streets ahead

safe and liveable streets for children

Tony Grayling
Karl Hallam
Daniel Graham
Richard Anderson
&
Stephen Glaister

Institute for Public Policy Research
30-32 Southampton Street
London WC2E 7RA
Tel: 020 7470 6100
Fax: 020 7470 6111
info@ippr.org.uk
www.ippr.org

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about the authors

Tony Grayling is an associate director and head of the sustainability team at the Institute for Public Policy Research.

Karl Hallam is a transport researcher and consultant in the sustainability team at the Institute for Public Policy Research.

Dr Dan Graham is a senior research associate in the Centre for Transport Studies at Imperial College, London. He attained his PhD at the London School of Economics.

Richard Anderson is a senior research associate at the Centre for Transport Studies at Imperial College, London, where he undertakes research in the fields of transport economics and planning.

Stephen Glaister is professor of transport and infrastructure at Imperial College, London. He is an adviser to the Commission for Integrated Transport and a board member of Transport for London.

executive summary

This report examines the relationship between deprivation and child pedestrian casualties in Britain and the use of 20mph zones to reduce injuries and inequality. Britain's good road safety record overall is marred by a poor record on child pedestrian safety. In Britain in 2000, the police reported over 16,000 child pedestrian casualties, including more than 3,000 serious injuries and more than 100 deaths. Although the number of child pedestrian casualties has decreased over time, this has been matched by a decrease in walking. It is not clear that Britain's streets are becoming significantly safer for children or other pedestrians.

For the first time, we have been able to map all the pedestrian injuries in England reported by the police in 1999 and 2000 to examine the relationship between injury rates and area deprivation using the official ward index of multiple deprivation. We find that children in the ten per cent most deprived wards were more than three times as likely to be pedestrian casualties as their counterparts in the ten per cent least deprived wards. This is compounded by the fact that more children live in deprived areas, so that more than one quarter of child pedestrian injuries happened in the most deprived tenth of wards.

We are able to show that the higher injury rate in deprived areas does not appear to be simply because the environment is inherently more dangerous, for example because deprived areas tend to be dense urban areas with more roads and traffic. Environmental factors are important but there appears to be a deprivation effect over and above the effect of the built environment. We estimate that the likelihood of a child pedestrian injury is four times higher in the most deprived ward in England compared to the least deprived ward, independent of factors such as population and employment density and the characteristics of the road network. A reasonable explanation is that higher rates of child pedestrian casualties in more deprived areas are the consequence of more dangerous environments combined with higher exposure rates. Children in more deprived areas are likely to make more journeys on foot because their parents are less likely to have a car and more likely to play on the street unsupervised because they are less likely to have access to gardens or other safe play areas.

One response to these findings would be to argue that children should have better road sense and parents should keep an eye on their children if not keep them indoors. We would agree that children should be taught good road sense and parents should take responsibility for their children but this is only one side of the story. Children are children and exploring their environment is an important part of growing up. If we can take reasonable action to protect children's freedom to walk and play safely in their own neighbourhoods, then we have a responsibility to do so.

We examined the transport plans of all the English local authorities outside London, to understand their road casualty reduction policies. Almost all have adopted the national targets of a 40 per cent reduction in road deaths and serious injuries and a 50 per cent reduction in child road deaths and serious injuries by 2010 on 1994-98 averages, though most were unclear whether these targets were achievable. The majority have also adopted additional local targets, including pedestrian casualty reduction targets in some cases. We recommend that all local transport plans should include pedestrian casualty reduction targets, preferably expressed as casualties per mile walked so that they cannot simply be

achieved by a reduction in walking. In spite of the importance of traffic speed to the number and severity of road casualties, only one in three local transport plans presently include a clear speed management policy. We recommend that all local transport plans should include a speed management policy, covering speed limits, their enforcement and traffic calming.

Traffic-calmed 20mph zones are extremely effective in reducing all road accidents and child pedestrian casualties in particular on average by about 70 per cent. We carried out a survey of traffic-calmed 20mph zones in England and Wales. Of the 171 county and unitary district councils in England and Wales, 119 completed our questionnaire, a response rate of 70 per cent. Eight out of ten of the responding authorities had implemented at least one traffic-calmed 20mph zone, a total of 684 zones. A further 441 zones were planned. Most local authorities had implemented only a handful of zones covering a tiny fraction of roads in residential and built up areas but a few authorities stood out, notably Hull with more than 100 zones covering a quarter of its road length.

We estimate that Hull's programme of 20mph zones since 1994 has already saved about 200 serious injuries and 1,000 minor injuries. Using standard valuations, the £4 million cost of the programme has already been repaid at least ten times over in casualty savings. With careful design and consultation with local residents and the emergency services, Hull has proved that 20mph zones can be both popular and effective. We recommend that other councils should follow Hull's example.

Most local authorities use casualty history and local demand to decide where to put 20mph zones and some take account of social factors or implement zones as part of regeneration schemes. Proximity to schools is also frequently a factor. Our analysis suggests that on the whole local authorities are tending to implement 20mph zones in more deprived areas with higher pedestrian casualty rates but that some are better at this than others.

Our main recommendations are that a maximum 20mph speed limit combined with traffic calming should become the norm in residential and built up areas and that priority should be given to traffic-calmed 20mph zones in deprived areas with high casualty rates. This would be effective in reducing pedestrian injuries and social inequality at the same time. We are encouraged that in the course of our work, the Treasury has amended one of its public service agreement targets with the Department for Transport so that the national road casualty reduction targets should now be achieved while tackling the significantly higher rate of casualties in disadvantaged areas.

Traffic calming and lower speed limits are only part of a wider strategy to make Britain's streets safer and more liveable for children and all pedestrians. The Government should now develop a national strategy for pedestrians promoting an increase in walking at the same time as a reduction in pedestrian casualties, not least as part of its strategy for an urban renaissance. That would be good for people's health and the vitality of neighbourhoods, as well as helping to reduce pollution and congestion. We recommend that home zones, which combine lower speed limits with redesigning streets to give priority to children, pedestrians and cyclists, should rapidly move beyond demonstration projects to widespread implementation. Similar schemes are already commonplace on mainland Europe.

Growth in car use and road traffic has eroded children's freedom of movement and independence, while precedence has been given to the rights of motorists. Other European countries such as the Netherlands and Germany have higher levels of car ownership but use them a little less and have a better record on child pedestrian safety. It is not a matter of being pro- or anti-car. The real debate is about a balance of rights and responsibilities of

different road users. If the freedom of children has been constrained in the age of the motor car, then public policy should seek to rebalance the rights and responsibilities of road users towards children's rights and motorists responsibilities. Making streets safe and liveable for children is the right thing to do. It is also a potentially popular political agenda.

key recommendations

- Traffic calming combined with a maximum 20mph speed limit should become the norm in residential and other built up areas
- Priority should be given to traffic calmed 20mph zones in deprived areas with high pedestrian casualty rates
- All local transport plans should include pedestrian casualty reduction targets
- All local transport plans should include a speed management strategy
- Home zones in Britain should rapidly move beyond demonstration projects to widespread implementation
- The government should develop a national strategy for pedestrians to promote an increase in walking at the same time as a reduction in pedestrian casualties

introduction

This report is set in the context of the present Government's commitment to reduce road casualties, to combat social exclusion and health inequalities, and to improve the quality of life. The Government's road safety strategy sets targets to reduce the number of people killed and seriously injured on Britain's roads by 40 per cent, of children in particular by 50 per cent, and slight injuries per vehicle kilometre by 10 per cent, by 2010 on 1994-98 averages (DETR 2000a). These complement commitments in the Government's public health strategy, which include targets to reduce deaths and serious injuries from all kinds of accidents and an objective to reduce health inequalities (HM Government, 1999). The Government aims to promote an urban renaissance by improving the built environment and liveability of Britain's towns and cities (DETR 2000b). In spring 2001, Tony Blair made a significant speech emphasising the importance of neighbourhood liveability (Blair 2001). A recent interim report by the Social Exclusion Unit highlighted the social inequality in child pedestrian casualties, based on our work (SEU 2002).

Britain's relatively good record on reducing road deaths and serious injuries is marred by a relatively poor record on child pedestrian safety. In the European Union in 1999, the most recent year for which comparative data were available for this report, the UK had the lowest overall rate of road deaths but nine of the other 14 member states had a lower rate of child pedestrian deaths (Figure 1).

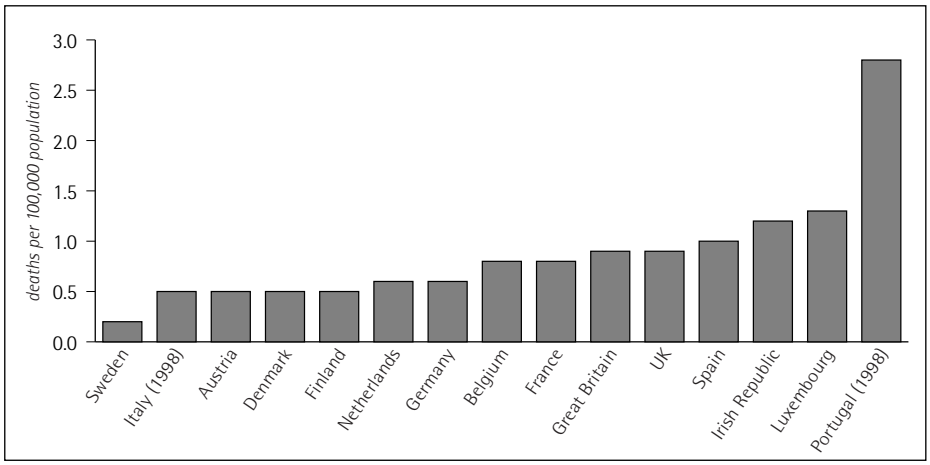


figure 1 Child (aged 0-14) pedestrian deaths in 1999 in EU states

Over 16,000 child pedestrian casualties were reported by the police in Britain in 2000, including more than three thousand serious injures and more than 100 deaths. Although the death of children in Britain is mercifully rare, collisions between cars and children are a significant cause of death and injury. In England and Wales, pedestrian casualties made up two per cent of child deaths, more than a quarter of child deaths by accident (27 per cent) and well over half of all child road deaths (61 per cent). The highest pedestrian casualty rates were for children in their final years at primary school and first years at secondary school (Figure 2). Most child pedestrian deaths and injuries happen in built up areas, close to home. Boys, who spend on average more time in the streets, have a much higher casualty rate than girls. Although the number of child pedestrian casualties has fallen over the years, this is mirrored by a decline in walking. The government's own analysis admits that it is far from clear that

figure 2 Pedestrian casualty rates in Britain in 2000 by age

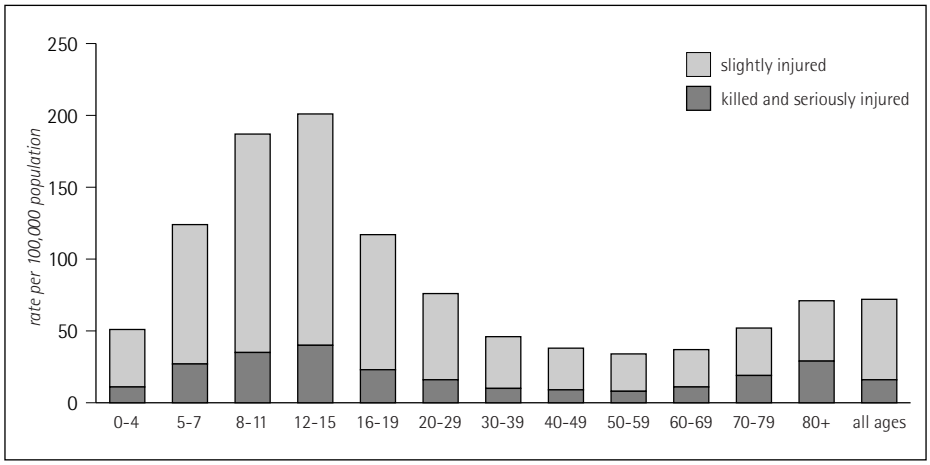
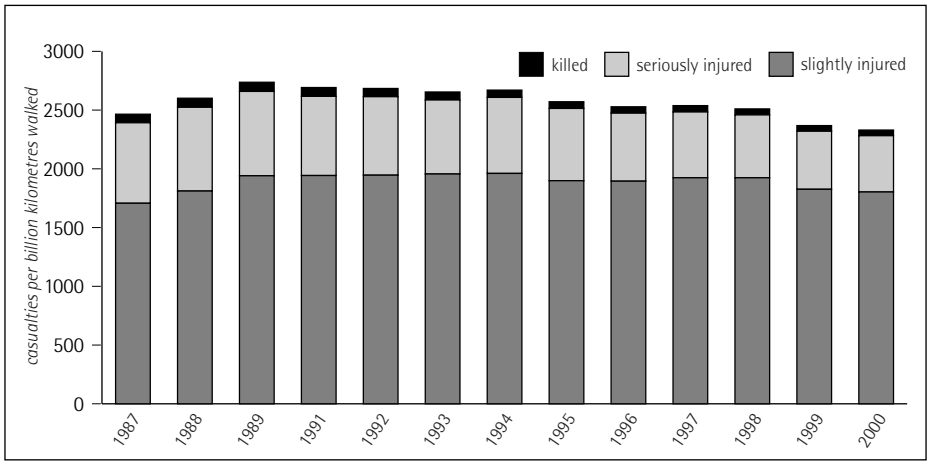


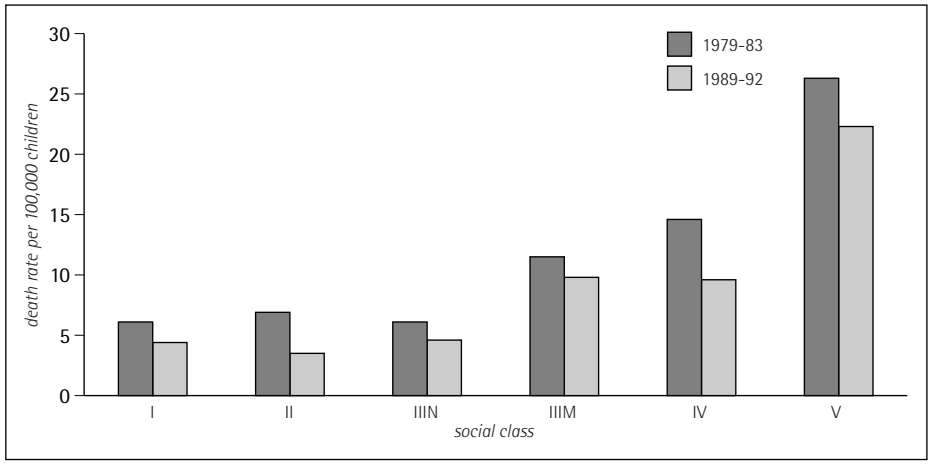
figure 3 All pedestrian casualty rates, 1987-2000



roads are becoming safer for pedestrians (DETR 1997). This is substantiated by Figure 3, which shows that when the amount of walking is taken into account, the risk of injury to pedestrians has changed little since the 1980s, though the risk of serious injury has declined.

Beneath Britain's bad record on child pedestrian safety lies social inequality. Acknowledgement of the social class gradient in child pedestrian deaths dates back at least to the Black report on health inequalities published in 1980 (Townsend *et al* 1992). Later analysis showed that children from households in England and Wales in the lowest socio-economic group were five times as likely to be killed as those from households in the highest socio-economic group (Roberts and Power 1996; Figure 4). A recent study, based on injury

figure 4 Inequality in child (0-15) pedestrian deaths in England and Wales



related hospital admissions of children from 862 electoral wards in the Trent region between 1992 and 1997, found that both the number of admissions for injury and admissions for injuries of higher severity increased with increasing deprivation. The steepest socio-economic gradient was for pedestrian injuries, with the rate of admissions from the most deprived fifth of wards more than four times the rate from the most affluent fifth (Hippisley-Cox *et al* 2002). This is similar to the findings of a study of the Lothian region around Edinburgh, based on police road accident records and small postcode areas, each containing about 50 households (Abdalla *et al* 1997). It compared road casualty rates of residents from the 15 per cent most deprived areas and 15 per cent most affluent areas from 1990 to 1992. It found higher casualty rates for residents of deprived areas, with the steepest gradient for pedestrian casualties and in particular for child pedestrian casualties. In the five to eleven year-old age group, the rate of child pedestrian casualties in the most deprived areas was seven times that of the most affluent areas.

There have been two comprehensive literature reviews of the evidence linking child pedestrian accidents and socio-economic deprivation in Britain, by Christie (1995) and White *et al* (2000). The aim of our study was to deepen understanding of the relationship between deprivation and child pedestrian casualties and to examine the impact of local and national transport policies. For the first time, we have been able to map all the pedestrian casualties in England and to test the relationship with deprivation and other area characteristics at ward level across the whole country. We also reviewed the transport plans of local authorities in England and carried out a survey of 20mph zones in England and Wales, since these are particularly effective in reducing child casualties (Webster and Mackie 1996). In this report, we summarise our findings and explore the implications for public policy at national and local level.

methodology

This section outlines the methods we used for our study. Further details are contained in two reports available on the ippr website (www.ippr.org). One report describes the methods and results of the spatial and deprivation analysis of child pedestrian casualties. The other report covers the review of transport plans of local authorities in England outside London and the survey of 20mph zones in England and Wales.

sources of data

Our source of data for road casualties is 'Road Accident Data – GB', generally known as the STATS 19 database, held by the Department for Transport. These data are based on records completed by police officers on all reported road accidents. A study comparing police records with hospital records estimated that about a quarter of child pedestrian casualties were not recorded on STATS 19 (Tunbridge *et al* 1988, cited in Christie 1995). Our analysis assumes that there is no significant socio-economic bias in reporting, which may be more true for deaths and serious injuries than for slight injuries.

STATS 19 contains a wealth of information about the circumstances of each accident recorded, including the date and time of day, road and vehicle characteristics and weather conditions. Crucially for our analysis, the STATS 19 data also records the age of the casualty, the grid reference of the location of the accident, whether the casualty was a pedestrian and the severity of injury (slight, serious or fatal). It also records the postcodes of residence of the drivers and casualties. We had hoped to use the postcode information but ran into data protection difficulties, which have yet to be resolved.

We used data for 1999 and 2000. STATS 19 records more than 300,000 road casualties in each of these years, of which more than 40,000 were pedestrian casualties and more than 16,000 child (age 0-15) pedestrian casualties (see Table 1).

table 1 Road accident casualties in Britain recorded on STATS 19

	1999	*2000*
Road casualties	320,310	320,283
Pedestrian casualties	41,682	40,665
Child pedestrians (age 0-15)		
Killed	107	107
Seriously injured	3,350	3,119
All severities	16,876	16,184
Adult pedestrians (age 16+)		
Killed	760	750
Seriously injured	5,461	5,362
All severities	24,806	24,481

For deprivation data, we used the indices published in 2000 for each of the 8,414 electoral wards in England by the Department of the Environment, Transport and the Regions (DETR 2000c). The

indices include 33 separate indicators of deprivation, which are combined into scores on six 'domain indices' that measure different aspects of deprivation, covering income, employment, housing, health, education and accessibility. All of the indicators are combined together into a ward-level index of multiple deprivation. Different deprivation indices are compiled for Scotland and Wales. Owing to incompatibility we therefore focused our attention on England alone.

mapping accidents to areas

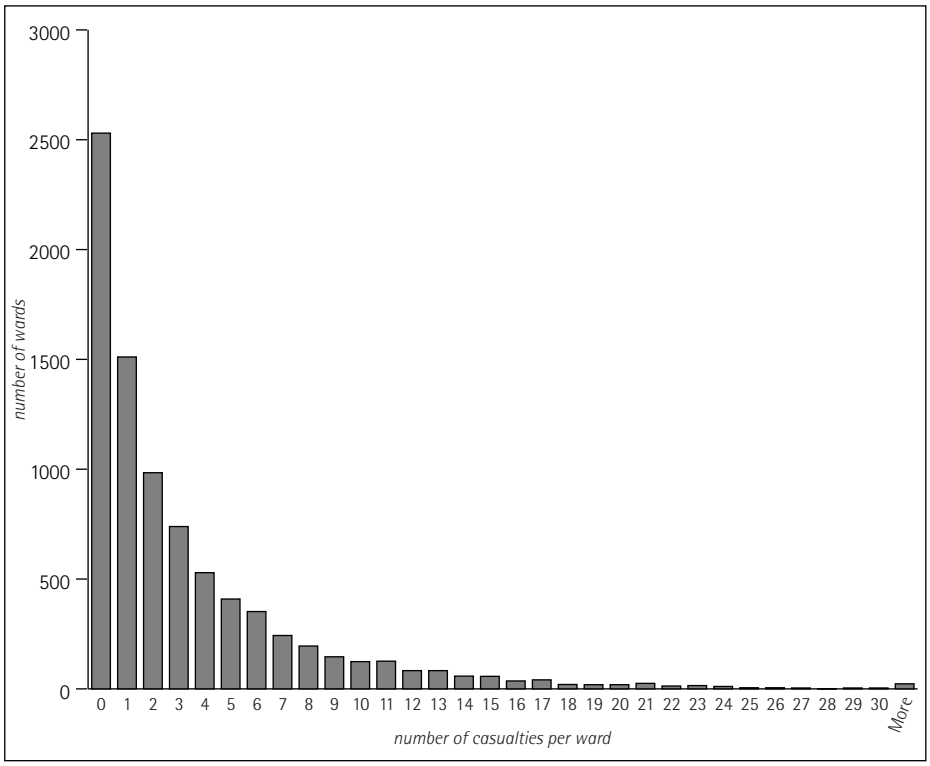
The grid references recorded on STATS 19 enable the mapping of accident locations. Figure 5 shows the map of all recorded road accidents in greater London in 2000. Each dot represents an accident. It shows all road accidents, not just those involving pedestrian casualties, and illustrates the high degree of spatial accuracy of the data. This is confirmed by inspecting the map at a much larger scale. The London road network can clearly be made out, as can areas of open space such as Hyde Park.

Using Geographical Information System (GIS) software we have been able to allocate each pedestrian casualty to one of the English wards, in order to correlate casualties with area characteristics such as indices of deprivation. We have counted the number of child and adult pedestrian casualties in each of the 8,414 wards. In any given year, there are usually relatively few pedestrian casualties recorded in a particular ward. The most common number is zero. The average for all wards in England in 1999 and 2000 is 3.4 child pedestrian casualties and 5.1 adult pedestrian casualties (Table 2). Figure 6 shows the distribution of frequencies in 1999 and 2000. The majority of wards have few casualties but a few wards have large numbers.

table 2 Pedestrian casualties in English wards in 1999 and 2000 together

	Children (0–15years)	Children killed and and seriously injured	Adults (16+ years)	Adults killed and seriously injured
Total number of casualties	28,228	5,713	42,848	10,964
Average number of casualties per ward	3.4	0.7	5.1	1.3
Average number of casualties per 1,000 children/adults	2.8	0.6	1.1	0.3

figure 6 Child pedestrian casualties in English wards, 1999 and 2000



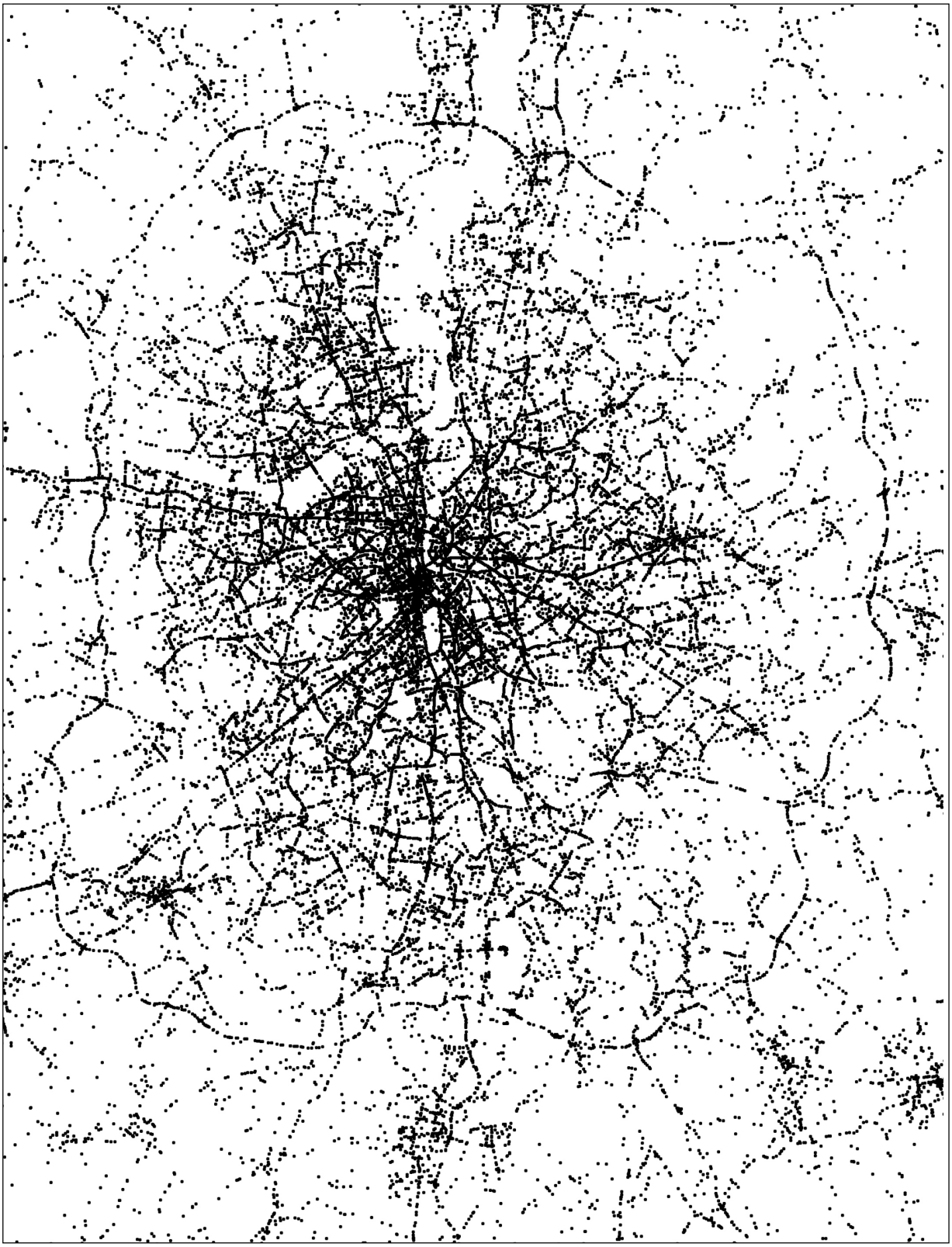


figure 5 Map of all recorded road accidents in Greater London in 2000

developing a statistical model

It is not sufficient to establish a correlation between deprivation and casualty rates, as the relationship could be misleading. For example, there could be a higher rate of child pedestrian casualties in deprived areas because these tend to be urban areas with more buildings, roads and traffic. It might be that areas of similar density but differing levels of deprivation have similar casualty rates. To separate the effects of deprivation from other environmental factors we therefore developed a statistical model, which enabled us to test the hypothesis that the number of child pedestrian casualties was dependent on six local factors:

- level of deprivation
- number of children
- traffic generating potential
- residential and employment density
- length and type of roads
- weather and other specific local factors

For some factors, such as the number of children, we have direct measurements. For other factors, such as traffic flows and land use, we have developed proxy measurements, which are clearly less preferable. We did not have access to data for traffic at ward level. Instead, we estimated the traffic generating potential of each ward as a function of resident population and employment, and the potential for through traffic generation as a function of population and employment in adjacent areas. We had access to data mapping the entire road network in England and were able to count the number of road junctions in each ward, where two or more roads meet. Employment per junction and population per junction were taken as indicative of employment and residential density. For each ward, we measured the length of A road, B road, minor road and motorway. Annual rainfall and sunshine are taken as measures of weather. We also tested for regional variations. There are important factors that are not presently included in the model, such as housing type and public open space, which it would be desirable to incorporate if the data were available.

Having measured the contribution of each of the factors that we were able to include in our analysis, we then constructed a model predicting casualty rates on the basis of all these factors together and tested the model against observed casualty rates. We then further refined the model by separating out the effects of different aspects of deprivation and reconstructing the model, using an index of deprivation with different weightings, so that it more accurately predicted casualty rates.

review of local transport plans

We reviewed the statutory local transport plans of all the 85 local highway authorities in England outside London – county and unitary district councils – in order to understand their road casualty reduction, traffic calming and speed management policies. This would provide a context for our survey of 20mph zones. The London boroughs have yet to publish their equivalent to local transport plans, known as local implementation plans.

survey of 20mph zones

The reason that we chose to survey 20mph zones as a measure of local traffic calming policies is because of their effectiveness in reducing pedestrian casualties. 20mph zones combine the lower speed limit with humps or speed cushions and other changes to the road layout to make them self-enforcing. A study of 72 such zones found that on average they reduced all road accidents and child pedestrian accidents in particular by an average of about 70 per cent (Webster and Mackie, 1996; Table 3). By contrast, reducing the speed limit to 20mph without changing the road layout had little effect on speeds or accidents.

table 3 Reduction of road accidents in 20mph zones

	Annual accident rate per scheme		Reduction in accident rate (%)
	before	*after*	
Pedestrian	1.69	0.62	63
Pedal cyclist	0.42	0.3	29
Motorcyclist	0.40	0.11	73
Other	0.87	0.29	67
Child pedestrian	1.24	0.37	70
Child cyclist	0.21	0.11	48
All accidents	1.45	0.48	67

source Webster and Mackie 1996

Through the Local Government Association, we carried out a survey of local highway authorities in England and Wales (county and unitary district councils). The survey was carried out between November 2001 and April 2002. A questionnaire was sent to each authority about the location of planned and implemented 20mph zones. Among other things, it asked for the postcode or grid reference of zones so that we would be able to relate zones to ward-level deprivation and other area characteristics.

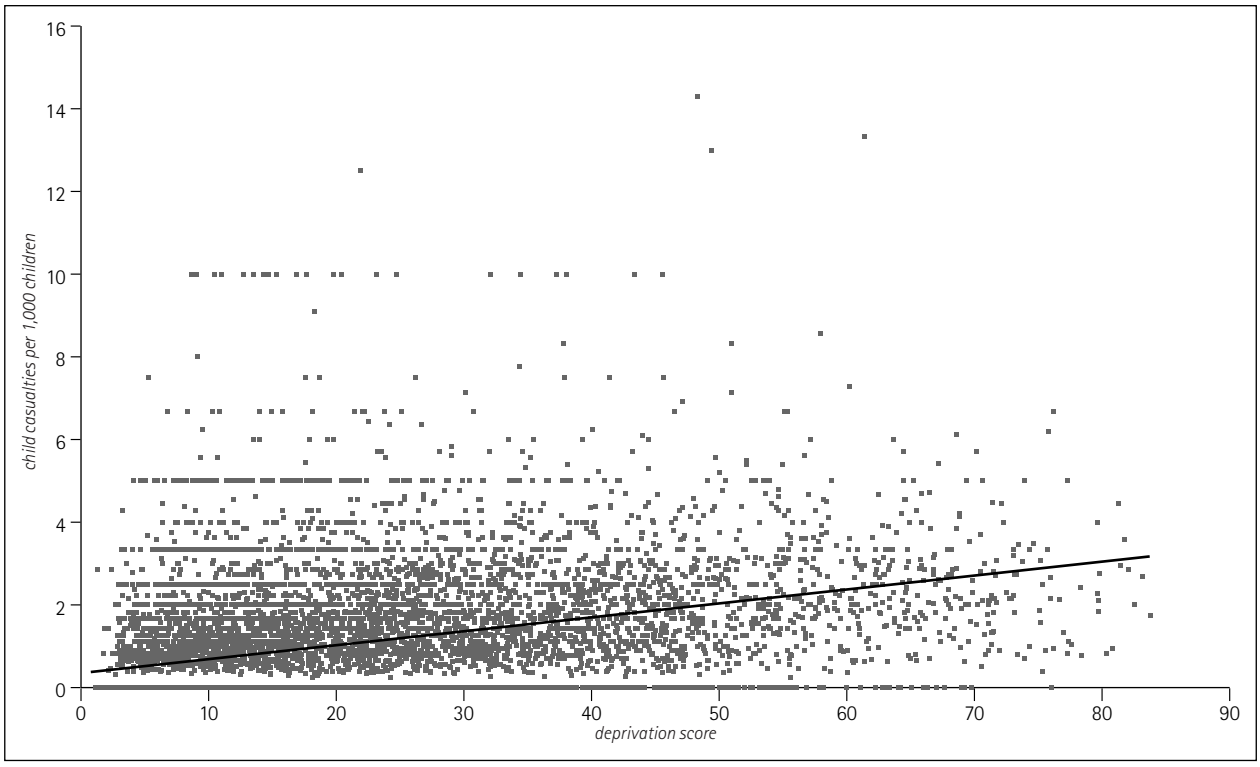
results

This section summarises our results. Further details and the statistical methods employed are set out in the two reports published on the ippr website (www.ippr.org).

child pedestrian casualties and deprivation

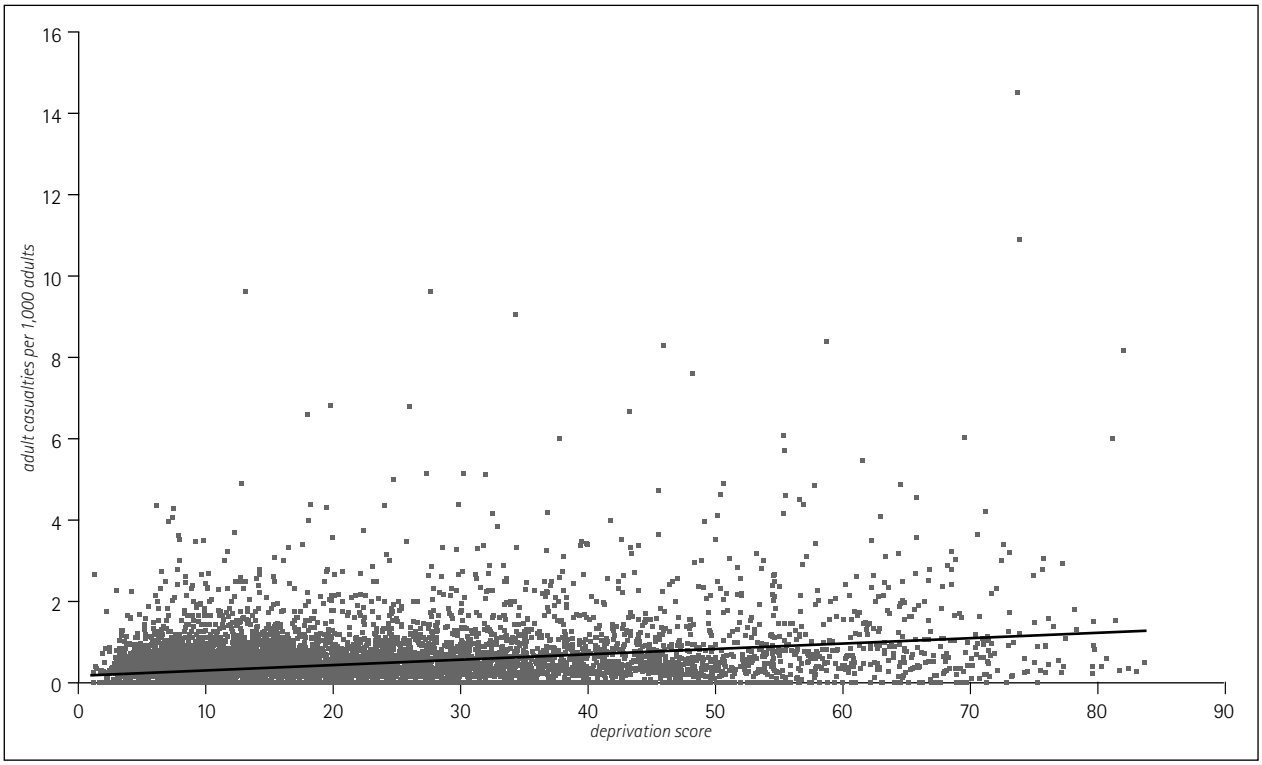
Figure 7 is a plot of the rate of child (up to 15 years old) pedestrian casualties in the year 2000 by score on the index of multiple deprivation, with each point representing one of the more than 8,000 wards in England. There is a visible correlation between child pedestrian accident rates and deprivation score, which is statistically significant, although there is also a great deal of scatter. The graph shows the correlation with area characteristics rather than the socio-economic profile of the individual casualties involved, though as we have already noted most child pedestrian injuries happen close to home. Figure 8 is the equivalent graph for adults, in this case meaning people 16 or more years old. In the case of adults, the correlation is less clear.

figure 7 Correlating child (0-15 years old) pedestrian casualty rates and deprivation in English wards in 2000



The data for both 1999 and 2000 are shown in a different way in Figures 9 and 10. In these histograms, wards are grouped according to their deprivation score. The ten per cent of wards with the lowest deprivation scores form one group, the next ten per cent another and so on to the ten per cent of wards with the highest deprivation scores. Deaths and serious injuries are distinguished from minor injuries. Figure 9 shows that children in the ten per cent most deprived wards in England were more than three times as likely to be pedestrian casualties as children in the ten per cent least deprived wards, with similar gradients for deaths and serious

figure 8 Correlating adult (16+ years) pedestrian casualty rates and deprivation in English wards in 2000



injuries and for minor injuries. Figure 10 shows that adults have lower pedestrian casualty rates but there does appear to be a similar proportionate increase in casualty rates with deprivation.

figure 9 Annual average rates of child (0-15) pedestrian casualties in deciles of English wards in 1999 and 2000

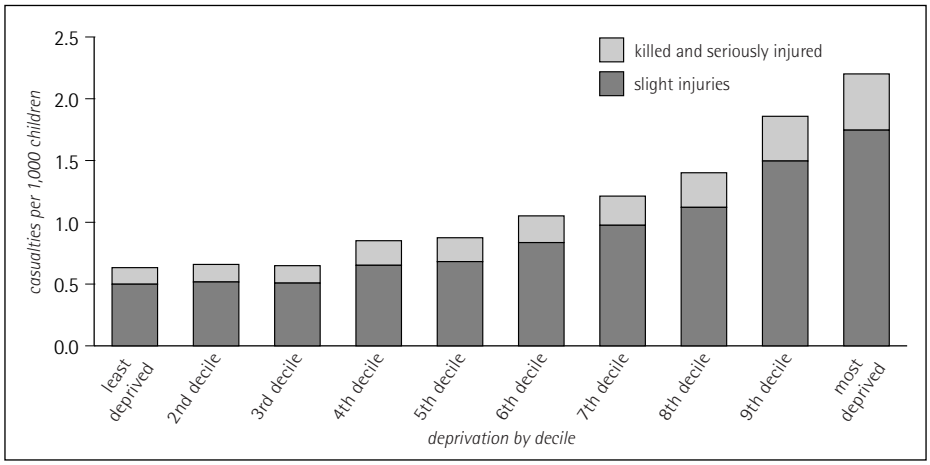
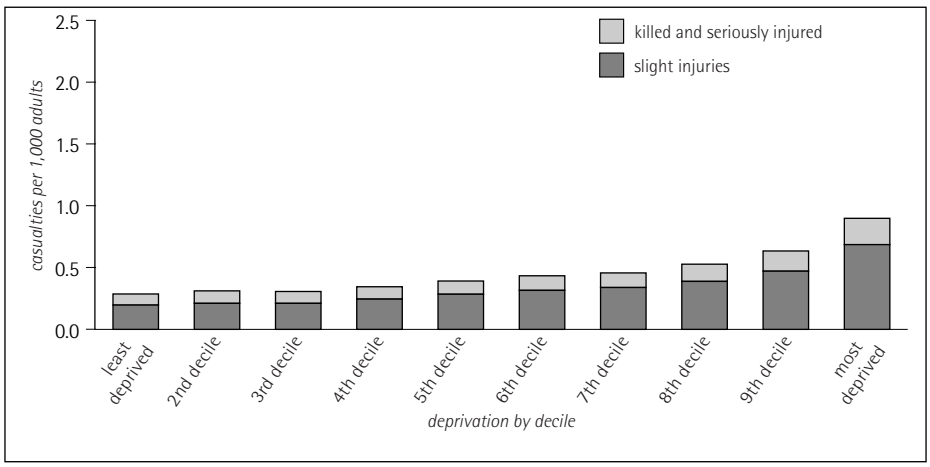


figure 10 Annual average rates of adult (16+) pedestrian casualties in deciles of English wards in 1999 and 2000



Higher rates of child pedestrian casualties in more deprived wards are compounded by larger child populations, because more people live in deprived wards and children are a larger proportion of the total. Figure 11 shows the number of child pedestrian casualties in each ten per cent of wards grouped by deprivation. It shows a steeper gradient. More than a quarter of child pedestrian injuries in England in 1999 and 2000 occurred in the ten per cent most deprived wards. This is the case for both deaths and serious injuries and for minor injuries.

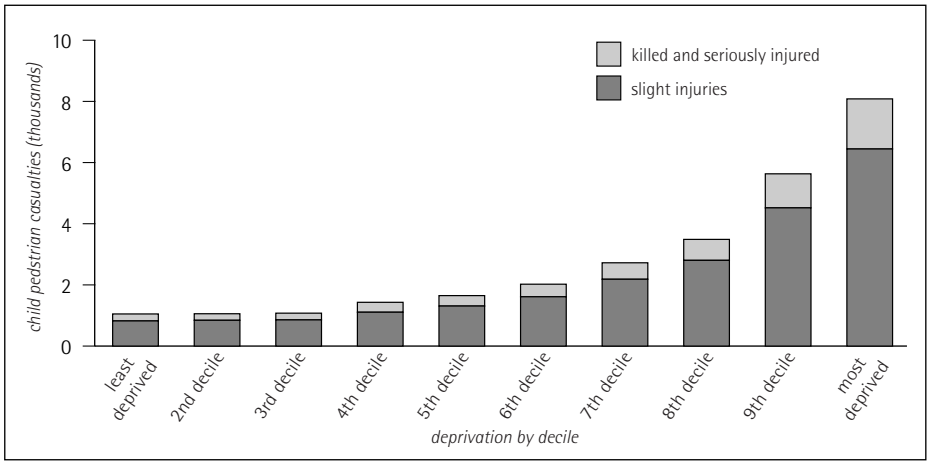


figure 11 Numbers of child pedestrian casualties in deciles of English wards in 1999 and 2000

an independent deprivation effect

We found a strong correlation between child pedestrian casualty rates and deprivation but also a great deal of unexplained variation between wards with similar deprivation scores. Some of this would be random variation owing to the small number of casualties in each ward but as noted earlier, simple correlation can also be misleading. Our statistical model enabled us to test whether there was a relationship between casualty rates and deprivation scores independent of other demographic and environmental factors. We found that there was and that it was highly statistically significant.

Table 4 shows how pedestrian casualty rates change with the different factors in our model. For example, an elasticity of 0.38 for the relationship between deprivation and child pedestrian casualties implies that a 10 per cent increase in score on the index of multiple deprivation is associated with a 3.8 per cent increase in the number of casualties, all other factors being held constant. This is a measure of the effect of deprivation independent of the other factors. The association is similar for deaths and serious injuries and for all categories of injuries. Using this elasticity, we estimated that the most deprived ward in England was more than four times as likely to have a child pedestrian casualty as the least deprived ward purely as an effect of deprivation. Our analysis also picks up an independent effect of deprivation on adult pedestrian casualty rates, although it is less strong. The elasticity is 0.23 and implies that an increase of 10 per cent in score on the index of multiple deprivation is associated with a 2.3 per cent increase in the number of adult pedestrian casualties.

Thus a central conclusion of our analysis is that having controlled for the other factors that we believe to be important in influencing rates of pedestrian casualties, we can still determine a distinct deprivation effect. This effect is present for both children and adults but is greater for children. The relationship is similar for minor and serious injuries. It appears that the effect of deprivation on the number of pedestrian casualties does not simply arise because deprived wards happen to be those with more traffic, or more densely developed, or with more roads.

The other results in Table 4 are discussed in more depth in the report on ippr's website but it is worth making a few observations. In assessing each of these factors, we have controlled

table 4 Effect of deprivation and other demographic and environmental factors on rates of pedestrian casualties in English wards 1999 & 2000

	Elasticity estimated from statistical model			
	Child (0-15 years) pedestrian casualties		Adult (16+ years) pedestrian casualties	
	all casualties	*killed and seriously injured*	*all casualties*	*killed and seriously injured*
Score on index of multiple deprivation	0.38	0.40	0.23	0.23
Child (0-15 years) population	0.18	0.15	-0.30	-0.32
Population	1.08	0.92	1.40	1.16
Population density	-	0.07	-0.61	-0.42
Population in proximity to ward	1.98	0.84	0.67	-
Employment	0.00	-	0.03	0.25
Employment density	0.11	0.08	0.31	0.24
Employment in proximity to ward	-1.84	-	-0.94	-
Road junctions	0.17	0.00	0.27	0.28
Length of A road	0.05	0.06	0.16	0.24
Length of B road	-	-	-	0.05
Length of minor road	-0.35	-0.21	-0.34	-0.19
Length of motorway	-	-	0.00	-
Annual rainfall	0.49	0.56	0.39	0.34
Annual sunshine	-0.55	-	-	-

note missing values indicate that there was no statistically significant relationship found

for all of the others. For example, we estimated that increasing the population by 1,000 would on average be associated with an increase of about 18 per cent in the number of child pedestrian casualties and about 25 per cent in adult pedestrian casualties. Since we have controlled for the number of children, this population effect is simply showing that where more people live, and presumably are active as drivers and pedestrians, more pedestrian injuries occur.

Similarly, we estimated that increasing the child population by 1,000 would on average increase the number of child casualties by about 15 per cent. Since we controlled for total population, in effect we had assessed increasing the proportion of children. It is therefore not surprising that an increase in child population was associated with a decrease in adult pedestrian casualties.

Population density appeared to have little impact on child pedestrian casualties but higher population density was associated with fewer adult pedestrian casualties. While adults were less likely to be knocked down in dense residential wards, they were more likely to be pedestrian casualties in wards with high employment density. It could be that adults spend more time walking near to work than near to home. Higher employment density was also associated with higher casualty rates for children pedestrians, though the effect was less strong than for adults. This suggested that areas with high employment density were more dangerous for pedestrians in general, perhaps because of the type and level of traffic.

Whereas an increase in population nearby was associated with more pedestrian casualties in the ward, an increase in nearby employment apparently had the opposite effect. In each case the effect was more intense for children than for adults. Thus two potential generators of traffic and pedestrian activity were having opposite effects. It appeared that pedestrian casualty rates were likely to be higher in wards in the midst of residential development than wards surrounded by industrial development.

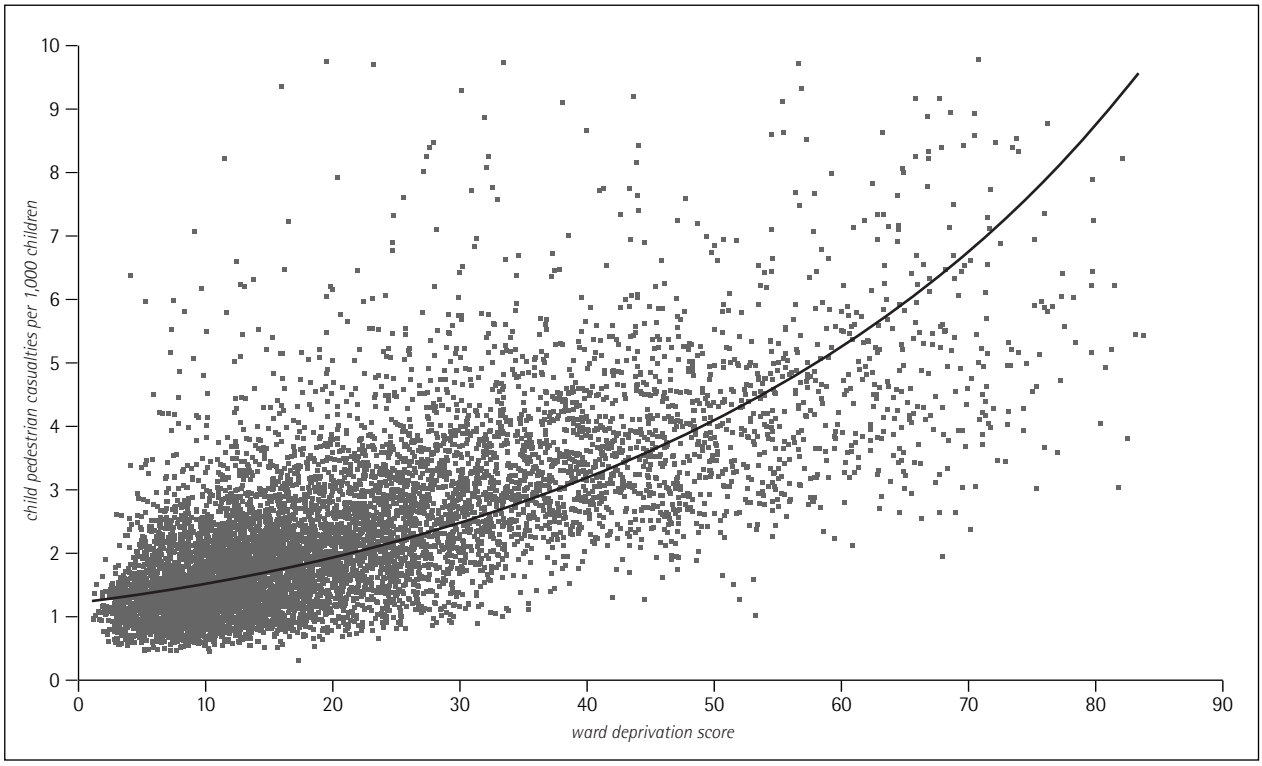
The more road junctions and the greater the length of A road in a ward, then the more pedestrian casualties there were likely to be, with a stronger effect for adults than children. By contrast, it appeared that the more minor road length, the fewer pedestrian casualties

there were likely to be, with very similar effects for adults and children and a stronger effect on minor injuries than on deaths and serious injuries. Perhaps it suggests that areas with more minor roads have less fast traffic.

As might be expected, there were more pedestrian casualties if it rained more, which makes conditions for both driving and walking worse. We estimated that an extra ten centimetres annual rainfall was associated with a 7 per cent increase in the number of child casualties and a 6 per cent increase in the number of adult casualties. The more hours of sunshine there were, the fewer child pedestrian casualties there were likely to be, though there was no discernible impact on adult pedestrian casualties.

Combining all of these factors together, Figure 12 shows how well our model is able to predict the rate of child pedestrian casualties. Compared to Figure 7, the amount of scatter is dramatically reduced as ward casualty rates have been adjusted for the effects of the other factors. Fitting an exponential curve, the model is able to explain 46 per cent of the variation in casualty rates between wards, which is a reasonable fit using data of this kind.

figure 12 Correlation between the model's prediction and actual incidence of child pedestrian casualties



separating the components of deprivation

The index of multiple deprivation incorporates six component indices of deprivation, for income, employment, health, education, housing and accessibility. Each is given a particular weight in the overall index. Having established an overall deprivation effect, we tested the effect of each of the components separately. The results are set out in Table 5 and reveal that different aspects of deprivation have very different effects, which are sometimes opposite for children and adults. The coefficients for elasticity measure the effect of changing one component of deprivation while the others are held constant. Their interpretation is speculative. In summary:

- Income deprivation was strongly associated with child pedestrian casualties but less strongly with adult pedestrian casualties. In fact, it appeared there were likely to be fewer serious injuries to adult pedestrians in areas with greater income deprivation.

- Employment deprivation was strongly associated with fewer child pedestrian casualties but a higher likelihood of adult pedestrian casualties. One interpretation could be that in areas of employment deprivation there is less traffic but unemployed adults spend more time there as active pedestrians.

- Health deprivation was strongly associated with greater numbers of child pedestrian casualties but less strongly associated with fewer adult pedestrian casualties.

- Education deprivation was positively associated with child pedestrian casualties but weakly associated with a reduction in adult pedestrian casualties.

- Housing deprivation was positively associated with both child and adult pedestrian casualties.

- Accessibility deprivation was associated with fewer child and adult pedestrian injuries, which makes sense since there is likely to be more traffic and pedestrian activity in areas where shops and other services are more accessible.

We recombined the six component indices into a new index of multiple deprivation, weighted according to the coefficients in Table 5, and reconfigured the model. Figure 13 shows how the predictive power of the model is improved, with the data points more closely clustered around the curve, which now explains 73 per cent of the variation in observed child pedestrian casualty rates, a very good fit.

table 5 Effect of different components of deprivation on rates of pedestrian casualties in English wards in 1999 and 2000

	Elasticity estimated from statistical model			
	Child (0–15 years) pedestrian casualties		**Adult (16+ years) pedestrian casualties**	
	all casualties	*killed and seriously injured*	*all casualties*	*killed and seriously injured*
Income	1.40	1.16	0.11	-0.22
Employment	-1.60	-1.24	1.83	2.12
Health	1.40	1.40	-0.20	-0.22
Education	0.36	0.71	-0.43	-0.19
Housing	0.41	0.27	0.66	0.64
Accessibility	-1.60	-1.03	-1.83	-1.55

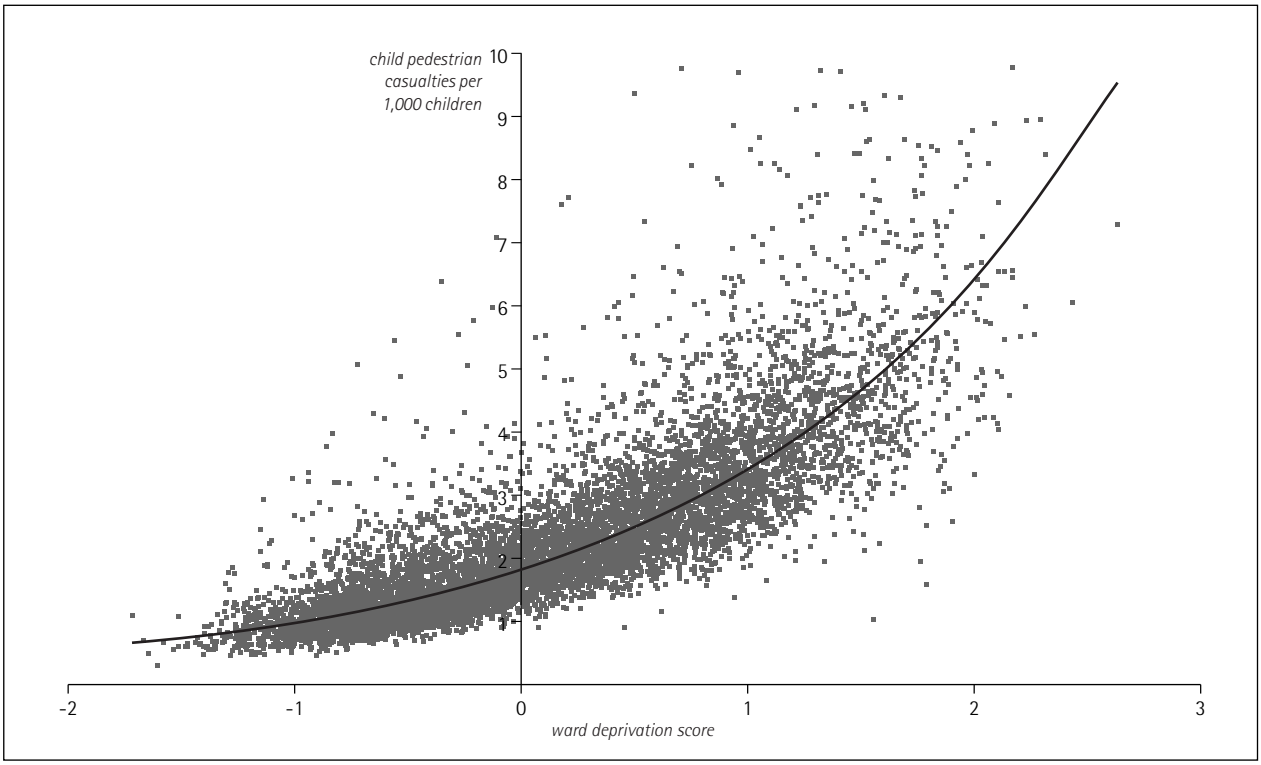
regional, urban and rural comparisons

To test whether the relationship between deprivation and pedestrian casualties varied between regions, urban and rural areas, we ran the model separately for the regions of England and for different area types. The results set out in Table 6 show that there is variation. Part of the explanation is the exponential curve describing the relationship between pedestrian casualty rates and deprivation, which is steeper at higher levels of deprivation (see Figure 13). Thus you would expect a stronger relationship in regions or area types with higher average deprivation scores. Generally speaking, the deprivation effect is stronger in urban areas and weaker in rural areas. London is an interesting case where the deprivation effect appears to be particularly strong for children but less so for adults.

Region or area type	Mean ward deprivation score (index of multiple deprivation)	Elasticity estimated from statistical model			
		Child (0–15 years) pedestrian casualties		Adult (16+ years) pedestrian casualties	
		all casualties	*killed and seriously injured*	*all casualties*	*killed and seriously injured*
East Anglia	18	0.37	0.55	-	0.30
South East	18	0.34	0.40	0.21	0.17
South West	19	0.39	0.37	0.33	0.33
East Midlands	21	0.29	0.41	0.24	0.41
West Midlands	22	0.36	0.40	0.14	0.27
Yorkshire & Humberside	26	0.30	0.24	0.10	0.18
North West	31	0.49	0.36	0.38	0.40
London	29	0.55	0.65	0.30	0.17
North	32	0.49	0.51	0.27	0.12
England	22	0.38	0.40	0.23	0.23
Wholly urban	25	0.41	0.43	0.26	0.29
Predominantly urban	19	0.39	0.46	0.22	0.32
Mixed urban	15	0.21	0.38	0.22	0.39
Wholly rural	15	0.26	-	0.07	-

table 6 Effect of deprivation on pedestrian accident rates in English regions and area types

figure 13 Improved predictive power of the model with weighted index of deprivation



note Data points are more closely clustered around the curve, which now explains 73 per cent of the variation in observed child pedestrian casualty rates—a very good fit

review of local transport plans

To provide a context for our survey of 20mph zones, we reviewed the statutory five-year local transport plans of all 85 top-tier county and unitary district councils in England outside London. Some of our main findings are set out in Table 7. Further detail is given in the report published on the ippr website.

Virtually all the local transport plans adopt the national targets for reducing road deaths and serious injuries but less than half are clear that the targets can be met at local level.

table 7 Road casualty reduction policies in transport plans of English local authorities outside London

Feature of Local Transport Plans	Number and percentage of Local Transport Plans					
	Yes		No		Unclear	
	No	*%*	*No*	*%*	*No*	*%*
Adopt national road casualty reduction targets for deaths and serious injuries adopted	83	98	0	0	2	2
Indicate national targets are achievable locally	33	39	2	2	50	59
Additional local road casualty reduction targets	60	71	13	15	12	14
Local road safety performance indicators	47	55	21	25	17	20
Partnership with other agencies to achieve road casualty reductions	69	81	0	0	16	19
Partnership with police	58	68	-	-	-	-
Partnership with health authority	41	48	-	-	-	-
Speed management strategy	29	34	29	34	16	19
Speed management strategy under development	11	13	-	-	-	-
Use casualty history to decide where to implement traffic calming	63	74	-	-	-	-
Implement traffic calming as part of regeneration schemes	13	15	-	-	-	-
Take social factors into consideration when planning traffic calming	25	29	-	-	-	-

note a dash indicates that the data was not collected

A majority of local authorities have set additional local casualty reduction targets, as encouraged by the government guidance. Relevant examples include Hull, which aims to halve the number of child pedestrian deaths and serious injuries by 2010, and Merseyside, which aims to cut the number of minor injuries to child pedestrians by 20 per cent by 2010. Most of the transport plans also include local road safety performance indicators. For example, Bedford measures the length of the road network covered by 20mph zones and North Nottinghamshire measures the amount of traffic calming and 20mph zones implemented and planned.

Three quarters of local transport plans cite casualty history as a major factor in deciding where to put traffic calming, while 15 per cent implement traffic calming as part of regeneration schemes and 12 per cent mention that they take social factors into consideration, especially deprivation. For example, Merseyside state that the poorest residents have the highest injury risk and that traffic calming should be targeted to take this into account and Wiltshire locates zones in areas where there are the greatest numbers of vulnerable road users. Only a third of authorities currently have a clear speed management policy, which is surprising given the importance of speed in terms of both the number and severity of road casualties.

Eight out of ten of the local transport plans highlight partnership working to reduce road casualties, most commonly with the police and local health authorities, though there is clearly room for improvement. A much smaller number mention transport operators, such as County Durham working with bus operators, or other partner organisations such as Greater Nottingham working with employers and the emergency services. In general, we found that the local transport plans were often ambiguous and difficult to interpret. They would benefit from a standard format that encourages brevity and clarity.

survey and analysis of 20mph zones

Of the questionnaires distributed to all the 171 unitary and county councils in England and Wales, we received 119 completed forms, a response rate of 70 per cent. Some of the key findings are set out in Table 8. Eight out of ten local authorities that responded had implemented traffic-calmed 20mph zones, an average of seven each for those with zones. Most planned to introduce further zones. Of the authorities without 20mph zones implemented, 14 planned to introduce them and ten had no plans to do so. Accident record and local demand were the most important factors determining the location of zones. Proximity to schools was also a common feature.

table 8 Local authority survey of 20mph zones in England and Wales

Do you have any traffic calmed 20mph zones?

Yes 95 (80%) No 24 (20%)

How many implemented zones do you have?

Total number 684

Do you have any (further) traffic calmed 20mph zones planned?

Yes 92 (79%) No 27 (21%)

How many new zones do you have planned?

Total number 441

How did you decide where both existing and planned zones would be located?
for the 107 local authorities with existing or planned 20mph zones

Accident record	82	(77%)
Local demand	75	(70%)
Safe routes to school	23	(21%)
Near schools	15	(14%)
New housing development	7	(7%)
Target deprived areas	1	(1%)
Vulnerable users	5	(5%)
Child pedestrians	1	(1%)
Speed problems	2	(2%)
Parking zone related	4	(4%)
Near services	3	(3%)
Rat runs	4	(4%)

Figure 14 shows a map of England and Wales highlighting the authorities that responded to the survey and the location of planned and implemented 20mph zones. Using the grid references and postcodes provided, we were able to show that wards with existing or planned 20mph zones tended to have higher deprivation scores and casualty rates than wards without 20mph zones and that the difference was highly statistically significant.

While in general 20mph zones were placed in more deprived wards with higher pedestrian casualty rates, there was variation between individual authorities. Table 9 shows the results of analysis of a selection of local authorities. For example, Leeds has targeted its 20mph zones in its more deprived wards and those with higher predicted casualty rates. On the other hand, Ealing did not appear to have targeted its 20mph zones either in areas of high deprivation or predicted high casualty rates, though reported that it was now trying to move away from simply meeting local demand towards taking accident rates into account.

The London Borough of Camden was the only authority in our survey that claimed an explicit policy of targeting 20mph zones in more deprived areas. Although the policy may have been successful on other grounds, such as improving the overall liveability of these areas, our analysis suggests that greater casualty reductions might have been achieved if Camden had

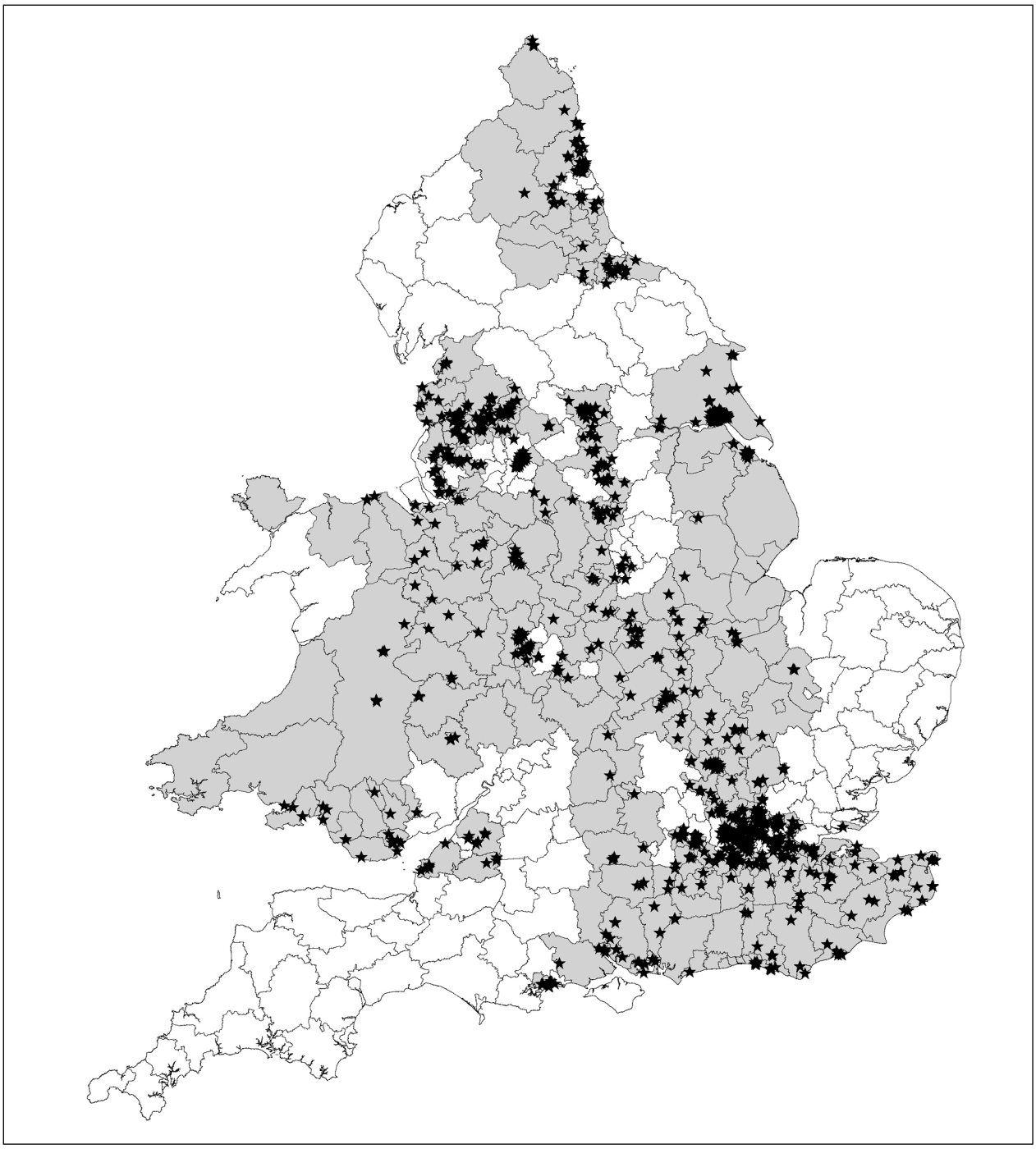


figure 14 Location of planned and implemented 20mph zones in England and Wales (shaded areas indicate local authorities who responded to the survey)

instead placed its zones in wards with higher predicted casualty rates. This makes the point that deprivation is only one of a number of important factors to take into account in targeting traffic calming measures.

Local authorities often locate 20mph zones where there has been a high incidence of pedestrian casualties in the past. However, pedestrian casualties can occur infrequently (see Figure 6), so there is a significant random element in the historical record for any one location. Therefore it is difficult to be confident that the implementation of traffic calming measures in a certain area is the right decision: the probability of casualties occurring in another area may be higher and therefore funds could have been better allocated to another area. By using the statistical model, we can identify in which wards pedestrian casualties are most likely to occur. It should be noted that the model only provides generic evidence upon which to make decisions regarding the location of traffic calming measures. There may be

table 9 Location analysis of traffic-calmed planned and implemented 20mph zones in selected local authorities

	Number of 20mph zones	*Minimum ward deprivation score*	*Maximum ward deprivation score*	*Average deprivation score: all wards*	*Average deprivation score: wards with 20mph zones*	*% difference in average deprivation score between wards with and without 20mph zones*	*Average weighted casualty score: all wards*	*Average weighted casualty score: wards with 20mph zones*	*% difference in average weighted casualty score between wards with and without 20mph zones*
Leeds	22	7	55	27	40	48	0.136	0.302	122
Blackburn & Darwen	14	7	72	43	50	17	0.084	0.113	34
Oldham	32	8	71	39	48	23	0.089	0.113	27
Hull	106	18	73	45	49	9	0.082	0.096	18
Windsor	20	3	12	7	7	-6	0.050	0.058	15
Luton	78	10	53	29	39	36	0.072	0.082	14
Kent	50	1	71	18	21	15	0.057	0.064	13
Lancashire	112	5	74	24	30	24	0.059	0.066	12
Sandwell	11	22	69	43	47	10	0.089	0.095	7
Hammersmith & Fulham	22	9	57	30	34	12	0.156	0.164	5
Ealing	36	8	48	26	28	7	0.095	0.096	1
Greenwich	15	9	63	36	40	9	0.092	0.093	1
Kingston-upon-Thames	16	5	74	24	30	24	0.059	0.066	12
Camden	16	8	65	36	42	15	0.200	0.150	-25

specific local factors in the ward, such as the lack of houses with gardens or a particularly dangerous junction, which have not been incorporated explicitly in the statistical model.

case study: 20mph zones in Hull

The City of Kingston-upon-Hull can rightfully claim the title of traffic calming capital of Britain, with more than one hundred 20mph zones covering a quarter of its road length, in total 120 miles of road subject to the 20mph limit. Hull is a city of about a quarter of a million people, in the north east of England, with a relatively high level of deprivation. Three of Hull's 20 electoral wards are among the 100 most deprived in England and all are in the 30 per cent most deprived.

Hull began a programme of 20mph zones in 1994, its 50th zone was implemented in 1998 and the 100th in 2002. Since 1994, Hull has a much better record of road casualty reduction than Britain as a whole. Figure 15 shows that the number of road casualties in Hull has been cut by 20 per cent, while the number of deaths and serious injuries and the number of pedestrian casualties have each been cut by about 40 per cent. The equivalent figures for Britain are little change in the overall number of casualties and about a 20 per cent reduction in both deaths and serious injuries and pedestrian casualties. A study of 13 of Hull's 20mph zones implemented in 1996/97 showed dramatic reductions in casualties (Table 10), similar to experience elsewhere (see Table 3). Hull has spent about £4 million on the programme to date, which has paid back over and again in casualty reductions. If we assume that about half the serious road injury reductions would have happened anyway, in line with national trends, then we estimate that since 1994 Hull's programme of 20mph zones has already saved about 200 serious injuries and about 1,000 minor injuries. At standard valuations of injury costs (about £150,000 for a serious injury and £15,000 for a slight injury), these savings are worth well over £40 million, so that the programme has already paid for itself at least ten times over.

figure 15 Reduction in road casualties in Hull and Great Britain

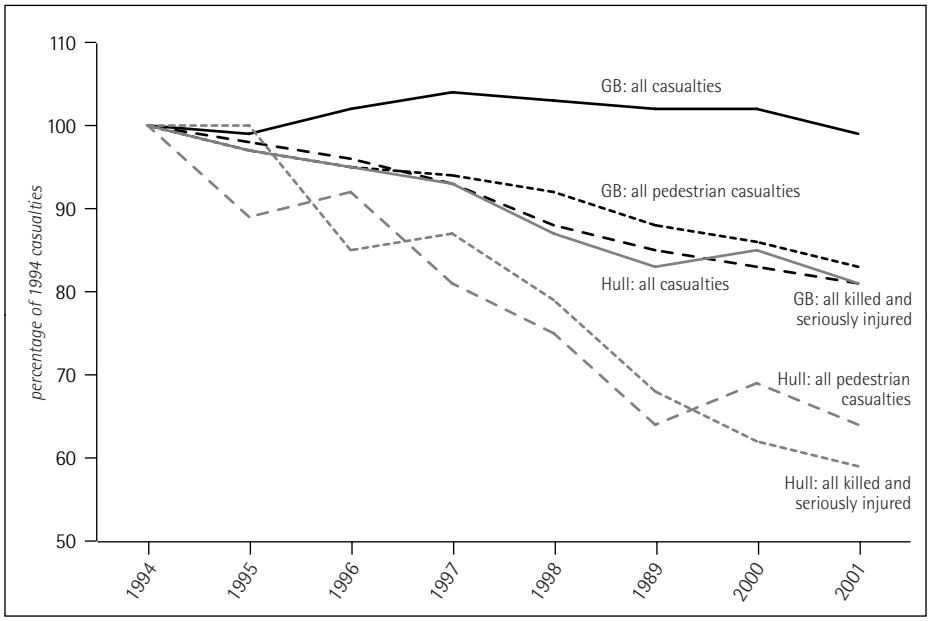


table 10 Accident reduction in 13 of Hull's 20mph zones

	casualties in 3 years before zones implemented	*casualties in 3 years after zones implemented*	*percentage change*
All injury	204	90	-56
Death and serious injury	39	4	-90
All pedestrian injury	70	32	-54
Child pedestrian injury	30	9	-74
All cyclist injury	55	30	-45
Child cyclist injury	13	4	-69
All child injury	50	18	-64

In the course of its programme, the council has gained great experience in consulting residents, designing zones and keeping the emergency services and bus operators on board. In every case, the emergency services have supported the measures and in some cases it has been possible to improve access for emergency service vehicles by the design and implementation of the schemes. Children at local primary schools design the customised signs for each zone (one is illustrated on the front cover) which are popular with residents. A survey of more than 500 residents in 20mph zones in August 2000 found that almost eight out of ten thought the zone where they lived was a good idea and seven out of ten would recommend traffic calming to other areas. More than half agreed that the zones had made their areas more pleasant places to live, an encouraging result in areas that suffer many other problems. Council officers reckon that 60 per cent of Hull's road length is suitable for 20mph zones. There is a queue of schemes waiting to be implemented. On traffic calming, Hull is a beacon of good practice for other councils to follow.

discussion

Our research has reinforced the findings of earlier studies showing that social inequality underpins Britain's relatively poor record on child pedestrian safety. While earlier studies were either based on individuals' social class or local area studies, we have been able to go further by mapping pedestrian casualties and deprivation across the whole of England. Moreover, we have been able to demonstrate that the higher pedestrian injury rates in deprived areas are not simply a consequence of the environment. There is a deprivation effect over and above the effect of the built environment and traffic conditions. This effect is stronger for children than adults and stronger in deprived urban areas than in less deprived rural areas. It is particularly strong for children in London, which is highly urban and where there are high levels of deprivation. The most likely explanation is differences in people's behaviour (Christie 1995). Children and adults in deprived areas are less likely to get about by car and are more likely to make journeys on foot. Kids from deprived backgrounds are less likely to have gardens to play in and are more likely to play on the street unsupervised. Thus people in deprived areas are more likely to be exposed to traffic danger.

We would like to have gone further in our analysis by using the postcode data on the residence of casualties as well as the accident locations, as this would be likely to shed some light on the behavioural question, for example the difference between adults and children. This analysis would be in the public interest and not in any way infringe on the civil liberties of individual pedestrian casualties, who would not be identified. We hope that the data protection issue can be overcome.

Regardless of the underlying causes, there are some highly cost-effective ways of reducing pedestrian casualties, including spot measures like pedestrian crossings but in particular area-wide traffic calming. The Transport Research Laboratory (TRL) has shown that the first year injury savings from area wide traffic calming schemes are on average worth more than double the capital costs. On a national scale, TRL conservatively estimated that a £3 billion programme of traffic calming would save one in four road casualties in urban areas, 50,000 casualties a year (DETR 1997). This is small beer in the context of the government's £180 billion ten-year transport plan (DETR 2000c).

A study comparing the Netherlands and Britain found that children in both countries spent on average about half an hour a day walking but in the Netherlands mainly on quiet, traffic-calmed streets and Britain more on fast, busy main roads. The analysis showed this to be a large part of the explanation of the Netherlands' better record on pedestrian safety (Bly *et al* 1999). We recommend that in built up areas of Britain, traffic calmed roads with speed limits no higher than 20mph should become the norm. Without further impetus from the centre it surely will not happen.

Our survey of local authorities in England and Wales showed that most are putting in only a small number of 20mph zones covering a tiny fraction of roads in residential and built up areas. On the whole, local authorities are implementing these zones in areas with higher levels of deprivation and pedestrian casualty rates but they could do better. In the course of our work, we have developed a powerful analytical tool, which could be used to guide traffic calming policies. A few local authorities stand out as ahead of the game, notably Hull, which

has so far spent £4 million on its programme of 20mph zones, about £40,000 per zone, which appears to have been worth every penny in casualty reductions alone.

We are encouraged that in the course of our research and as a result of our input through the Social Exclusion Unit, the Treasury has amended one of its public service agreement targets with the Department for Transport (HM Treasury 2002). Thus the national road casualty reduction targets should now be achieved while tackling the significantly higher level of casualties in disadvantaged communities. In our opinion, this means reducing traffic speeds in built up areas and targeting traffic calming in particular in deprived areas with high pedestrian casualty rates. We recommend that all local transport plans should include pedestrian casualty reduction targets. These should preferably be expressed in terms of casualties per mile walk so that they cannot simply be achieved by a reduction in walking. We also recommend that all local transport plans should include a speed management strategy, covering speed limits, their enforcement and traffic calming policies.

In spite of good intentions, the government has so far been weak in the face of the media and motoring lobby on the questions of traffic speed, pedestrian safety and street liveability. It is possible that the national road casualty reduction targets could be achieved without making streets safer for pedestrians, simply as a result of reductions in car occupant casualties and the ongoing decline in walking. That would hardly be consistent with an urban renaissance. Almost 40 years ago, the Buchanan report on traffic in towns concluded that speeds above 20mph were incompatible with residential areas (HMSO 1963). It is shocking that so little progress has been made. Other northern European countries like the Netherlands and Germany are streets ahead, with widespread traffic calming and speed limits of 30kph (18mph) or lower. The previous Conservative government came round to the idea of developing a strategy for pedestrians, setting up a steering group for the purpose in 1996. The strategy was downgraded to advice to local authorities by the present government (DETR 2000e). The Labour government should now make amends by publishing a strategy for walking that is not only about making streets safer for pedestrians, but about increasing the number of journeys made on foot and promoting improvement in urban design. The Government should promote an increase in walking and cycling at the same time that the number of pedestrian and cyclist casualties is reduced.

Reducing traffic speeds is extremely effective in reducing the severity and number of road casualties but only a first step in encouraging more pedestrian activity. A study of five urban 20mph zones showed that residents liked them and the number of road casualties was dramatically reduced but there was little evidence of increased pedestrian activity by children or adults (DTLR 2001). It is highly desirable for both social and environmental reasons to encourage more journeys on foot and more street life. The classic San Francisco street liveability study showed that the traffic environment could have a profound effect on neighbourhood community life (Appleyard 1970). Comparing architecturally similar streets but with different levels of traffic, it found that the street with fast heavy traffic was alien territory even to its residents who tended not to know their neighbours. By contrast, children played on the quiet street and many families lived there, counting neighbours among their friends and acquaintances. The study led to the designation of residential protected areas and contributed to one of the first modern urban design plans (San Francisco Department of City Planning 1971).

Traffic calming needs to be seen in the context of wider urban design, street liveability and transport policies, to achieve the urban renaissance that the government desires. The introduction of home zones, in which the whole street is redesigned to give priority to pedestrians, children and cyclists over motorised traffic, combined with the lower speed limit, is another step in the right direction. We need to move rapidly beyond a few demonstration projects to their widespread implementation in residential areas. In the Netherlands and

Denmark, even home zones are no longer cutting edge. Traditional traffic engineering aims to separate pedestrians, cyclists and motor vehicles. With widespread acceptance of 30kph (18mph) or lower speed limits, in Holland and Denmark in a number of areas it has been possible to deregulate traffic so that there are no road markings or traffic lights and pedestrians and other road users are on the same level. Thus the diverse users of the street must make eye contact and negotiate at junctions, with the result that there are fewer casualties and traffic flows more smoothly (Hamilton-Ballie 2001). Britain has a lot of catching up to do.

The transport debate is often presented in polarised terms as if people are either pro- or anti-car. The real debate is about a balance of freedoms, of rights and responsibilities of different road users. A conservative view is that roads are for cars and pavements for people and never the twain shall meet. Thus if accident rates are higher in deprived areas, then children should be taught better road sense and parents should keep an eye on them, if not keep them off the streets. A more liberal view is that children should have the freedom to play and explore their environment and that doing so is an important part of growing up. The age of the motor car has undoubtedly had a profound effect on children's freedom of movement. One classic study surveyed children at five primary schools across England in 1971 and the same schools again in 1990 (Hillman *et al* 1990). Children's licence to get about independently had been dramatically constrained, most graphically illustrated in the proportion of 7 and 8 year-olds getting to school by themselves, which had declined from 80 per cent to 9 per cent. The visibility and freedom of children is surely one of the marks of a civilised society. If the freedom of children is constrained in the motor age, then public policy should seek to rebalance the rights and responsibilities of road users towards children's rights and motorists' responsibilities. This means tackling the issue of speed head on, both speed limits and their enforcement, and that will require leadership from the top. The prize is safe and liveable streets for children, surely an election winning agenda.

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