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ORIGINAL ARTICLE

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Objectives: To evaluate the outcome of the World Health Organization (WHO) Safe Community model with respect to child injuries.

Study design: A population based quasiexperimental design was used. Cross sectional pre-implementation and post-implementation data were collected in intervention (Motala municipality) and control (Mjölby municipality) areas, both in Östergötland county, Sweden.

Results: The total relative risk of child injury in the intervention community decreased more (odds ratio 0.74; 95% confidence interval (CI) 0.68 to 0.81) than in a control community exposed only to national level injury prevention programs (0.93; 95% CI 0.82 to 1.05). The relative risk of moderately (abbreviated injury scale (AIS) 2) severe injury in the study area was reduced to almost a half (odds ratio 0.49; 95% CI 0.41 to 0.57), whereas the risk of minor (AIS 1) injuries decreased only slightly (odds ratio 0.89; 95% CI 0.80 to 0.99). The risk of severe or fatal (AIS 3–6) injuries remained constant.

Conclusions: After introduction of an injury prevention program based on the WHO Safe Community model, the relative risk for child injury in the intervention community decreased significantly more than in a control community exposed only to national injury prevention programs.

Despite several decades of concerted efforts worldwide,^{1–3} unintentional injuries remain a significant health problem for children and adolescents. Among the youngest children, most fatal injuries occur at home.⁴ Among older children, traffic accidents, drownings, and accidents at playgrounds and sports facilities cause the most severe injuries. While national level vital statistics routinely include data on fatal injuries, surveillance of non-fatal injuries is less common due to the need to integrate data from many different sources.⁵ Studies of injury by severity suggest that the determinants of more severe injuries differ from those of less severe injuries.⁶

In several countries, community based programs to prevent common non-fatal injuries have been implemented as complements to national safety programs and legislation.^{7–12} Decentralized planning and implementation of injury prevention addresses specific needs and optimizes local resource use. In the USA, the Harlem Hospital Injury Prevention Program was created in response to surveillance reports indicating that local child injury morbidity was twice the national rate.¹³ The intervention program used postal codes to link injured children to neighborhoods, making targeted prevention measures for specific injury event environments possible. As a result, traffic injuries decreased by almost 50% in the targeted neighbourhoods.¹⁴

This report presents an outcome evaluation of a program to prevent severe and less severe unintentional child injuries. The program was developed following the World Health Organization (WHO) Safe Community model. Using a quasiexperimental design to compare intervention and control communities, the study investigated changes in the all-cause injury risk after program implementation.

In addition, changes in the distribution of injury severity and injury event contexts in the intervention community were examined. An assessment of the structure and process of the program has previously been reported.¹⁵ In Sweden, the positioning of the local government in the program structure appears to be the most important factor determining program effectiveness.

METHODS

The WHO Safe Community model describes desirable features of community oriented injury prevention policies (box 1). The process model used in Safe Community programs relies on input from local politicians, civil servants, representatives of non-governmental organizations, and public health workers to identify problems and implement actions. Implementation of the Motala program began in 1985 and it fulfilled the Safe Community criteria by 1988.

This report is based on data collected before (1983–84) and after (1989) program implementation in the intervention area (Motala municipality) compared with that obtained in a neighboring control area (Mjölby municipality). At the time of the study, both populations had similar age and gender structures, and these did not differ significantly from the national average. The number of children decreased in the intervention area by 3% and in the control area by 6% between 1983 and 1989. In both areas, the proportion of adults with more than an elementary school education remained 5% below the national average (60%). Residential and income characteristics also remained stable. Motor vehicle ownership increased by 12% in the intervention area and by 13% in the control area. No extraordinary weather conditions influencing traffic occurred during either of the data collection periods. The intervention area had four health care centres and a county annex hospital with a casualty department, while the control area shared the annex hospital and had two health care centres, one with an emergency unit.

Implementation of the Motala program

Program structure

In 1985, the Health Services Board of the County Council and the Municipal Government Board agreed to share responsibility for a local injury prevention program and a self regulating

Abbreviations: AIS, abbreviated injury scale; CI, confidence interval; CSC, Child Safety Council; WHO, World Health Organization

Box 1: Elements of a Safe Community program**I. General requirements**

- The program covers all age groups, environments and situations, and has a long term planning perspective.

II. Program structure

- A cross sectoral group is responsible for coordinating injury prevention in the community.
- Local community networks are used for planning and implementation.
- Health care organizations have a central role in the program.

III. Program process*Analyses*

- The community organizations and their opportunities/capacities to participate in injury prevention are documented.
- Appropriate indicators to evaluate processes and effects are used.
- Both the frequency and causes of injuries are documented on a regular basis.

Interventions

- All levels of the community contribute to preventing unintentional injuries.
- High risk groups and environments are given specific attention.

IV. Networking

- Experience is disseminated nationally and internationally.
- Experience from other sites in the Safe Community network is used.

Child Safety Council (CSC). CSC members included politicians, county officials whose departments were responsible for the care and welfare of children, and representatives of non-governmental organizations. In 1987, the CSC used its influence within the local social network to establish an organization for the regular implementation of safety measures.

Program process*Analyses*

All injuries treated at health care units were reported to the program. The registration procedure was based on earlier experience in Sweden.¹⁶ For all injured patients treated at the emergency room at the local hospital, a form is filled in by staff with the time of contact and standard personal data. Statistical analyses identified high risk age groups, the most common injury environments, and the most common types.

Interventions

Community-wide measures—The CSC cooperated with local mass media in the intervention area to provide regular information about injury prevention.

Specific measures—To reach preschool children, nurses in the intervention area were trained and asked to provide age adjusted safety information to parents at compulsory annual health visits. Follow up interviews with parents who had visited childcare nurses showed that almost all families had received the safety information. However, despite receiving the information, only a minority were aware of the major hazards. Therefore, a video demonstrating safety modifications in the home was distributed to all parents with children younger than 6 as part of a behavioral safety education and information program directed at falls in the home. In addition, safety products and examples of modifications of risk environments were displayed at public places. Indoor environments at all daycare centres were also evaluated, but required only minor modifications. Regular safety rounds were introduced for safety maintenance at the daycare centres as well as at playgrounds and other public facilities frequented by preschool children.

Table 1 Relative risk of child injuries of different severity (95% CI), estimated using the odds ratio, in the study and control areas after the program implementation

	Study area		Control area	
	1983–84	1989	1983–84	1989
Minor (AIS 1)				
Injured	794	694	NA	NA
Non-injured	7772	7621		
Odds ratio (CI)	0.89 (0.80 to 0.99)			
Moderate (AIS 2)				
Injured	444	215	NA	NA
Non-injured	8122	8100		
Odds ratio (CI)	0.49 (0.41 to 0.57)			
Severe (AIS 3–6)				
Injured	21	26	NA	NA
Non-injured	8545	8289		
Odds ratio (CI)	1.28 (0.72 to 2.27)			
Not classified				
Injured	1	5		
Total				
Injured	1260	940	610	537
Non-injured	7306	7375	4933	4659
Odds ratio (CI)	0.74 (0.68 to 0.81)		0.93 (0.82 to 1.05)	

To target schoolchildren, indoor environments at schools and sports facilities were evaluated, and regular safety rounds for maintenance were also introduced. Furthermore, all physical education teachers in the intervention area participated in an injury prevention course focusing on high risk groups of children. This course was intended to contribute to meeting the goal that every child performing physical exercise would have the basic skills for the activity and be informed about rules and injury risks. Local sports clubs were also asked to contribute to the injury prevention program. For the most popular team sport, soccer, workshops for coaches and referees were used to discourage foul play. For the most popular individual sport, horseback riding, an attempt was made to support the supervision of novices, including new rules requiring supervision of young riders during all interaction with horses.

Both structural and educational measures were taken to improve traffic safety. A “Safe way to school” program was implemented at every primary school in cooperation with the municipality’s planning department. The program included a “Cut your garden hedge” initiative to increase driveway visibility in residential areas. In addition, voluntary organizations and the police provided traffic education programs aimed at primary and lower secondary school students. A one hour traffic lesson was scheduled each week for all fourth graders. Last, a safe cycling program was initiated to subsidize the price of cycle helmets and to promote helmet use. Children were also offered courses to “shape up your bike” to reduce risks of equipment failure.

Data collection

Pre-implementation data were collected from 1 October 1983 to 30 September 1984. Post-implementation data collection covered 1 January 1989 to 31 December 1989. All children and adolescents under 16 arriving at any health care unit located in the intervention and control areas during the study periods were included in the evaluation. The nature and event context of injuries was classified using the *International Classification of Diseases*, eighth revision,¹⁷ and the abbreviated injury scale (AIS) was used to measure injury severity.¹⁸ Two specially trained nurses classified injuries after the care episode, based on information from medical records. When necessary, the attending physician was asked to verify the accuracy of the classification. Data on injury severity and event context were not collected from the control area due to a lack of resources.

Table 2 Relative risk of child injuries in different injury event contexts (95% CI) estimated using odds ratio after the program implementation in the study area

Injury event context (E code)	0–6 years		7–12 years		13–15 years		All	
	1983–84	1989	1983–84	1989	1983–84	1989	1983–84	1989
Traffic (807–846)								
Injured	43	19	66	42	57	45	166	106
Non-injured	3313	3661	3293	2913	1794	1635	8400	8209
Odds ratio (CI)	0.40 (0.23 to 0.69)		0.72 (0.49 to 1.06)		0.87 (0.58 to 1.29)		0.65 (0.51 to 0.84)	
Falls (880–887)								
Injured	202	203	188	124	96	61	486	388
Non-injured	3154	3477	3171	2831	1755	1619	8080	7927
Odds ratio (CI)	0.91 (0.75 to 1.11)		0.74 (0.59 to 0.93)		0.69 (0.50 to 0.96)		0.81 (0.71 to 0.93)	
Fire and environmental factors (890–909)								
Injured	14	9	30	18	7	17	51	44
Non-injured	3342	3671	3329	2937	1844	1663	8515	8271
Odds ratio (CI)	0.59 (0.25 to 1.35)		0.68 (0.38 to 1.22)		2.69 (1.11 to 6.51)		0.89 (0.59 to 1.33)	
Ingestions (914–915)								
Injured	20	13	7	1	2	3	29	17
Non-injured	3336	3667	3352	2954	1849	1677	8537	8298
Odds ratio (CI)	0.59 (0.29 to 1.19)		0.16 (0.02 to 1.32)		1.65 (0.28 to 9.91)		0.60 (0.33 to 1.10)	
Falling objects or blows (916–917)								
Injured	37	53	103	79	78	64	218	196
Non-injured	3319	3627	3256	2876	1773	1616	8348	8119
Odds ratio (CI)	1.31 (0.86 to 2.00)		0.87 (0.64 to 1.17)		0.90 (0.64 to 1.26)		0.92 (0.76 to 1.12)	
Crushing (918)								
Injured	32	24	22	18	10	4	64	46
Non-injured	3324	3656	3337	2937	1841	1676	8502	8269
Odds ratio (CI)	0.68 (0.40 to 1.16)		0.93 (0.50 to 1.74)		0.44 (0.14 to 1.40)		0.74 (0.51 to 1.08)	
Physical overexertion (919)								
Injured	12	15	40	20	59	18	111	53
Non-injured	3344	3665	3319	2935	1792	1662	8455	8262
Odds ratio (CI)	1.14 (0.53 to 2.44)		0.57 (0.33 to 0.97)		0.33 (0.19 to 0.56)		0.49 (0.35 to 0.68)	
Other (859–877, 910–913, 920–939)								
Injured	46	39	59	34	30	17	135	90
Non-injured	3310	3641	3300	2921	1821	1663	8431	8225
Odds ratio (CI)	0.77 (0.50 to 1.18)		0.65 (0.43 to 1.00)		0.62 (0.34 to 1.13)		0.68 (0.52 to 0.89)	
All								
Injured	406	375	515	336	339	229	1260	940
Non-injured	2950	3305	2844	2619	1512	1451	7306	7375
Odds ratio (CI)	0.82 (0.71 to 0.96)		0.71 (0.61 to 0.82)		0.70 (0.59 to 0.84)		0.74 (0.68 to 0.81)	

To estimate the quality of the specific injury registration procedure, secondary sampling of all acute health care attendances in the intervention area was undertaken during the third week of the pre-implementation registration period and in both the intervention and control areas during the third week of the post-implementation registration period. In addition, university hospital emergency department records from September 1984 were analyzed for any systematic differences between persons from the intervention and control areas receiving care outside the care units providing data for this evaluation.

Data analysis

Outcomes were reported as numbers of persons injured and incidence rates were based on person years of residence (that is, exposure) during the two study periods. No data on exposures to injury risks, other than residence in the municipalities under study, were available. Odds ratios were used to compare all-cause injury risk between the two time periods for both the intervention area and control area. For individuals injured more than once, only the first episode was included in the data. Statistically significant differences between intervention and control areas were assessed by comparing the 95% confidence interval (CI) for the area specific odds ratio. SPSS software was used for these analyses.

RESULTS

Missing data

Fewer than 1% of the eligible patients could not be identified in the medical record archives for secondary analyses. During

1983–84, child all-cause injury rates were 172 per 1000 population years in the intervention area, and 124 per 1000 population years in the control area. This difference is due, in part, to a lower proportion of injured residents from the intervention area than in the control area seeking emergency care at the university hospital. Only 3% of residents from the intervention area were taken directly to the university hospital for care, compared with 12% from the control area.

Changes in injury rates

The all-cause injury rate was reduced more in the intervention area than in the control area exposed only to national safety programs (table 1). In the intervention area, the all-cause injury rate decreased 25%, from 172 to 127 injuries per 1000 population years. The risk of moderately (AIS 2) severe injuries fell by approximately half, whereas the risk of minor (AIS 1) injuries decreased only slightly. However, the risk of severe (AIS 3–6) injuries remained constant. Among preschool children, rates of injury due to traffic injuries were significantly decreased as were falls and overexertion among schoolchildren (table 2).

DISCUSSION

After introduction of an injury prevention program based on the WHO Safe Community model, rates of all-cause injury decreased more for children in the community receiving the program than in a control community exposed only to national injury prevention programs. Rates of moderately severe injury were halved in the intervention community, suggesting that the program had less influence on the number of

injuries than on their consequences in terms of physical harm. Children enjoy and require many potentially hazardous activities. Preventing all minor injuries may be impossible without markedly restricting physical activities and hampering development.

The differences in program effect on rates of injury from falls may be due to its primary focus on environments outside the home. Falls among 0–6 year olds did not decrease. These injuries are typically sustained in private homes,¹⁹ where the injury event context usually involves stable structures—for example, furniture and stairs.²⁰ Although all parents in the intervention area had received information about these risk factors, no information was available about how many modified their homes or the supervision of their children.

By comparison, falls among schoolchildren decreased significantly. These children participate in play in public spaces and interventions could be targeted directly at environments they occupy outside the home. One example is the prevention of injuries during physical education classes. It is known that when participating in team sports, children who have less experience are at higher risk of injury.²¹ In contrast to the preschool children, supervision and changes to facilities were provided equally to all schoolchildren at risk, regardless of social background. Implementing environmental modification of public spaces or improving supervision of physical education is also not contingent on household purchase of safety equipment or renovations to improve safety in the home. As a result, the primary role of the home in falls among preschool children, coupled with the informational nature of the intervention, may have combined to create costs that households were unable or unwilling to pay, rather than being an example of failed health education.

That the most severe injuries did not decrease may be due to differences in etiology with increasing injury severity. The context of severe injury events has been described as an interplay between specific and unfavorable circumstances in parallel with exposure to extreme physical forces or conditions.²² Severe injuries may therefore be best prevented by separating children completely from hazardous extreme conditions rather than by modifying the physical and social environment.

The study has some important features that must be considered when interpreting the results. The baseline injury rate in the intervention community (172 per 1000 children years) is similar to that reported from other Western countries.⁶ Although a randomized community cluster analysis would have been preferable, it was impractical.²³ Therefore, a quasiexperimental design was used. Given this choice, a central question is whether this design can distinguish the program effect in the intervention area from general trends in injury rates. Although the control area's reduction in all-cause injury rates was not statistically significant, it suggested a generally decreasing temporal trend in injury rates. However, some other studies based on hospital discharge data report increasing trends for non-fatal injuries for the period of the study, though these may not be strictly comparable.¹⁰ In light of the failure to use an experimental study design, a cautious interpretation of the results appears to suggest that the all-cause injury rate decreased more in the intervention area than in the control area. This could indicate a modest but significant effect of the local intervention, despite a general decline in injury rates over time.

One of the fundamental features of community based injury prevention is its shift away from focusing on individual responsibility towards ensuring that everyone in a community is involved in safety promotion and can gain from its effects.²⁴ In the end, however, this study also highlights several methodological challenges in evaluating injury prevention programs.

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