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A controlled evaluation of the WHO Safe Communities model approach to injury prevention: increasing child restraint use in motor vehicles

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ABSTRACT

Objective To measure the effect of the WHO Safe Communities model approach to increasing child restraint use in motor vehicles.

Design Pre- and post-intervention observations of restraint use in motor vehicles in several sites in the target area, and in a comparison area community.

Setting Community; southeast Dallas, Texas, 2003—2005.

Interventions A multifaceted approach to increasing use of child safety seats, booster seats and seat belts that included efforts in schools, day care centres, neighbourhoods and a local public clinic, along with child safety seat classes and a low-cost distribution programme.

Main outcome measures Prevalence of restraint use among children 0—8 years old riding in motor vehicles.

Results In the target area, the adjusted child restraint use increased by 23.9 percentage points versus 11.8 in the comparison area (difference 12.1; 95% CI 9.9 to 14.3), and adjusted driver seat belt use increased by 16.3 percentage points in the target area versus 4.9 in the comparison area (difference 11.4; 95% CI 11.0 to 11.7). Multivariable multilevel analysis showed that the increase in the target area was significantly greater than in the comparison area for child restraint use (OR 1.6; 95% CI 1.2 to 2.2), as well as for driver seat belt use and proportion of children riding in the back seat.

Conclusions The Safe Communities approach was successful in promoting the use of child restraints in motor vehicles through a multifaceted intervention that included efforts in various community settings, instructional classes and child safety seat distribution.

BACKGROUND

Motor vehicle crashes are the leading cause of death for children in the USA, and one of the leading causes of death of children around the world.[1] Child safety seats (CSSs) have been proven to prevent deaths and injuries among children who are involved in motor vehicle crashes.[1] Community-based models for injury prevention have become an accepted injury prevention strategy, but there are few well-controlled studies that have evaluated these programmes to increase child restraint use.[2] A recent community-based programme to increase booster seat use was effective in an Hispanic community but not in a low-income community,[3] and another booster seat programme based in day care centres showed an increase in knowledge about booster seats but did not result in increased use of booster seats.[4]

One model of community injury prevention is the Safe Communities approach.[5–7] The Safe Communities model has been adopted in numerous communities around the world, and has been embraced by the World Health Organization (WHO) for more than 20 years as the model for injury prevention, through its official designation of at least 198 sites as 'WHO Safe Communities'.[5] Dallas, Texas was designated a Safe Community by WHO in 1996, and re-certified in 2007. Although there have been studies evaluating the impact of a few communities using this model,[6–10] a recent paper reviewing the model pointed to the lack of controlled efficacy trials and the need for more evaluations of this approach to injury prevention.[11] Our study is one of the first controlled evaluations of the effect of the WHO Safe Communities model approach to increasing child restraint use in motor vehicles.

METHODS

Overview

We used the Safe Communities model in an ethnically diverse population in the southeast part of Dallas, Texas, in order to increase child restraint use among children 0—8 years of age, in motor vehicles in that population. In this model, members of the target community are involved in the design and decision-making of injury prevention programmes.[10] The intervention involved a multifaceted, community-based, culturally integrated programme, similar to a strategy that had been successfully developed and implemented in another geographic area of Dallas a few years earlier.[12] We focused our efforts on increasing compliance with Texas state child restraint law, which required children under 4 years old to ride in a child safety seat, and children 4—16 years old to ride either in a child safety seat or a seat belt; we also emphasised the added protection for children 5—8 years old to ride in a booster seat. Collection of observational data of child restraint usage in the target area and in a comparison area where no intervention took place allowed us to use this quasi-experimental observational design to evaluate the research problem: whether the Safe Communities approach resulted in increased child restraint usage.

Setting

The target population included three zip codes in southeast Dallas County, with a population in the 2000 census of 176 656, including 29% black, 36%

Hispanic, 32% white and 3% other; 19% were children less than 10 years of age. A comparison population in the far southwest part of Dallas County, where no formal intervention was performed, included five contiguous zip codes with a population of 132 734, with 21% black, 26% Hispanic, 48% white and 6% other; 17.2% were children less than 10 years of age (table 1).

Programme interventions

The Safe Communities model involved a multifaceted approach consisting of assessing the community, getting input from community members about issues and views regarding injury prevention and seat belt use, designing the intervention, and then evaluating its impact. A series of focus groups among various ethnic groups helped to determine the location and times of CSS classes and important additional content for the classes. Included in the assessment were several community groups and agencies in the area, including business leaders, churches, schools, day care centres, Camp Fire, Salvation Army and Social Services, as well as the staff of two local paediatric clinics. The various groups helped to recruit young parents to attend CSS classes and to publicise the activity. A detailed review of the process involved in setting up the interventions can be found in appendix 1, available online at the following website: http://www.injurypreventioncenter.org/pdf/Community%20Program%20Intervention%20SE%20Dallas%20TX%202002-2005.pdf.

The staff of the Injury Prevention Center of Greater Dallas supervised the project; the Injury Prevention Center is housed within the Parkland Health & Hospitals System. The assessment phase began on 1 October 2002, the pre-intervention observations took place from January to June 2003, and the post-intervention observations took place from January to June 2005. The interventions took place from January 2003 through June 2005.

The interventions in the target community included a multi-dimensional awareness programme about the importance of children riding in CSSs and booster seats and the applicable state laws, and ongoing classes at various locations and times, where parents could receive instruction about CSS usage and receive a CSS or booster seat if they needed one (see link to appendix 1 above). A ten dollar donation was requested, but no one was refused a seat if they were unable to afford it.

There were three main areas of emphasis in the CSS classes: (1) children riding restrained in CSSs, booster seats or seat belts, depending on age; (2) drivers wearing a seat belt, both for the driver's protection and as a good example for the child; and (3) children riding in the back seat of the vehicle, which is safer in crashes. CSS classes were held at the community clinic, day care centres, grade schools and occasionally at churches, apartment complexes and neighbourhood recreation centres. In addition, multiple free 'car seat checks' were held at community locations including schools, day care centres, grocery stores and police stations, where CSS technicians checked CSSs for proper installation and gave out CSSs if the family did not have a proper one in the vehicle at the time. No interventions took place in the comparison area.

Data collection

A series of observational surveys of child and driver restraint use were conducted in several sites in the target area and the comparison area during January–June 2003 and January–June 2005. The purpose of these surveys was to collect data regarding the prevalence of restraint use over time and to determine whether there was an increase that could be attributable to the programme. Observers were trained in the use of a standardised observation survey form that had been modified slightly from one used by the Texas Transportation Institute for the past 20 years for longitudinal studies of restraint use throughout Texas.[13] Before beginning the formal observations, duplicate observations were performed by two observers during training sessions to ensure consistency of observations and coding. Surveys were conducted as vehicles entered parking lots at three types of selected locations in the target and comparison areas: grocery stores, day care centres and elementary schools. In this setting, vehicles typically were travelling at approximately 8 km/h. All vehicles that were observed during a pre-set 1 hour period of time and that carried at least one passenger estimated to be 0–8 years of age were included in the sample. Observers noted the use of CSSs, booster seats or seat belts among child passengers, the use of seat belts among drivers, the child's location within the vehicle (ie, front or back seat), the type of vehicle, and an estimate of the age, gender and race/ethnicity of all child passengers. Race/ethnicity was estimated by the observer, and categorised as black, white, Hispanic, other or unknown. This variable was included in order to estimate whether the impact of the programme varied by race/ethnicity, and, if it did, to attempt to control for differences in the multivariate analysis.

Data management/analysis

Initially, a univariate analysis was performed to measure the association of several variables on the odds of a child being properly restrained (compliant with state law), irrespective of the time frame. Subsequently, variables that were found to be associated with child restraint use in this univariate analysis were

Table 1 Characteristics of target and comparison area zip codes, Dallas, Texas, from the 2000 census

Zip code	Population	Children <10 years (%)	Median income (US$)	Black (%)	Hispanic (%)	Other (%)	White (%)	Poverty (%)
Target site								
75227	49066	19.5	33428	36.8	43.1	2.3	17.7	19.1
75149	54693	17.5	48245	15.1	16.8	5.1	63.1	8.2
75217	72897	19.9	31532	34.6	46.4	1.5	17.6	20.9
Total	176656	19.0		29.1	36.3	2.8	31.7	16.5
Comparison site								
75051	31299	19.7	34208	12.4	46.1	4.5	37.0	18.9
75052	56252	16.0	60254	17.5	22.2	9.5	50.8	5.5
75116	18185	14.5	45314	19.8	18.7	3.4	58.1	8.1
75249	9186	17.4	51959	51.6	17.0	4.3	27.1	6.9
75137	17812	13.7	59459	29.2	11.8	3.9	55.1	4.1
Total	132734	17.2		20.5	25.6	6.4	47.5	8.9

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incorporated into a multivariable model (see below). The impact of the programme was assessed based on analysis of outcome variables (child restraint use, driver seat belt use, and child location in the back seat) between the baseline period when the intervention started (January through June 2003) and the post-intervention period when the intervention ended (January through June 2005). The change for the outcome variables within the target area was compared with the change within the comparison area and tested for statistical significance using a multivariable statistical model. For these analyses, the unit of analysis was the child. A total of 9478 observations were included. For analyses, restraint use was defined as a child being restrained in compliance with Texas state law for the estimated age of the child. Texas state law during the period of this study required that children less than 4 years old be restrained in a child safety seat, and children between 4 and 16 years old had to be restrained, either in a child safety seat or a seat belt.[14] Although the law also required children who were less than 36 inches tall to ride in a child safety seat even if they were older than 4 years, we made no attempt to measure child height in this survey.

Data were entered using Epi Info 6.2. Accuracy of data entry was checked by re-entering a 10% sample of records; the error rate was less than 1%. Data was exported to a Stata V.10.0 format for statistical analysis using the xtmelogit command for multilevel analysis.

We used a multilevel hierarchical model to estimate the effect of the programme. The model accounted for clustering of patient data within each of 34 sites with repeated measures over time, and for clustering of passengers within a vehicle. Specifically, we used the random intercept mixed-effects logistic regression model (Stata/SE 10.0, xtmelogit) with random effects for vehicle and site. The final model also included race, gender, age, seat location, driver belt status and vehicle type, all measured as fixed-effect covariates. p Values of <0.05 and ORs with 95% CIs that did not include 1.0 were considered significant. We also separately constructed two similar multilevel models to assess the change in the target area versus the comparison area for two other outcomes: driver seat belt use and children riding in the back seat of the vehicle. For these models, 265 (2.8%) records with missing data were excluded from analysis, leaving 9213 (97.2%) child observations. For driver seat belt use, the model would not converge with all of the variables included, so that model did not include the additional level of site, but did include other variables.

Additional data

Another means of monitoring child restraint use in the target area used data that had been collected by the Texas Transportation Institute (TTI) for observations of restraint use among preschool age children in Dallas that included one of the target zip codes (75 217) for 2003 and 2005 (the first and last years of the project). These observations have been performed in March of each year since 1984,[13] and were carried out without knowledge of the interventions that were part of this project.

RESULTS

Between January 2003 and June 2005, a total of 8308 seats were distributed through the classes and car seat checks (5440 were CSSs and 2868 were booster seats) in the target area. The majority of seats (7780) were distributed at 298 formal classes, 438 were distributed at car seat check stations, and, for 90, the site was unknown.

A total of 9478 child observations were included in the analysis: 5743 in the target area (with 3312 of these in the pre-intervention period and 2431 in the post-intervention period) and 3735 in the comparison area (with 2612 of these in the pre-intervention period and 1123 in the post intervention period). The distribution of observations by selected demographic and other variables is shown in table 2.

The effectiveness of the intervention on child restraint use was estimated using the multilevel model, adjusted for child level variables (age, sex, ethnicity, child location in vehicle) and vehicle level variables (vehicle type, driver seat belt use), and incorporated the effects of clustering at the levels of vehicle and site. The adjusted prevalence of child restraint use for the target and comparison areas can be found in table 3. Adjustment was performed through the multilevel model, using the combined population of all observed children as the standard population. Thus each adjusted prevalence may be interpreted as the expected prevalence of child restraint use that would have been observed in each group if such children had had the same distribution of covariates (age, gender, ethnicity, driver seat belt use, etc) as did the study population as a whole.[15] The adjusted prevalence of child restraint use increased by 23.9 percentage points in the target area versus 11.8 percentage points in the comparison area (difference 12.1 percentage points; 95% CI 9.9 to 14.3). On the basis of the results from the multivariable multilevel model, this change was significantly greater in the target area than the comparison area (OR 1.6; 95% CI 1.2 to 2.2) (table 4).

In addition, the adjusted prevalence of drivers who were wearing a seat belt increased more in the target area than in the comparison area (16.3 percentage points versus 4.9 percentage points; difference 11.4 percentage points, 95% CI 11.0 to 11.7), and the multivariable multilevel model showed that the increase

Table 2 Comparison of unadjusted frequencies of variables from observations of restraint use in the target area versus the comparison area, Dallas, Texas, 2003–2005

Variable	Target area	Comparison area
Child age		
0–4 years	52.6 (3023)	45.5 (1699)
5–8 years	47.4 (2720)	54.5 (2036)
Child race/ethnicity		
Black	22.2 (1273)	23.6 (883)
Hispanic	59.1 (3396)	37.8 (1413)
White	17.5 (1004)	34.6 (1292)
Other/unknown	1.2 (70)	3.9 (147)
Child gender		
Male	51.2 (2939)	54.0 (2016)
Female	45.5 (2613)	45.1 (1683)
Unknown	3.3 (191)	1.0 (36)
Vehicle type		
Auto	55.1 (3165)	47.6 (1776)
Pickup truck	14.0 (803)	10.0 (375)
SUV	15.2 (872)	26.7 (999)
Van	14.6 (840)	15.6 (583)
Other/unknown	1.0 (63)	0.1 (2)
Site type		
Grocery stores	28.5 (1639)	21.6 (805)
Day care centres	14.2 (814)	34.1 (1274)
Schools	57.3 (3290)	44.3 (1656)
Child restraint use		
Pre-intervention	32.8 (1085/3312)	40.8 (1066/2612)
Post-intervention	52.4 (1273/2431)	46.0 (517/1123)

Values are % (number); N = 9478. All comparisons between the two areas are significant at $p<0.01$.
SUV, sport utility vehicle.

Table 3 Observed child restraint use in target and comparison areas

Site type	Baseline observations Jan–June 2003 No	Adjusted child restraint use (%)*	Follow-up observations Jan–June 2005 No	Adjusted child restraint use (%)*	Change in child restraint use (% (95% CI))
Target area					
Day care centres	528	47.6	247	67.4	19.8 (16.6 to 23.0)
Grocery stores	906	39.2	537	60.4	21.2 (19.6 to 22.8)
Schools	1647	23.0	1616	49.9	26.9 (25.8 to 28.0)
Total†	3081	32.4†	2400	56.3†	23.9 (22.6 to 25.3)
Comparison area					
Day care centres	1043	57.5	230	71.2	13.7 (11.1 to 16.3)
Grocery stores	500	49.7	305	58.0	8.3 (5.3 to 11.3)
Schools	1066	19.1	588	31.8	12.7 (11.3 to 14.1)
Total†	2609	35.1†	1123	47.0†	11.8 (10.1 to 13.6)
Difference in change in total restraint use between target and comparison areas					12.1 (9.9 to 14.3)

*Percentages are adjusted through multivariable regression modelling for child age, gender, ethnicity, vehicle type, site type, driver seat belt use and child location in vehicle. The multilevel model also accounted for clustering at the level of site and vehicle, as outlined in the text. N = 9213.
†Total percentages are weighted averages of observations for each area, using the combined population of all observed children as the standard population, to adjust for differences in frequency of observations by site type.

was significantly greater in the target area (OR 2.2; 95% CI 1.5 to 3.2) (table 4). As can be seen in table 4, a similar model demonstrated that the increase in the target area was also significantly greater for children riding in the back seat, although the magnitude was somewhat less.

Additional data

The observations performed by TTI for its annual survey of child restraint use among children 0–4 years, which were carried out without knowledge of which areas of Dallas were involved in the intervention, also revealed a larger increase in child restraint use in the zip code that happens to be in the target area compared with observations in all other zip codes in Dallas (34% vs 10.4%, respectively; difference 23.6 percentage points; 95% CI 7.1 to 40.1). There were no observations performed in the TTI surveys for zip codes in the comparison area. These observations include any restraint use, including both proper and improper restraint use (unpublished data courtesy of KNW of the TTI).

DISCUSSION

The multi-faceted, community-based intervention successfully raised the prevalence of proper child restraint usage, defined as compliant with state law, in the target area. The multivariate analyses showed significantly greater increases for child restraint use, driver seat belt use, and children riding in the back seat of a vehicle. Each of these outcomes was an area of focus for the educational component of the intervention, and all were a priori measures chosen in the design of the evaluation. The analyses controlled for several factors that were associated with child restraint use, including age, gender, race and ethnicity, vehicle type, type of site (eg, grocery store, day care or school), driver seat belt use, and number of children in the vehicle, as well as for effects of clustering at the vehicle and site levels.

In addition, the data collected independently by observers with TTI, who had no knowledge of the study interventions, showed the same trend as the observations collected for the study. However, those data were limited to preschool age children in one zip code in the target area, and are not directly comparable to the observations that were collected as part of this project because it included any restraint use, whether compliant with state law or not, and did not include observations in the comparison area of the study.

The 23.9 percentage point increase in the target area for child restraint use compliant with state law is somewhat higher than that reported from most other community-based studies,[2] and similar to the result seen in west Dallas in a previous study by our group.[12] We think that the multifaceted approach used in the Safe Communities model was the major reason for the programme's success, but the study was not designed to sort out which components may have been most important in its success.

There are several limitations to the evaluation of this programme. Firstly, some of the increase in compliant restraint use among older children (4–8 years) was accounted for by increased seat belt usage, rather than booster seat usage. For example, a 6-year-old child who was restrained by a seat belt

Table 4 Multivariable model results for various outcomes comparing change over time (follow-up versus baseline) for target area versus comparison area

	Target area % Baseline	% Follow-up	Change	Comparison area % Baseline	% Follow-up	Change	Difference (95% CI)	OR (95% CI)
Child restraint								
Restrained per law*	32.4	56.3	+23.9	35.1	47.0	+11.8	+12.1 (9.9 to 14.3)	1.6 (1.2 to 2.2)
Child location								
Riding in back seat†	65.0	69.2	+4.2	75.9	74.5	−1.4	+5.6 (4.4 to 6.7)	1.3 (1.0 to 1.6)
Driver restraint								
Driver wearing seat belt‡	76.8	92.3	+16.3	87.6	92.6	+4.9	+11.4 (11.0 to 11.7)	2.2 (1.5 to 3.2)

Percentages are adjusted through multivariable multilevel modelling as outlined in the text, and below. Difference = change in target minus change in comparison area. OR (95% CI) represents the odds ratio of the change in the designated outcome in the target area versus the change in the comparison area. Baseline = January – June 2003; follow-up = January – June 2005. N = 9213 (265 observations were excluded from the model because of missing data). Each outcome model was separately constructed.
*Compliant with state law (see text). Model controlled for age, gender, ethnicity, vehicle type, site, driver seat belt use, child location in vehicle, vehicle clustering and site clustering.
†Model controlled for age, gender, ethnicity, vehicle type, site, driver seat belt use, vehicle clustering and site clustering.
‡Model controlled for age, gender, ethnicity, vehicle type, site, child location in vehicle, vehicle clustering, but did not include site clustering.

nevertheless met the definition of compliant restraint for the purpose of the analysis, based on state law that allowed seat belt restraint for children at least 4 years of age, even though booster seat use is now considered optimal for most children of this age group. So while some children may not have been optimally restrained, they were nonetheless restrained in compliance with state law. Secondly, we did not check CSSs for proper installation; other studies have shown that many CSSs are not properly installed.[16] Thirdly, our observers made estimates of the age, race, ethnicity and gender of the child. We were unable to verify this information because we did not interview the drivers or passengers in the vehicles. Internal review of duplicate, simultaneous observations by two different observers showed a high concordance between two observers for these factors, but we have no mechanism to verify the accuracy of these variables. Misclassification of age had the potential to create inaccurate classification of proper (compliant with state law) restraint use, but it is likely that any misclassification would have been consistent through the periods observed, and would have had minimal impact on comparisons over time. In addition, an analysis of any restraint use (whether compliant with state law or not), the determination of which is not dependent on our observers' estimates of age (data not shown), showed similar significant results, implying that our estimates of age may have had little influence on the results. Fourthly, the target and comparison communities were not randomly chosen, and so there is the possibility of unmeasured confounders, even though the analyses controlled for such covariates as age, race/ethnicity, vehicle type, type of site, etc. And finally, the project was not designed to measure injuries, but rather the proportion of restraint use.

This community-based intervention used the Safe Communities model and focused on the issue of occupant restraint in motor vehicles. The project involved members of the community in the design and implementation of the interventions, and was carried out at various sites in the community. There are few controlled trials of community-based interventions addressing this topic.[2] This is one of the few evaluations of a community-based programme that controlled for several other variables (eg, child age, race/ethnicity, vehicle type, setting) with the use of a multivariate analysis, in a manner similar to that of the study by Ebel *et al*.[15] The results of our investigation are generally in line with those of the few studies that are published,[2 15 17] and support the finding that a community-based programme using the WHO Safe Communities model can be effective in this regard.

What is already known on this subject

- Despite recent gains in the use of child safety seats, many children remain unrestrained in motor vehicles, and motor vehicle crashes remain one of the leading causes of injury deaths among children.
- There are few, if any, controlled evaluation studies of the WHO Safe Communities model for community injury prevention interventions in the USA.

What this study adds

- Child restraint use, driver seat belt use, and children riding in the back seat (versus front seat) increased significantly in the target community after implementation of a community-based intervention that focused on these topics.
- The WHO Safe Communities model was effective at increasing the use of these prevention measures, all of which have been associated with a lower risk of injury and death in motor vehicle crashes.

CONCLUSION

A multi-faceted community-based intervention was successful at increasing the use of vehicle child restraints in compliance with state law. The data support the use of a Safe Communities model to address this important public health issue.

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Competing interests None.

Patient consent Informed consent was obtained from parents enrolled in the safety seat classes.

Ethics approval This study was conducted with the approval of the University of Texas Southwestern Medical Center, Dallas, Texas, USA.

Contributors Conception and design: GRI, MS, MAMcC, RJA. Acquisition of data: MS, MAMcC, KNW. Analysis and interpretation of data: GRI, MAMcC, BJM, DC, KNW. Drafting of manuscript: GRI. Critical revisions of manuscript: all authors. Statistical analysis: GRI, BJM. Obtaining funding: GRI, MS, RJA. Administrative, technical, or material support: GRI, MS, MAMcC, RJA. Supervision: GRI, MS, RJA. GRI, MAMcC, BJM had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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