EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Evaluation of the health effects of a neighbourhood traffic calming scheme

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Study objective: To assess the secondary health impacts of a traffic calming scheme on a community.
Methods: Prospective cohort study of a randomly selected sample of the local community using postal questionnaires and pedestrian counts on the affected road six months before and six months after the implementation of the scheme. The setting was a community in which a traffic calming scheme was built in the main road (2587 households). The Short Form 36 version 2 was included in the questionnaire and summary measures of physical health (physical component summary) and mental health (mental component summary) calculated. A random sample of 750 households was initially posted the pre-intervention questionnaire.
Main results: There were increases in observed pedestrian activity in the area after the introduction of the traffic calming scheme. Physical health improved significantly but mental health did not change. Traffic related problems improved, while other local nuisances were reported to be worse.
Conclusions: The introduction of a traffic calming scheme is associated with improvements in health and health related behaviours. It is feasible to prospectively evaluate broader health impacts of similar transport interventions although poor response rates may limit the validity of results.

Transport is an important determinant of public health. It affects physical activity levels, accidents and injuries, social and economic opportunities, and general wellbeing.[1] However, research evidence on the effects of transport interventions on health seems to be heavily weighted towards injuries and accidents and these have been the sole focus of identified systematic reviews.[2 3] These highlight an important gap in research on the potential to make wider health impacts through increasing walking and cycling, improving perceptions of safety, and improving the environment and neighbourhood context.[4 5]

Traffic calming schemes are common neighbourhood based transport interventions that are primarily intended to reduce accidents and injuries to pedestrians through traffic speed reduction. Systematic reviews suggest that traffic calming schemes do reduce the number of accidents by around 15%[3] and a recent Cochrane review[6] of area wide traffic calming in towns and cities suggested that it may be a promising intervention for reducing the number of road traffic injuries and deaths, with a pooled rate ratio of 0.89 (95% CI 0.80 to 1.00). Other proposed benefits of traffic calming, based on cross sectional data, include improved pedestrian and cycling facilities leading to increased exercise, increased neighbourly interactions, reduced antisocial behaviour, increased green space and environmental improvements, and increases in property values.[7] Thus the net effects of traffic calming may go well beyond injury reduction to improvements in broader aspects of health and wellbeing.

Empirical support for some of these proposed secondary impacts is sparse but in one recent UK study residents reported increased neighbourly interaction, improved perceptions of pedestrian safety, improved neighbourhood appearance, reduced crime risk and increases in walking (4%–28%) and cycling (1%–15%).[8] However, the focus of this study was on community acceptability, the study was retrospective, and no measure of health was included.

This paper presents the findings of a study that was designed to assess the secondary health and health related impacts on a local population after the introduction of a traffic calming scheme in a small deprived neighbourhood on the outskirts of Glasgow. Measures of health, perceptions of nuisance and risk from traffic, physical activity, and view of the neighbourhood environment before and after the scheme was put in place were compared and analysed for changes.

METHODS

The traffic calming scheme was built in the main road bisecting a deprived urban housing estate in Glasgow, Scotland. The scheme comprised five sets of speed cushions (raised platforms on the road to slow car drivers), two zebra crossings with adjacent railings, and creation of parking bays. We conducted postal questionnaire surveys and counted pedestrians before (first survey) and after (second survey) it was built. All 2587 neighbourhood household addresses were obtained from a commercial data company, CACI Inc International, and a random sample of 750 selected using SPSS software. The sample size had sufficient power to detect 10% differences between before and after prevalences assuming a 25% non-response rate. Questionnaires were posted to all 750 addresses followed by up to two reminders if no reply was received. In the second survey we sent questionnaires to the same addresses, excluding those who had asked not to be contacted again or where an address no longer existed. The second survey comprised 576 addresses who were sent a questionnaire and up to two reminders.

The same questionnaire was used at both time points and comprised 23 main questions, some of which had dependent questions or sections. It included questions on ease of use of different modes of transport, perceptions of the neighbourhood, and perceptions of traffic problems and safety. Health was measured using the SF-36 version 2 (SF-36v2).[9] We encouraged residents to respond by offering a £50 supermarket voucher to a randomly selected respondent in both the first and second waves of the survey. We reported on the results of the first survey by distributing an information leaflet.[10]

A market research company, Count on Us, conducted before and after pedestrian counts at three locations on the affected road. The first survey was carried out on Tuesday 27 June 2000

Abbreviations: SF-36v2, Short Form 36, version 2; PCS, physical component summary; MCS, mental component summary

Table 1 Age, sex characteristics of first and second survey samples, with 2000 mid-year estimates of local population (95% confidence intervals for population shown)

	Male			Female			All		
Age	first n, %	second n, %	census	first n, %	second n, %	census	first n, %	second n, %	census
15–24	4 (2)	3 (2)	9.7% (6.9 to 12.4)	4 (2)	3 (2)	9.5% (6.7 to 12.2)	8 (3)	6 (3%)	19.1% (16.5 to 21.7)
25–34	13 (5)	6 (3)	10.0% (7.3 to 12.7)	38 (16)	29 (16)	10.8% (8.0 to 13.5)	51 (21)	35 (19%)	20.8% (18.2 to 23.3)
35–44	13 (5)	9 (5)	8.1% (5.4 to 10.9)	38 (16)	26 (14)	9.7% (7.0 to 12.4)	51 (21)	35 (19%)	17.8% (15.2 to 20.4)
45–54	15 (6)	13 (7)	7.0% (4.2 to 9.8)	30 (12)	29 (16)	7.4% (4.6 to 10.2)	45 (19)	42 (23%)	14.4% (11.7 to 17.0)
55–64	18 (7)	12 (7)	4.5% (1.7 to 7.3)	12 (5)	9 (5)	5.3% (2.5 to 8.1)	30 (12)	21 (12%)	9.8% (7.1 to 12.6)
65–74	12 (5)	11 (6)	4.1% (1.3 to 6.9)	16 (7)	13 (7)	5.6% (2.9 to 8.4)	28 (12)	24 (13%)	9.7% (7.0 to 12.4)
75+	7 (3)	9 (5)	2.8% (−0.1 to 5.6)	22 (9)	11 (6)	5.6% (2.8 to 8.4)	29 (12)	20 (11%)	8.4% (5.6 to 11.1)
Total	82 (34)	63 (34)	46.1% (44.0 to 48.2)	160 (66)	120 (66)	53.9% (51.9 to 55.8)	242* (100)	183* (100%)	100.0%

*Two missing data on both age and sex.

and the second on Thursday 28 June 2001. Both recorded all pedestrian activity between 08 00 and 18 00 hours. In the first survey, the weather was overcast and in the second the weather was dry with intermittent showers. Schools were in term time in both surveys and there were no public holidays.

Questionnaire data were entered on SPSS software twice by two administrative staff and discrepancies between the two were resolved by a third person (DSM). The SF-36v2 was scored according to protocols described by Ware and others.[9] We used United Kingdom norms[11] to standardise the results by z score and *t* score transformations. The SF-36v2 was scored to produce two summary measures—the physical component summary (PCS) and the mental component summary (MCS). In all 131 cases where a second questionnaire was received from the same address, the age and sex of the respondents suggested that the same person had completed both questionnaires and we therefore used paired *t* tests to evaluate changes in self reported health in these people. In 117 cases there were sufficient items completed in the SF36v2 to conduct paired analyses. The Wilcoxon signed ranks test was used to compare changes in perceptions of traffic safety, attitudes to the local neighbourhood, levels of walking in the local area, and safety for children to play and exercise outside.

RESULTS

Response rates

After allowing for questionnaires that were returned undelivered by the Post Office (126, 16.8%), 244 of 624 (39.1%) replies were received from the first survey. Altogether 185 replies were received from the second survey, a response rate of 32.1% (185 of 576). Both samples comprised two thirds women and were older than the local population (table 1). Male respondents were slightly older than female respondents, although this was not statistically significant in the first survey.

Changes in the local environment

Residents rated their happiness with the area on a visual scale of 1 (happiest) to 7 (unhappiest). There was no significant difference in overall feelings about the area between the first and second surveys, with the median being ''fairly happy'' in both surveys (Wilcoxon signed ranks, $z = -0.693$, $p = 0.488$).

Table 2 How much of a problem are the following for you? Individually matched differences between first and second survey answers (n = 131, Wilcoxon signed ranks test)

Problem		Δ	Z	p (two tailed)
Road safety				
	Speeding traffic	<	−2.72	0.007*
	Road safety (for pedestrians)	<	−0.76	0.446
	Road safety (for cyclists)	<	−0.24	0.025*
	Road safety (for motorists)	<	−3.60	0.000*
	Crossing the road	<	−2.19	0.029*
Traffic	Noise from traffic	<	−2.83	0.005*
	Traffic fumes	<	−2.88	0.004*
	Vibration from traffic	<	−2.89	0.004*
	Parking	<	−1.96	0.050*
General environment				
	Lack of public transport	<	−1.18	0.236
	General facilities for pedestrians	<	−2.60	0.009*
	Safe children's play areas	<	−1.11	0.269
	Litter and rubbish	<	−0.30	0.767
	Smells and fumes	<	−1.56	0.004*
	Uneven or dangerous pavements	<	−2.86	0.784
Nuisance and crime				
	Facilities for teenagers/young people	<	−3.28	0.001*
	People drinking in public places	>	−0.59[neg]	0.557
	Adequate street lighting	>	−0.71[neg]	0.477
	People hanging around	<	−1.21	0.228
	Reputation of neighbourhood	<	−1.21	0.227
	Drug dealing and drug taking	<	−4.39	0.000*
	Other noise, for example, factories, shouting	<	−2.32	0.021*

Δ, change in problem (<less of a problem, >more of a problem). All based on positive ranks, except where indicated on negative ranks, *$p \leq 0.05$.

Table 3 Have you done any of the following more as a result of the introduction of the traffic calming scheme? From 185 replies to second survey

	Number	% (95% CI)
Walk in the area more (n=175)	35	20.0 (14.1 to 25.9)
Cycle in the area more (n=159)	6	3.8 (0.8 to 6.8)
Allow children to play out (n=152)	18	11.8 (6.7 to 16.9)
Allow children to walk more (n=152)	19	12.5 (7.2 to 17.8)
Allow children to cycle more (n=155)	18	11.6 (6.6 to 16.6)

In general, residents perceived that problems with road safety, traffic, and the general environment had improved after the traffic calming scheme was introduced. Road safety for cyclists and motorists but not for pedestrians, traffic nuisance, and some aspects of the general environment such as pedestrian facilities, and traffic smells and fumes were all reported to be significantly less of a problem in the second survey (table 2). Some aspects of nuisance and crime in the area were reported to have worsened by the time the second survey was carried out, such as public drinking and adequate street lighting, although neither change was statistically significant.

Changes in physical activity

After the introduction of the traffic calming scheme 20% of respondents said that they walked in the area more as a result of it. There were smaller percentages of respondents who said that they cycled or allowed children to play, walk, or cycle as a result of the traffic calming scheme (table 3). We did not, however, record whether people felt that the scheme had made them exercise less.

With the exception of pensioners on one stretch of the road, the pedestrian count recorded substantial increases at most sites and in most age groups after the traffic calming scheme was built (table 4), which corroborates the self reported increases in walking.

Table 6 Physical component score of SF-36v2 among those who reported walking more, and not walking more, as a result of the traffic calming scheme

Walking behaviour	First survey	Second survey	Difference (95% CI)
Have walked more (n=24)	31.6	43.7	+12.1* (6.7 to 17.4)
Have not walked more (n=86)	33.5	41.8	+8.3* (5.8 to 10.9)

*A higher score indicates better health. Eligible paired results, 117; 7, don't know; 110 pairs included in *t* test.

Health impacts: SF-36 version 2

Table 5 shows that there was a rise in physical component summary (PCS) scores between the first and second surveys that constituted a statistically significant improvement in physical health status. Mental component summary scores (MCS) fell slightly in men and improved slightly in women, but neither change was statistically significant.

Physical health status was not significantly different among those who did and did not report walking more as a result of the traffic calming scheme (table 6).

DISCUSSION

Health impacts of neighbourhood traffic calming

This study provides support for the proposed theoretical links that the health impacts of neighbourhood traffic calming schemes may go beyond accident and injury reduction.[1 7] Self reported physical health, observed pedestrian activity, and traffic related nuisance improved in the local population after a traffic calming scheme was built in the main road.

However, low response rates and selection biases may have affected our findings. Men were under-represented and it is possible that healthier people responded to the survey. Information biases might include a tendency for people to report improvements after a major engineering intervention in their neighbourhood, either because they feel they ought to, or

Table 4 Walking on Faifley Road—2000 and 2001, from 8 am to 6 pm. Changes in pedestrian counts, by age and site

	Child (<16 y)	Adult (16–60 y)	Pensioner (>60 y)
Site 1	+156	+134	+13
	18.0	12.3	5.9
	(15.4 to 20.6)	(10.3 to 14.3)	(2.8 to 9.0)
Site 2	+380	+709	+66
	44.1	54.9	36.3
	(40.8 to 47.4)	(52.2 to 57.6)	(29.3 to 43.3)
Site 3	+379	+144	−147
	40.0	11.4	−53.8
	(36.9 to 43.1)	(9.6 to 13.2)	(−48.3 to 59.3)

Percentage changes and 95% confidence interval shown.

Table 5 Change in SF36 physical and mental component scores: pre-intervention and post-intervention results from 117 individually paired analyses

	Mean					
	First survey		Second survey		Difference between surveys (95% CI)	
Summary score	Male (n=39)	Female (n=78)	Male	Female	Male	Female
PCS	31.3	33.2	42.0	40.7	10.7 (7.0 to 14.5)	7.5 (4.7 to 10.21)
MCS	51.6	45.1	49.3	45.9	−2.2 (−5.2 to 0.8)	0.8 (−1.5 to 3.1)

Key points

- The introduction of a traffic calming scheme was associated with increases in walking and willingness to allow children to exercise outside that were attributed to the traffic calming scheme; increased observed pedestrian activity; improvements in local traffic related nuisances; and improvements in physical health.
- Traffic calming schemes may have wider benefits on the health of a local population in addition to accident reduction.
- It is feasible to conduct prospective assessments of the health impacts of community interventions. These are likely to provide information on the wider health and social impacts of such interventions and may be used to inform future health impact assessments.

Policy, practice, and research implications

- Traffic calming schemes may be promoted on the basis of wider benefits to health than accident reduction.
- Outcomes other than injuries and crashes should routinely be assessed in transport interventions.
- Health impact assessments, where feasible, should gather prospective data on actual health impacts, as well as speculative data on potential impacts.

because of recall bias.[12] We asked only about increases in physical activity as a result of the traffic calming scheme (table 3) and a more balanced question would also have captured reductions and null effects on physical activity. A trade off was made by addressing letters to households rather than named individuals. Named letters might have been more likely to be answered by an individual but the pool of potential respondents would be restricted to only named residents. We did not control for temporal changes so that other social and environmental factors such as house building or changes in the local bus service may have confounded our findings. However, overall neighbourhood satisfaction was unchanged, suggesting that gross shifts in health and social perceptions had not occurred that might provide an obvious alternative explanation of the positive impacts reported. Despite the possible effects of systematic and random error on the findings of this study, the correlation between self reported changes in behaviour and observed behaviour suggest that changes may be real and not artefact.

An ideal study would include greater comparative data but this contributes to both the methodology and evidence for the wider impacts of social interventions, such as traffic calming. While the study does have drawbacks and more rigorous experimental evaluations are still required, it does indicate the possible scale and magnitude of public health impacts that may be expected from traffic calming, and is novel in attempting to quantify the wider effects on wellbeing of such schemes.

Assessing the health impacts of neighbourhood improvement

The identification of secondary health impacts linked to traffic calming is interesting and may also have implications for similar neighbourhood interventions prioritising pedestrian use of neighbourhood space such as the introduction of European style Home Zones in the UK (http://www.homezones.org/concept.html). These may generate positive health impacts beyond that of accident and injury reduction.

The impacts of complex community interventions are often difficult to assess. Findings can be difficult to interpret because of multiple social confounding factors and this may dissuade attempts to assess impacts. The ability of an intervention to meets its primary aims is likely be prioritised over assessing secondary health and wellbeing outputs. As a result surprisingly little is known about the health impacts of many social interventions, which is why we piloted a method of collecting such data.[13 14] As such, this study is comparatively unusual, showing that assessment of health impacts of community interventions is possible albeit subject to the effects of poor response rates, at least in the case of postal surveys. Intervention studies, like this one, can provide empirical evidence to support and add value to activities such as health impact assessment, where prospective judgements about possible health impacts of a specific community improvement are often required but where the current research evidence is scant.[15]

CONCLUSIONS

Measuring the wider health and health related impacts of a community based intervention, such as traffic calming, is feasible although significant resources may be required to help achieve acceptably high response rates and reduce bias. Bias can be reduced by triangulating self reported changes in behaviour with observed activity, as in this case. Our findings require validation in further observational and experimental studies but they do suggest that traffic calming schemes can have important health impacts for the affected community.

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