EVIDENCE BASED PUBLIC HEALTH POLICY AND PRACTICE

Increasing child pedestrian and cyclist visibility: cluster randomised controlled trial

C A Mulvaney, D Kendrick, M C Watson, C A C Coupland

J Epidemiol Community Health 2006;**60**:311–315. doi: 10.1136/jech.2005.038216

See end of article for authors' affiliations

Correspondence to:
Dr C Mulvaney, Division of
Primary Care, 13th Floor,
Tower Building, University
of Nottingham,
Nottingham NG7 2RD,
UK; Caroline.Mulvaney@
nottingham.ac.uk

Accepted for publication
19 December 2005

Study objective: Visibility aids have the potential to reduce child pedestrian and cyclist injury but scarce data exist relating to their use or to interventions for increasing visibility aid use among children. This cluster randomised controlled trial was designed to assess the use of free visibility aids one and eight weeks after their provision among primary school children in Nottingham, UK.

Design: One class from each of 20 schools representing 377 children aged 7, 8, and 9 years old participated in the trial and were randomly assigned to treatment and control arms. Children in the intervention arm received two visibility aids, namely, a reflective and fluorescent slap wrap (an item that can be worn around an arm or trouser leg and is readily removed), and a reflective durable sticker in addition to educational material on the importance of being seen in the dark. Observers visited schools to observe use of reflective and fluorescent slap wraps, stickers, piping and patches on coats, and bags at baseline and at one and eight weeks after distribution of the visibility aids. The study used random effects logistic regression to calculate odds ratios (OR) and confidence intervals (CI).

Main result: The results showed that children provided with free visibility aids were significantly more likely to use any visibility aid at one week (adjusted OR 59.5, 95% CI 18.5 to 191.0) and eight weeks (adjusted OR 5.9, 95% CI 3.4 to 10.4) after distribution than children in the control arm.

Conclusions: Providing free visibility aids and an educational booklet on road safety significantly increases use of visibility aids for up to eight weeks during the winter among primary school children. On the basis of an eight week follow up trial in Nottingham of 20 classes of children aged 7 to 9 years old, these results suggest that campaigns providing free visibility aids to primary school children should be encouraged.

Child pedestrian death rates in the UK are among the worst in Europe.¹ Between 15% and 24% of child road casualties occur on the school journey.² In Great Britain the number of children walking to school is decreasing³ with many parents discouraging their children from walking and cycling to school because they are worried about the dangers from traffic.¹ However, lower levels of physical activity are contributing to increasing rates of child obesity.⁴ While the government is encouraging more children to walk and cycle to school⁵ parents need to be assured of their child's safety on the journey.

Lack of visibility is an important factor contributing to injury in child pedestrian-motor vehicle collisions.⁷ Visibility aids have been found to improve drivers' responses in detecting and recognising pedestrians and cyclists⁸ and reflective or fluorescent clothing is associated with a 37% reduction in injury risk among motor cyclists.⁹ Although visibility aids have the potential to reduce child pedestrian and cyclist injury, scarce data exist relating to their use or to interventions for increasing visibility aid use among children. This study was undertaken to assess the effectiveness of providing free visibility aids on their use after one and eight weeks during the winter among primary school children in Nottingham, UK.

METHODS

Participants

All 81 state primary schools in Nottingham were faxed an invitation to take part in this cluster randomised controlled trial. Twenty (25%) responded and all agreed to participate.

One class of children aged 7, 8, or 9 years old from each school was chosen by the school to participate in the trial. Only one class was chosen from each school because of the difficulties of observing a large number of children leaving

school at one time possibly through multiple exits. After discussions with road safety officers at Nottingham City Council we provided the intervention to children in year 4 (aged 8 to 9 years) as at this age at least some children may walk or cycle home by themselves. However, some schools had a mixed class of children in years 3 and 4 resulting in a number of participating children aged 7. Written consent was obtained from parents for children to participate.

Intervention

A focus group was held with 10 children aged 8 and 9 years in a school not participating in the trial to determine children's preferences for a range of visibility aids. The two most popular aids were chosen for use in the trial. Children in classes in the intervention arm received a reflective and fluorescent slap wrap (a 30 cm × 3 cm × 0.3 cm item that can be worn around an upper arm or trouser leg and is readily removed), a reflective durable self adhesive sticker (3 cm × 3 cm × 0.3 cm), a Department for Transport road safety educational booklet¹⁰ that included a section on the need to be seen in the dark and two posters. Letters were sent to parents informing them about the visibility aids and the importance of wearing them. Children in the control arm did not receive the visibility aids and additional material until the end of the trial. All classes continued to receive the road safety education usually provided within the school.

Outcome measures

The primary outcome measure was wearing of reflective or fluorescent items at one and eight weeks after intervention. Observers visited participating schools at baseline in November and December 2004 before the intervention to observe use of reflective and fluorescent slap wraps, stickers, piping and patches on coats and bags. Visibility aids were

given to teachers of intervention classes to distribute after the baseline count. Further observations of visibility aid use were undertaken one week and eight weeks later. Observations were carried out at the end of the school day when children were leaving school. Children from participating classes were asked to get ready to go home with their coats and bags and

observations were made of each participating child as they left through the classroom door. Thus each child knew they were being observed, but they had not been informed in advance that observations would be made on that day. At each observation children were also asked how they were travelling home from school that day.

Table 1 Characteristics of participating children and schools by treatment arm. Figures are numbers (percentages) unless otherwise stated

	Control	Intervention
Sex		
Boy	94 (44.6)	80 (48.2)
Girl	117 (55.4)	86 (51.8)
Number of children per class given parental consent (median (IQR))	21 (19 to 24.5)	15.5 (13.8 to 19.5)
Percentage of children per class given parental consent (median (IQR))	83.2 (75.3 to 92.6)	66.7 (52.9 to 85.6)
Percent children receiving free school meals (median (IQR))	38.5 (19.4 to 54.3)	36.8 (17.7 to 48.6)
Mode of transport home from school		
Walk	131 (71.2)	99 (68.8)
Cycle	1 (0.5)	2 (1.4)
Bus	4 (2.2)	10 (6.9)
Car	48 (26.1)	33 (22.9)

Table 2 Numbers and percentages of children wearing visibility aids at each count and odds ratios for wearing visibility aids at one week and eight weeks after intervention

Visibility aid	Baseline		One week after intervention				Eight weeks after intervention				ICC	
	Intervention (number %) (n = 144)	Control (number %) (n = 184)	Intervention (number %) (n = 147)	Control (number %) (n = 192)	Adjusted OR* (95% CI)	Adjusted OR† (95% CI)	ICC†	Intervention (number %) (n = 138)	Control (number %) (n = 192)	Adjusted OR* (95% CI)		Adjusted OR† (95% CI)
Slap wraps	0	0	43 (29.3)	0	‡	‡	0.36	19 (13.8)	0	‡	‡	0.21
Stickers on bags	30 (20.8)	26 (14.1)	59 (40.1)	24 (12.5)	19.9 (5.2, 75.4)	19.1 (3.1, 119.6)	0.41	55 (39.9)	27 (14.1)	6.2 (2.2, 17.4)	8.4 (2.3, 30.8)	0.32
Stickers on coats	3 (2.1)	2 (1.1)	32 (21.8)	2 (1.0)	35.0 (3.1, 399.3)	37.2 (5.2, 264.2)	0.05	17 (12.3)	3 (1.6)	13.2 (1.4, 124.0)	17.0 (2.0, 142.3)	0.23
Other	19 (13.2)	18 (9.8)	15 (10.2)	8 (4.2)	2.7 (1.0, 7.4)	4.1 (1.1, 14.8)	0.30	15 (10.9)	26 (13.5)	0.8 (0.4, 1.6)	0.7 (0.3, 1.5)	0.01
Any visibility aid	46 (31.9)	40 (21.7)	104 (70.8)	31 (16.2)	24.5 (9.3, 64.6)	59.5 (18.5, 191.0)	0.45	85 (61.6)	50 (26.0)	5.9 (3.2, 11.0)	5.9 (3.4, 10.4)	0.21

*Adjusted for stratum (% children in school receiving free school meals). †Adjusted for stratum, sex, and baseline wearing of visibility aids. ‡Incalculable. ICC, intraclass correlation coefficient.

Sample size

A sample size calculation showed that one class from each of 20 schools would be required to detect an absolute difference of 15% in the percentage of children wearing visibility aids based on 10% of control arm children wearing aids, an average of 20 participants per class, an intraclass correlation coefficient of 0.05, 80% power, and a two sided 5% significance level.

Randomisation

Schools agreeing to participate were stratified by percentage of children receiving free school meals (dichotomised at the median) and were randomly allocated within stratum to treatment arm. One researcher generated the allocation schedule using the Stats Direct computer program (DK), the research unit co-coordinator allocated the schools to treatment arm blind to the identity of each school and a second researcher (CM) enrolled schools. It was not possible to blind those distributing visibility aids, those assessing outcomes, or schools to treatment arm allocation.

Statistical methods

We used random effects logistic regression adjusting for stratum (percentage of children receiving free school meals) to calculate odds ratios (OR) and confidence intervals (CI) comparing the proportion of children in the intervention and control arms wearing slap wraps, stickers on coats or bags, other reflective items and any visibility aid one week and eight weeks after distribution. In two additional analyses we adjusted for sex and baseline wearing of visibility aids as well as stratum, and then also adjusted for mode of travel from school (categorised as walking or cycling compared with travelling by car or bus). We assessed whether the effect of the intervention varied by sex or deprivation by including terms for an interaction between treatment group and sex, and between treatment group and deprivation in the models. Analyses were performed using Stata 8.2. The trial was approved by the medical school ethics committee, University of Nottingham, UK.

RESULTS

Figure 1 shows the progress of schools and children through the trial.

Schools agreeing to participate in the trial were geographically located throughout Nottingham. Table 1 gives baseline characteristics of the participating children and classes.

The prevalence of use of any visibility aid at baseline was low in both treatment arms with no children wearing slap wraps (table 2). Children provided with free visibility aids were significantly more likely to use any type of visibility aid at one week (OR 59.5, 95% CI 18.5 to 191.0 adjusted for stratum, sex, and baseline wearing of visibility aids) and eight weeks (OR 5.9, 95% CI 3.4 to 10.4 adjusted for stratum, sex, and baseline wearing of visibility aids) after distribution than children in the control arm (table 2) although the prevalence of use was lower at eight weeks than at one week, particularly for slap wraps. Odds ratios changed little in an additional analysis that also adjusted for the mode of travel from school at follow up; at one week after intervention children provided with visibility aids were significantly more likely to wear stickers on bags (OR 17.8, 95% CI 3.4 to 93.1), stickers on coats (OR 34.0, 95% CI 5.3 to 274.2), other reflective items (OR 4.2, 95% CI 1.2 to 14.5), and any reflective item (OR 61.3, 95% CI 19.5 to 192.7) than children not provided with visibility aids and similarly at eight weeks after intervention children provided with visibility aids were significantly more likely to use stickers on bags (OR 7.7, 95% CI 2.1 to 28.4), stickers on coats (OR 16.0, 95% CI 1.9 to

133.0), other reflective items (OR 0.7, 95% CI 0.3 to 1.5), and any reflective item (OR 6.1, 95% CI 3.4 to 11.0) than children not provided with visibility aids (all odds ratios adjusted for stratum, sex, baseline wearing of visibility aids, and mode of travel).

Stickers on bags were the most commonly used visibility aid at both one and eight weeks after intervention. An interaction between sex and stickers on coats at one week after intervention was unable to be assessed because of small numbers. There was no evidence that any of the other outcomes at one week after intervention varied by sex (p values all >0.05). At eight weeks after intervention the effect of the intervention for stickers on bags was significantly greater ($p=0.04$) in boys (OR 24.4, 95% CI 3.3 to 152.0 adjusted for stratum) compared with girls (OR 6.3, 95% CI 1.3 to 30.2 adjusted for stratum). There was no evidence that any of the other outcomes at eight weeks after intervention varied by sex (p values all >0.05). An interaction between treatment group and deprivation for stickers on bags at eight weeks after intervention was unable to be assessed because of small numbers. There was no evidence that any of the other outcomes at one or eight weeks after intervention varied by deprivation (p values all >0.05).

DISCUSSION

Providing free visibility aids and an educational booklet on road safety significantly increases use of visibility aids in the winter for up to eight weeks among primary school children.

Only 25% of the schools invited to participate in the trial agreed to participate. From the recruitment visits to schools it was clear that head teachers were keen to participate only if the research involved minimum input from teachers and was of obvious benefit to the children. Although only 25% of state primary schools in Nottingham participated in our trial the participating schools were similar in terms of the median percentage and interquartile range of children receiving free school meals to those of non-participating primary schools in Nottingham (median percentage of children receiving free school meals of 38.0% (IQR 23.5% to 51.2%)). Thus our results are probably generalisable to primary schools in Nottingham. The eight week follow up period included two weeks school holiday at Christmas when children may receive new school bags as presents that would not include the reflective stickers or during which children may mislay the visibility aids. We therefore consider that the prevalence of use of visibility aids at eight weeks may be lower than that found if observations were carried out over a different eight week winter period. It is possible that prevalence of use of visibility aids would decrease further with a longer follow up period, and future research should include a longer follow up period, ideally to the following winter. In addition, as we observed use of visibility aids during the winter months when the importance of being seen as a pedestrian or cyclist is most frequently promoted we may not observe the same levels of wearing of visibility aids by children during other seasons.

What is already known on this subject?

- Visibility aids improve drivers' responses in detecting and recognising pedestrians and cyclists and are associated with a reduction in injury risk among motor cyclists.
- Scarce data exist relating to the use of visibility aids by child pedestrians and cyclists or to interventions for increasing visibility aid use among children

What does this paper add?

- Providing free visibility aids and an educational booklet on road safety significantly increases use of visibility aids for up to eight weeks during the winter among primary school children, thus increasing their conspicuousness to other road users and potentially reducing their risk of an accident.
- On the basis of an eight week follow up trial, campaigns providing free visibility aids to primary school children should be encouraged.

Most children (about 70%) in both treatment arms either walked or cycled to school and therefore the need to use visibility aids was relevant to most children in the trial. Observers in our trial were not blinded to treatment arm allocation and any future research should address this weakness. Our study had insufficient power to detect a reduction in child pedestrian or cyclist injury rates and a much larger study would be needed to address this.

We observed that more children in the intervention group were wearing a visibility aid than children in the control group at baseline. However, the two groups did not differ on sex distribution or the percentage of children receiving free school meals and the results remained significant after adjusting for baseline differences in use of visibility aids, sex, and the percentage receiving free school meals.

Our baseline assessment of the prevalence of visibility aid use (26%) was higher than that found among children who attended the Children's Traffic Club in Scotland, where 15% said they wore reflective clothing when out at night.¹¹ This difference may have several potential explanations. Firstly, visibility aid use may have increased in the six years since the Children's Traffic Club survey was undertaken. Secondly, it is possible that the children in our trial wore the visibility aids because they were aware that they were taking part in the trial and would be observed as part of this. However, they were not given prior warning on which days they were to be observed, hence if they did not have their visibility aids with them would be unable to wear them.

The fact that 61% of children in the intervention arm were wearing any type of visibility aid at eight weeks after distribution is very encouraging. Between one and eight weeks the number of children with stickers on their bags reduced only slightly suggesting that this was the most effective means for ensuring children wore visibility aids. This might be particularly so during the spring and summer when children may not wear a coat but will continue to take a bag to school. Some schools already used school bags with reflective patches sewn into them and these too would be an effective means for ensuring children use visibility aids. Frequent campaigns are run where children receive visibility aids often sponsored by companies. Our results suggest that such campaigns should be encouraged. Further research is needed to determine strategies to maintain high levels of wearing in the long term and to evaluate whether use of such visibility aids can reduce the risk of child pedestrian and cyclist injury.

Policy implications

Campaigns providing free visibility aids to primary school children should be encouraged.

ACKNOWLEDGEMENTS

We thank the teachers, children, and parents who consented for their children to participate in this study. Thanks to Kate Fletcher, road safety officer at Nottingham City Council for her advice throughout the trial. We thank Kaye Smith and Alison Pinkett, road safety officers at Nottingham City Council, and Lindsay Groom and Jane Stewart who observed visibility aids. Nottingham City Council School Transport Team supported our trial.

CONTRIBUTORS

CC contributed to conception of the trial. CM and MW ran the focus group. CM, CC, and DK planned and designed the trial. DK and MW provided advice throughout the trial. All authors collected data. CM analysed the data. DK and CC checked the analyses and contributed to the interpretation of the data. CM wrote the initial manuscript and coordinated subsequent revisions. All authors contributed to the critical revision of the manuscript. CM coordinated the trial and is guarantor.

Authors' affiliations

C A Mulvaney, D Kendrick, C A C Coupland, Division of Primary Care, University of Nottingham, Nottingham, UK

MC Watson, School of Nursing, Queen's Medical Centre, Nottingham, UK

Funding: Broxtowe and Hucknall Primary Care Trust Injury Prevention Research Programme. All researchers were independent of funders.

Competing interests: none declared.

REFERENCES

- 1 **British Medical Association Board of Science and Education.** *Injury prevention.* London: BMA, 2001.
- 2 **Department for Transport.** *Child road safety achieving the 2010 target.* London: Her Majesty's Stationery Office, 2003.
- 3 **National Statistics.** National Travel Survey: 1998/2000 London: Her Majesty's Stationery Office, 2001.
- 4 **Sproston K, Primates P, eds.** *Health survey for England 2002. Vol 1. The health of children and young people.* London: The Stationery Office, 2003.
- 5 **Department of Health.** *Delivering choosing health: making healthier choices easier.* London: DoH, 2005.
- 6 **Department for Transport and Department for Education and Skills.** *Travelling to school: an action plan.* London: Her Majesty's Stationery Office, 2003.
- 7 **Mayr JM, Eder C, Berghold A, et al.** Causes and consequences of pedestrian injuries in children. *Eur J Pediatr* 2003;**162**:184–90.
- 8 **Kwan I, Mapstone J.** Interventions for increasing pedestrian and cyclist visibility for the prevention of death and injuries. *Cochrane Library.* Issue 1. Chichester: Wiley, 2005.
- 9 **Wells SM, Mullin B, Norton R, et al.** Motorcycle rider conspicuity and crash related injury: case control study. *BMJ* 2004;**328**:857–62.
- 10 **Department for Transport and Think! Road Safety.** *Road safety activity book 1.* London: DETR, 2000.
- 11 **Bryan-Brown KH, Harland G.** *An evaluation of the children's traffic club in Scotland 1999.* Edinburgh: Scottish Executive Central Research Unit, Development Department Research Programme Research Findings no 69, 1999.

THE JECH GALLERY

Health protection: a contemporary issue worldwide

Since September 11th, 2001, public health workers around the world have been finding that their role has extended into what was previously the world of science fiction—bioterrorism, its prevention and responses to it. Here, workers in England and in Hong Kong are involved in preparing for the unthinkable. The price of public health security is eternal vigilance and preparedness.

John R Ashton

North West Public Health Team, Department of Health, 18th Floor, Sunley Tower, Piccadilly Plaza, Manchester M1 4BE, UK;
johnrashton@blueyonder.co.uk