higher education, and the proportion of working age adults with no or low qualifications.
(vi) *Crime* (CRMSCR): the crime domain reflects the rate of recorded crime combining indicators on burglary, theft, criminal damage and violence.
(vii) *Environment* (ENVSCR): the living environment domain measures the 'quality' of the internal and external environment. Indicators of the internal environment are the conditions of social and private housing and the existence of central heating. Characteristics of the external environment considered are air quality and the number of road traffic accidents involving injury to cyclists or pedestrians.

The seven individual domain indices are also weighted and combined into a single overall *Index of Multiple Deprivation* (IMDSCR). In order to combine the domain indices they are first standardized to a uniform metric and then transformed to a common distribution. They are then weighted according to available research evidence about the nature of multiple deprivation, which in fact results in income and employment deprivation being awarded the most importance and therefore being weighted most highly.

2.3. Current deprivation data

Deprivation data are published at the SOA level. This is a much finer level of spatial disaggregation than we can achieve in our model because other necessary sources of data are not available at such a fine scale. For this reason, we have constructed weighted average deprivation domain scores for larger geographical units defined by the Census Area Statistic (CAS) ward disaggregation of Britain. There are 7927 CAS wards in England. To construct the aggregated scores we use the ward share of population in each of the smaller areas as the weight. The SOA resident population data are taken from the UK Census of Population 2001.