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# Childhood Injury Prevention in a Suburban Massachusetts Population

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**I**NJURIES are the leading cause of death in childhood (1). They are a leading cause of childhood morbidity as well (2). In 1978, the Massachusetts Department of Public Health established a Statewide Childhood Injury Prevention Program (SCIPP), whose aim was to document the epidemiology of childhood injuries in the State and to establish model interventions based in urban, rural, and suburban communities within the State (2). As one of the SCIPP interventions, the Pediatric Accident Prevention Project (PAPP) of the Department of Pediatrics, Framingham Union Hospital, was used to incorporate injury prevention counseling into pediatric practice settings (3). This counseling took place within the context of several SCIPP community-based education programs.

The general results of the SCIPP have recently been reported (4). Although a significant decrease in motor vehicle injuries was observed, a demographic shift—so that a greater proportion of households in some of control communities are

## Synopsis .....

*A controlled population-based study of a childhood injury prevention program in four suburban Massachusetts communities was able to demonstrate a 15.3 percent decrease in injury rates for children ages 0–5 years. A substantial improvement was seen in the relative risk for injury in the intervention as compared with control communities.*

*The major intervention was a pediatric counseling program taking place within a context of various community education efforts. Process data on patient satisfaction and physician compliance, and educational and behavioral outcomes from previously reported studies, when combined with injury incidence data in this report, support the hypothesis that physician counseling may be an important factor in the favorable results observed in these suburban communities. These data also suggest that a decrease in injury incidence may be possible when interactive physician counseling takes place within the context of community education programs. A comprehensive strategy that includes technological, legislative, and educational activities is suggested as the optimal approach to childhood injury prevention.*

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classified as poor—complicated the interpretation of the data (4). Since such a shift did not take place in the suburban intervention and control settings, it was possible to obtain a more reasonable comparison between these communities. In addition, the suburban intervention communities had the greatest penetration of participatory pediatric counseling, and the outcomes for these populations were of particular interest. The purpose of this report is to analyze the changes in the epidemiology of childhood injuries in the SCIPP suburban intervention and control populations of children ages 0–5 years.

## Materials and Methods

The major intervention in three suburban sites—Southboro, Westboro, and Hopkinton—was the PAPP. Five pediatricians participated, including four from a multispecialty group practice and one solo practitioner. (Those five pediatricians had

Figure 1. Survey form completed by parents during visit to physician's office. Only wrong answers appear on page 2.

**FIRST PAGE - for parent's responses**

FRAMINGHAM SAFETY SURVEY  
For Children Less than Nine Months of Age

NAME \_\_\_\_\_ Child's Date of Birth \_\_\_\_\_

Number of Children in Family \_\_\_\_\_ Please X through one answer

1. Do you put the crib side up whenever you leave the baby unattended? Always Sometimes Never

2. Do you use crib bumpers? Yes No

3. What is the distance between your baby's crib slats? Less than 2½ inches More than 2½ inches Don't know Have no crib

**Appropriate responses are not transferred to the second page**

**"At-risk" responses are transferred and require discussion**

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**SECOND PAGE - for physician's screening**

FRAMINGHAM SAFETY SURVEY  
For Children Less than Nine Months of Age

NAME \_\_\_\_\_ Child's Date of Birth \_\_\_\_\_

Number of Children in Family \_\_\_\_\_ Please X through one answer

1. Do you put the crib side up whenever you leave the baby unattended? Always Sometimes Never

2. Do you use crib bumpers? Yes No

3. What is the distance between your baby's crib slats? Less than 2½ inches More than 2½ inches Don't know Have no crib

offices in Southboro, and four of them had offices in Westboro as well. Hopkinton, which is adjacent to Southboro and Westboro, had no pediatric office.)

The Framingham Safety Surveys, a series of developmentally oriented safety surveys, was the basic PAPP activity. The survey forms are designed in a unique manner that allows for efficient use in pediatric office settings (3). The parent completes the form in the physician's office while waiting to be seen. Only the wrong answers are marked on the physician's copy. The physician can then counsel the parents on the issues for which they demonstrate an educational need (fig. 1). The reading level of the materials is sixth grade for the Infants, fifth grade for Preschool I, and sixth grade for Preschool II survey forms. The topics covered include all the SCIPP target injuries—motor vehicle occupant, burns, falls, and poisonings. Parents were also given written materials from the American Academy of Pediatrics to supplement those specific survey areas in which

they demonstrated a need for counseling. In selected cases, when "at risk" responses were noted on the questionnaire, free safety materials (shock stops, outlet covers, cabinet locks) were distributed, and a home safety demonstration board was used to demonstrate the use of these materials to parents (3).

Pediatricians were trained individually in the use of the materials by a project research assistant, who then monitored compliance with the program by periodic collection of completed survey forms from participating physicians. A previously reported study of the survey's impact on the pediatrician's office (3) documented that parents spent approximately 3 minutes completing the forms, and that physicians spent approximately 3 minutes counseling the parents. The combined mean time for the entire process (physician and parent) was 6 minutes and 27 seconds (3).

In addition to PAPP, which was an active intervention, the suburban communities were also experiencing a variety of community educational

programs. These programs were a part of the overall SCIPP, with reported general penetration of 17 percent for the auto passenger safety program, 10 percent for the burn prevention program, and 1 percent for poison control (4). The programs used a variety of approaches including perinatal, school-based, and public education efforts, which have been described elsewhere (2).

The towns of Southboro, Westboro, and Hopkinton had populations that were of high socioeconomic status based on data from the 1980 U.S. census (table 1) (5). The combined population in these towns of children ages 0-5 was 2,007. Residents of the control town, Andover, also had a high socioeconomic status and 1,828 children ages 0-5.

In SCIPP, baseline data were compiled, as well as data during the intervention period, to document the numbers of target injuries (motor vehicle occupant, burns, falls, and poisonings) requiring a hospital visit (2). Since the focus of the intervention was the 0-5 age group, all statistical comparisons were made using data referenced to the 0-5 population for the targeted injuries. The number of injuries and the injury rate per 10,000 child years was computed for the period September 1, 1979, to September 14, 1980, before the interventions. The number of injuries and injury rate per 10,000 child years was also computed for the period of September 15, 1980, to August 15, 1982, when the interventions were implemented. Incidence density in child-years was used for this analysis because the intervention period was approximately twice as long as the baseline period.

The injury rates were then compared for the suburban control and intervention towns both *before* and *during* the interventions. Since injury rates in communities may fluctuate randomly from year to year, the temporal change in the intervention community was compared with the temporal change in the control community. The measure of change in the injury rate used was the rate during the intervention divided by the rate before it took place. A simple estimate summarizing the difference in these ratios is computed by taking the ratio from the control town divided by the ratio from the intervention town (see box). The numerator and denominator of this ratio are independent risk ratios. Since the logarithm of each of these risk ratios is approximately normally distributed (6a), the standard error for the overall ratio was computed after logarithmic transformation of that ratio, and the calculation of the 95 percent confidence interval (CI) was performed based on the standard error.

Table 1. 1980 demographic data for Statewide Childhood Injury Prevention Program (SCIPP) intervention and control towns

| Place                      | Population, 0-5 years | Median family income | Percent of persons below poverty level |
|----------------------------|-----------------------|----------------------|--|
| State of Massachusetts ... | 404,764               | \$21,166             | 9.1                                    |
| Southboro .....            | 459                   | \$28,605             | 2.5                                    |
| Westboro .....             | 868                   | \$27,355             | 4.2                                    |
| Hopkinton .....            | 680                   | \$26,009             | 3.1                                    |
| Andover .....              | 1,828                 | \$31,153             | 3.8                                    |

SOURCE: U.S. Census of the Population 1980.

Table 2. Number of injuries and injury rate (per 10,000 child years) of 0-5-year-olds in intervention and control communities in Massachusetts, SCIPP

| Population group                 | Before intervention <sup>1</sup> | During intervention     |                          |                    |
|----------------------------------|----------------------------------|-------------------------|--------------------------|--------------------|
|                                  |                                  | First half <sup>2</sup> | Second half <sup>3</sup> | Total <sup>4</sup> |
| <b>Intervention:<sup>5</sup></b> |                                  |                         |                          |                    |
| Number of injuries ....          | 41                               | 34                      | 30                       | 64                 |
| Injury rate .....                | 196.22                           | 176.47                  | 155.71                   | 166.28             |
| <b>Control:<sup>6</sup></b>      |                                  |                         |                          |                    |
| Number of injuries ....          | 25                               | 37                      | 31                       | 68                 |
| Injury rate .....                | 131.36                           | 210.84                  | 176.85                   | 193.97             |

<sup>1</sup> Sept. 1, 1979-Sept. 14, 1980.

<sup>2</sup> Sept. 15, 1980-Aug. 31, 1981.

<sup>3</sup> Sept. 1, 1981-Aug. 15, 1982.

<sup>4</sup> Sept. 15, 1980-Aug. 15, 1982.

<sup>5</sup> Southboro, Westboro, Hopkinton, (N=2,007). Population ages 0-5 years from U.S. census.

<sup>6</sup> Andover (N=1,828). Population ages 0-5 from 1980 U.S. census.

## Results

The PAPP was able to reach 29.6 percent of the 0-5-year-old population in the intervention towns (N=594). Penetration data include both direct counts determined by a completed copy of the safety survey (N=500) as well as indirect counts based on data obtained from SCIPP, which provided the percentage of families with a child ages 0-5 who had a sibling in the same age group (N=94). The indirect counts were included because the counseling was considered relevant to all children in the family, ages 0-5.

The results of injury rates in the suburban control and intervention populations are summarized in table 2. For the intervention towns, there was an overall reduction in injury incidence of 15.3 percent, and for each half of the intervention period, the injury rate in the intervention population was lower than the preintervention rate. The relative risk for injury during the intervention compared with before the intervention was 1.49 for the control towns and .85 for the intervention

## Method of Computation of Relative Risk for Injury, Ages 0–5 Years

$$\text{Relative risk} = (\text{control injury rate}_{D^1} \div \text{control injury rate}_B) \div (\text{intervention injury rate}_D \div \text{intervention injury rate}_B)$$

<sup>1</sup> Injury rates per 10,000 child years for target injuries (motor vehicle occupant, burns, falls, and poisonings). *D* = period during intervention; *B* = period before intervention.

NOTE: Andover, MA, was the control community; Southboro, MA, Westboro, MA, and Hopkinton, MA, were the intervention communities.

towns, giving a ratio of relative risks of  $1.49 \div .85$  or 1.75 for control (box) as compared with intervention sites (95 percent CI, .95–3.19).

## Discussion

The prevention of children's injuries is an important public health and pediatric challenge. Children's injury prevention programs must address not only the diversity of the injuries that children sustain, but the complexity of factors that lead to an injury, including social, environmental, and parental issues. They must also address the child's individual developmental, temperamental, and cognitive variations. The most successful programs to date have been those that involve passive interventions relying predominantly on technologies (for example, child proof medication packages). Certain types of injuries will require, however, parental action to be effective. For example, even when an effective passive technology such as a smoke detector is available, there are still behavioral actions that parents need to perform (for example, maintaining the detector's batteries).

The steps in establishing and analyzing the efficacy of injury prevention counseling programs are outlined in figure 2. This approach is derived from the general strategy of analyzing health services interventions from the perspective of structure, activities, and health status as described by Starfield (7). The three basic stages in this process include establishing counseling goals, designing and testing the counseling process, and testing the outcome of the program. We have accomplished each of these steps in some manner for the pediatric office-based counseling strategy used in PAPP.

Establishing counseling goals was based upon widely available information concerning the national scope of childhood injuries (8). The local

significance of this problem was confirmed by the baseline SCIPP surveillance (2), which determined that injuries are a leading cause of morbidity as well as mortality in Massachusetts. Effective parental strategies to prevent injuries have been well documented and include the use of car seats and seat belts, the installation of smoke detectors, lowering of tap water temperature, and a wide variety of other countermeasures (9,10).

The fact that parents require education to implement these strategies has been demonstrated by data collected from the Framingham Safety Surveys, which revealed significant need for education about how to prevent injuries among parents of various social (11) and geographic (12) strata within Massachusetts, including parents in the suburban intervention communities in the study. Analysis of the process stage of PAPP, which has been described in detail elsewhere (3), has documented that parents find the use of the safety surveys to be a very desirable counseling method with greater than 90 percent parental satisfaction with the process (3). In addition, the safety surveys have been well accepted by pediatric practitioners with 82 percent of physicians demonstrating good compliance in using the materials (3).

A variety of outcome measures have also been assessed for the SCIPP communities. A strong association between positive educational outcomes, as measured by SCIPP telephone surveys, was demonstrated for persons who were identified as having experienced a participatory intervention (4). Physician counseling is considered a participatory intervention. Although the population in the survey reported by Guyer and coworkers was much broader than the suburban intervention sites, they are included in the telephone survey sample, and these results are consistent with the injury incidence data reported for the suburban intervention towns.

Further support for the value of the pediatric counseling can be inferred from a study of behavioral outcomes for the PAPP suburban families, which was performed at the end of the intervention period (3). This study was able to document, through unannounced home inspections, that counseled families had safer homes. Although only 24 houses were inspected, these results are of particular interest because unlike the rest of the SCIPP data, which are population based, in the home visit study, specifically counseled parents were compared with uncounseled controls in the same town.

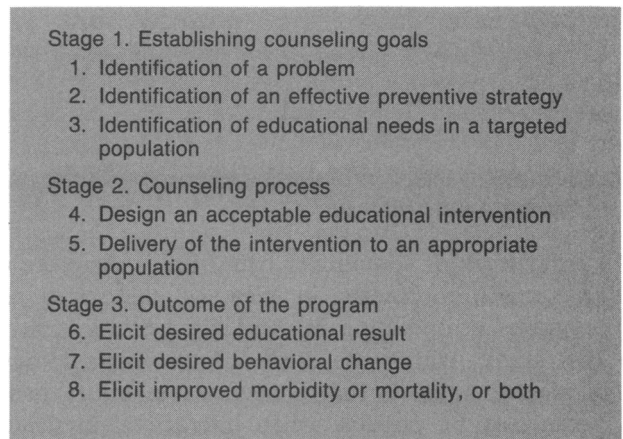
Of most interest, however, is the population-based epidemiologic data that showed a sustained decline in injury incidence, as well as a substantial

improvement in the relative risk for injuries in the suburban intervention communities. Because, as happened in our control town, the injury rates in a population may fluctuate without any evident explanation, the statistical method of comparing the intervention and control injury incidence densities for the entire duration of the study was used. The summary statistic, (see box) a relative risk ratio, is based on injury rates for the entire period both before and during the interventions (September 1, 1979, through August 15, 1982). A ratio of 1.0 would suggest that the variation in injury rates was a random occurrence. A higher ratio would suggest an improvement in the intervention town. Taking into account the range and scale of the 95 percent confidence interval (.95–3.19), the location of the null value (1.00) at the lowest limit of the interval with most values well above the null, and the fact that a parameter is more likely to be located centrally in an interval than near its limit (6b), we feel that the observed risk ratio of 1.74 for the control as compared with intervention communities lends support to the hypothesis that the educational program was effective.

There are, however, certain inherent limitations to any population-based study (4). For example, it is impossible to state with certainty the intervention exposure status of injured children. It is also difficult to control strictly the exposures of participating communities to other educational interventions or risks. Because of these difficulties, any conclusions drawn from this type of research must always be interpreted with circumspection as the possibility exists that, for example, the children who were not injured may not have been exposed to the intervention. In addition, in our study the pediatric intervention took place within the context of community education programs, and the results must be interpreted accordingly.

In view of the supportive findings at each stage of the counseling evaluation strategy (fig. 2) summarized earlier, as well as the greater penetration of the PAPP intervention compared with the community programs, it seems reasonable to conclude that the pediatric counseling played an important role in the outcomes reported. Our results are also consistent with other studies that have demonstrated a variety of positive outcomes for physician counseling, including seat belt use (13), car seat utilization (14–17), purchase of smoke detectors (18), safer tap water temperatures (19), knowledge of poisoning prevention strategies (20–22), and prevention of falls (23). A significant factor in most of the successful injury prevention counseling

Figure 2. Three stages and eight steps in the design and evaluation of strategies for counseling in injury prevention



studies is the involvement of the personal physician (13,22), which was precisely the model that was followed in PAPP.

If these results could be replicated on a larger scale, the impact would be encouraging. Although the generalizability of our results could be affected by different counseling styles of physicians, variations in patient populations, and differing approaches to community education, this report should certainly stimulate research on the efficacy of pediatric counseling as an approach to injury prevention. It is clear, however, that parent education is not a comprehensive solution to the reduction of childhood injuries. A concerted effort that involves a variety of targeted strategies including technological innovations, legislative actions, and educational programs offers the best chance for success (24). Since passive interventions are most effective, they should be pursued whenever possible. Since some injuries can only be prevented by parental action, physician counseling of parents may be a practical approach for these problems.

The implementation of these types of strategies to prevent childhood injuries is currently a major national priority (25). Educational programs in injury prevention that are community focused are being promoted by numerous agencies and institutions at the local, State, and national levels (26). In addition, to encourage injury prevention counseling by pediatricians, the American Academy of Pediatrics in 1987 established "TIPP"—The Injury Prevention Program (10). TIPP consists of a policy statement establishing injury prevention counseling as a standard of care, a developmental schedule of counseling topics, and supportive materials for office use, including the Framingham Safety Surveys. A combination of physician counseling within

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a framework of community education is therefore a very realistic scenario in view of the scope of programs in operation in the United States today. This study, within the limits of the methodology employed, suggests that a decrease in injury incidence may be possible when interactive physician counseling takes place in a context of ongoing community education programs.

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