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Success in the Prevention of Infant Walker–Related Injuries: An Analysis of National Data, 1990–2001

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ABSTRACT

OBJECTIVE. Here we describe the epidemiologic characteristics and secular trends of infant walker–related injuries among children who are younger than 15 months in the United States.

METHODS. A retrospective analysis was conducted of data from the National Electronic Injury Surveillance System of the US Consumer Product Safety Commission, 1990–2001. Sample weights that were provided by the National Electronic Injury Surveillance System were used in all analyses to adjust for the inverse probability of case selection and make national projections regarding infant walker–related injuries.

RESULTS. An estimated 197 200 infant walker–related injuries occurred among children who were younger than 15 months and treated in US emergency departments from 1990 through 2001. Five percent of these children required admission to the hospital. The number of infant walker–related injuries remained relatively constant from 1990 through 1994, averaging 23 000 cases per year. After the introduction in 1994 of stationary activity centers as an alternative to mobile infant walkers and the implementation of the revised American Society for Testing and Materials F977 voluntary infant walker standard in 1997, there was a marked decrease in the number of infant walker–related injuries. Overall, there was a 76% decrease in the number of injuries from 1990 to 2001 from 20 900 injuries in 1990 to 5100 in 2001. Soft tissue injuries and lacerations represented 63% of the injuries. Trauma to the head region occurred in 91% of cases. Skull fractures were the most common (62%) type of fracture. Falls down stairs was the mechanism of injury in 74% of cases.

CONCLUSIONS. The adoption of passive injury-prevention strategies, such as use of stationary activity centers as alternatives to mobile infant walkers and redesign of infant walkers to prevent falls down stairs, were associated with a marked decrease in the number of infant walker–related injuries.

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Key Words

children, infant walker, injuries, injury prevention

Abbreviations

ED—emergency department
ASTM—American Society for Testing and Materials
CPSC—Consumer Product Safety Commission
NEISS—National Electronic Injury Surveillance System
OR—odds ratio
CI—confidence interval

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THE USE OF infant walkers dates back to at least the mid-1600s,¹ and the hazards associated with their use have been recognized increasingly during the past 3 decades. Parents like infant walkers because they think that walkers help young children learn to walk and believe that walkers are a source of entertainment for children.²⁻¹⁴ They also state that walkers give their child enhanced mobility and serve as a baby-sitter, thereby keeping the child occupied so that they can do other necessary things.^{6,8,9,12,15} However, infant walkers allow infants mobility beyond their natural capability, thus providing them with a means of getting into dangerous situations.^{1,7,10} Moving at 1 m/second, an infant can be across the room and down a flight of stairs before the caregiver has time to react.¹⁶

The majority of serious injuries to infants in infant walkers involve falls down stairs.^{1,3,5,6,8,15-27} Other mechanisms of injury include walker tip-overs, finger entrapment, and allowing the infant to gain access to such hazards as oven doors, hot and/or heavy objects, and poisonous substances.^{8,13,15,22,27-30} Injuries that are associated with walker use include fractures, closed-head injuries, burns, dental injuries, lacerations, poisonings,^{1,5,7,16,17,20-25,28,29,31-36} and death.^{37,38}

Despite implementation of prevention strategies, such as public education and warning labels, children continue to be treated in emergency departments (EDs) for infant walker-related injuries. A voluntary performance standard,³⁹ American Society for Testing and Materials (ASTM) F977, was introduced in 1986 to address walker tip-overs and structural failures. It was revised in 1996 to address falls down stairs in walkers. The 1996 revision applies to infant walkers that were manufactured after June 30, 1997, and requires that the walker meet 1 of 2 standards: (1) the base of the walker must be too wide to fit through a standard 36-inch doorway, or (2) the walker must incorporate features to stop the walker at the edge of a step to prevent falling down the stairs. In addition, stationary activity centers were introduced into the marketplace in 1994 as a safer alternative to mobile infant walkers. Stationary activity centers allow children to bounce, swivel, and tip but do not have wheels. We hypothesized that the number of infant walker-related injuries would decline after introduction of stationary activity centers into the marketplace and the implementation of the revised voluntary performance standard for mobile infant walkers. The goal of our study was to test this hypothesis and describe the epidemiologic characteristics and secular trends of infant walker-related injuries among children who are younger than 15 months in the United States.

METHODS

Data Source

The Consumer Product Safety Commission (CPSC) monitors injuries that are treated in US hospital EDs through

the National Electronic Injury Surveillance System (NEISS). The NEISS was established in 1972 with revisions made in its sampling frame in 1978, 1990, and 1997. The NEISS obtains data from a probability sample of 98 hospitals, selected from the population of all hospitals with EDs that have at least 6 beds in the United States and its territories.⁴⁰ Projections of injuries that occur nationally are made from this probability sample. Data regarding injuries that are associated with consumer products and recreational activities are collected on a daily basis via computer from each participating hospital. The NEISS has been shown to be highly sensitive and accurate in identifying consumer product-related injury cases.⁴¹⁻⁴⁴

Data were obtained from the CPSC regarding infant walker-related injuries (product code 1508, "baby walkers and jumpers") reported through the NEISS during the 12-year period 1990-2001. The narrative for each case was reviewed, and cases that described "jumpers" or "bouncers" were excluded from this study. Children who were older than 14 months were also excluded.

Data Analysis

The type of injury was grouped into 6 categories during study analyses: (1) closed-head injury; (2) laceration; (3) burn; (4) soft tissue injury (abrasion, contusion, crushing injury, hematoma, and strain/sprain); (5) fracture/dislocation; and (6) other (ingestion, aspiration, foreign body, dental injury, nerve damage, hemorrhage, submersion, dermatitis, and conjunctivitis). Likewise, the body part injured was grouped into 4 categories during study analyses: (1) head; (2) upper extremity; (3) lower extremity; and (4) other (shoulder, upper trunk, pubic region, lower trunk, $\geq 25\%$ of the body, internal, and neck). The number of cases in which the patient fell down stairs or fell from another elevated surface was estimated using the NEISS product codes for stairs (1842); ramps or landings (1843); and porches, balconies, open-sided floors, or floor openings (1817).

Data were analyzed using by PCSAS⁴⁵ and Epi Info⁴⁶ software. Sample weights that were provided by the NEISS were used in all analyses to adjust for the inverse probability of selection and to make national projections regarding infant walker-related injuries. National injury estimates were rounded to the nearest 100 when reported in the text of this article. Unweighted numbers < 20 were not used for data analyses because they would provide unstable estimates. Statistical analyses included linear regression and χ^2 analysis with Yates' correction. Computation of odds ratios (ORs) with 95% confidence intervals (CIs) was also performed. The level of significance for all statistical tests was $\alpha = .05$.

Ethical Considerations

This study was approved by the institutional review board of the Columbus Children's Research Institute.

RESULTS

Sample Description

During the 12-year period 1990–2001, 6133 infant walker-related injuries were reported to the NEISS for patients of all ages. These injuries represent an estimated 216 100 infant walker-related injuries nationally. An estimated 197 200 (91.2%; 95% CI: 154 700 to 239 700) of these injuries were to children who were younger than 15 months. Among this young age group, the average age of injured children was 8.7 months (median: 9 months; range: 1–14 months); 59% were male; and 70% of these injuries occurred to children who were 7 to 10 months of age (Fig 1).

The number of injuries per year remained fairly constant from 1990 through 1994, averaging 23 000 cases per year. A steady decrease in the number of injuries occurred from 1994 through 2001 ($P < .01$; $r = 0.991$; slope = -2529 ; 95% CI: -2868 to -2190). Overall, there was a 76% decrease in the number of infant walker-related injuries during the 12-year period 1990–2001, from 20 900 injuries reported in 1990 to 5100 in 2001, and a 78% decrease from 1994 (23 300 injuries) through 2001. The greatest number of injuries occurred in 1991, during which time an estimated 25 100 injuries were reported. Thirty-three percent of infant walker-related injuries occurred during the months of April, May, and June. Most (99%) injuries occurred in the home, with the remaining 1% occurring at schools/child care centers or on other public property.

Injuries Sustained

Head injuries accounted for 91.3% of infant walker-related injuries. The remaining 8.7% of injuries occurred to the upper extremity (3.1%), lower extremity (1.3%), and other (4.3%) parts of the body. Injury diagnoses were soft tissue injuries (53.0%), closed-head injuries (25.1%), lacerations (10.1%), fractures/dislocations

(5.2%), burns (2.2%), and other (4.4%). Of the estimated 178 200 head injuries, 54.7% were soft tissue injuries, 27.7% were closed-head injuries, and 17.6% were other types of injury. Skull fractures accounted for 6043 injuries and 62.3% of all fractures. Other fractures were to the trunk (15.9%), upper extremity (10.8%), lower extremity (5.6%), and face (5.4%).

Mechanism of Injury

Falls down stairs or from other elevated surfaces accounted for an estimated 150 400 injuries, with falls down stairs representing 96.7% (145 400) of these injuries and 73.7% of infant walker-related injuries overall. Falls down stairs in infant walkers were significantly associated with an increased risk for skull fracture ($P < .01$; OR: 3.74; 95% CI: 3.42 to 4.09).

Secular Trends

The secular trend in the number of cases in which the child fell down stairs in the infant walker compared with that of the number of cases that were caused by other mechanisms of injury is depicted in Fig 2. Before 1997, an average of 76% of all infant walker-related injuries were caused by falls down stairs in a walker. This decreased to an average of 65% after 1997, and by 2001, this proportion had decreased to 53%.

Figure 3 depicts the secular trend in the number of injuries to various parts of the body. There was a marked decrease in the number of head injuries during the 12-year period, and this decline was proportionally greater (80.4%) than that seen for injuries to the lower and upper extremities and other body regions (34.1%). Figure 4 demonstrates the parallel decreases in the number of infant walker-related injuries overall, the number of injuries that resulted from falls down stairs in a walker, and the number of head injuries. These decreases coincide with the introduction of stationary activity centers

FIGURE 1

Estimated number of children who were younger than 15 months and had infant walker-related injuries according to age and gender (■, male; □, female): United States EDs, 1990–2001.

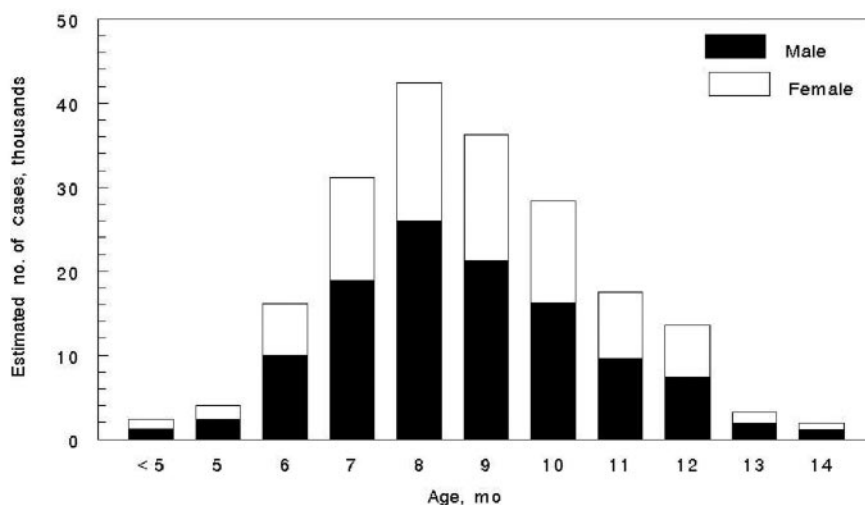


FIGURE 2

Estimated number of children who were younger than 15 months and injured by falling down stairs (■) in an infant walker compared with other mechanisms of injury (□) according to year of injury: United States EDs, 1990–2001.

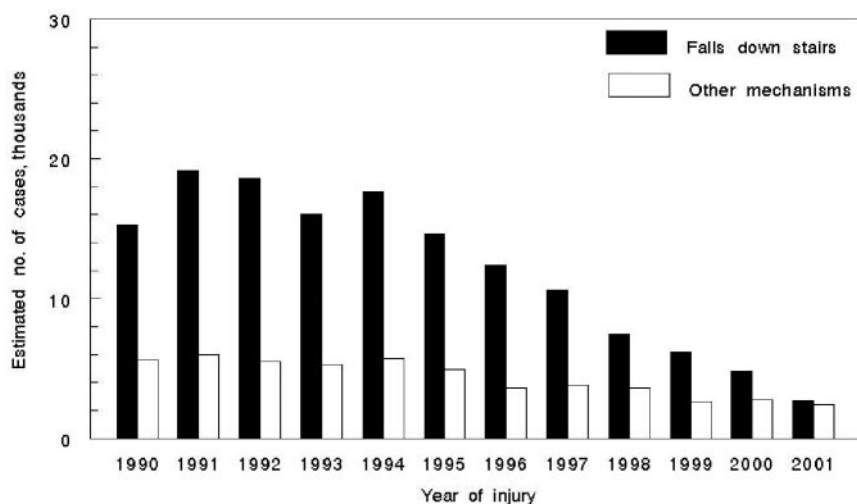
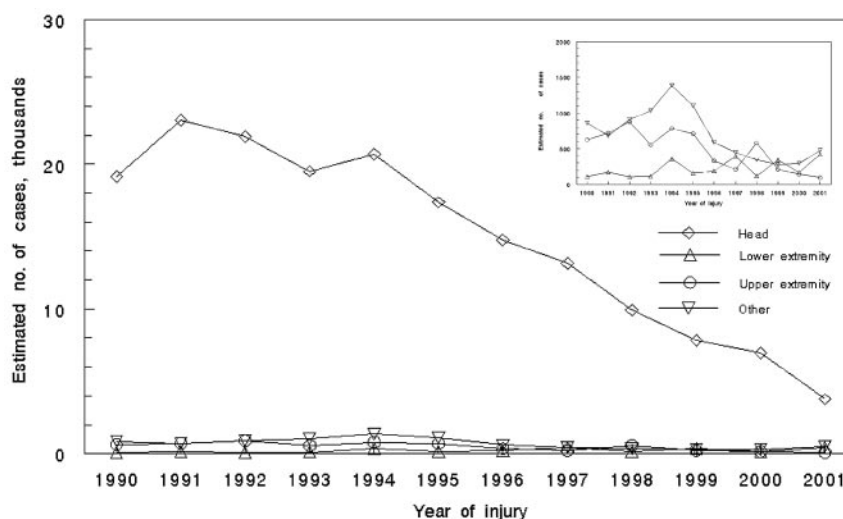


FIGURE 3

Estimated number of children who were younger than 15 months and had infant walker–related injuries according to body part injured and year of injury: United States EDs, 1990–2001. Inset, Estimated number of injuries to the lower extremities, upper extremities, and other parts of the body according to year of injury. ◇, head; △, lower extremities; ○, upper extremities; ▽, other.



into the marketplace in 1994 and revisions to the ASTM voluntary standard³⁹ in 1996, affecting walkers that were manufactured after June 30, 1997.

Table 1 summarizes the results of linear regression analyses for the number of head injuries, lower extremity injuries, upper extremity injuries, injuries to other regions of the body, falls down stairs in an infant walker, and the total number of infant walker–related injuries per year from 1990 through 2001. These results indicate that the decrease in the total number of infant walker–related injuries was paralleled by decreases in the number of head injuries and falls down stairs in an infant walker during the same time period, whereas the number of injuries to the lower extremities, upper extremities, and other regions of the body remained relatively unchanged.

Hospital Admissions

The majority (95.4%) of children with infant walker–related injuries were treated and released from the ED.

Children who sustained skull fractures were more likely to be admitted to the hospital than were those who sustained other types of injuries ($P < .01$; OR: 49.11; 95% CI: 46.32 to 52.07). Falls down the stairs in an infant walker were significantly associated with admission to the hospital ($P < .01$; OR: 1.27; 95% CI: 1.21 to 1.34) and accounted for 7100 infant walker–related hospital admissions.

DISCUSSION

To our knowledge, this study is the first to report national estimates and trends of infant walker–related injuries to young children. There was a 76% decrease in the number of infant walker–related injuries that were treated in US EDs from 1990 through 2001, with a marked decrease occurring between 1994 and 2001. Many of the findings of this study are similar to those reported by others.^{1,5,6,16,18,20–27,37} The majority (97%) of children were injured when they fell down stairs in their infant walker. Head injuries were sustained most fre-

FIGURE 4

Secular trends in the estimated number of infant walker-related injuries to children who were younger than 15 months: total number of injuries (\diamond), number of head injuries (\square), and number of injuries that were caused by falling down stairs in an infant walker (\triangle)—United States EDs, 1990–2001.

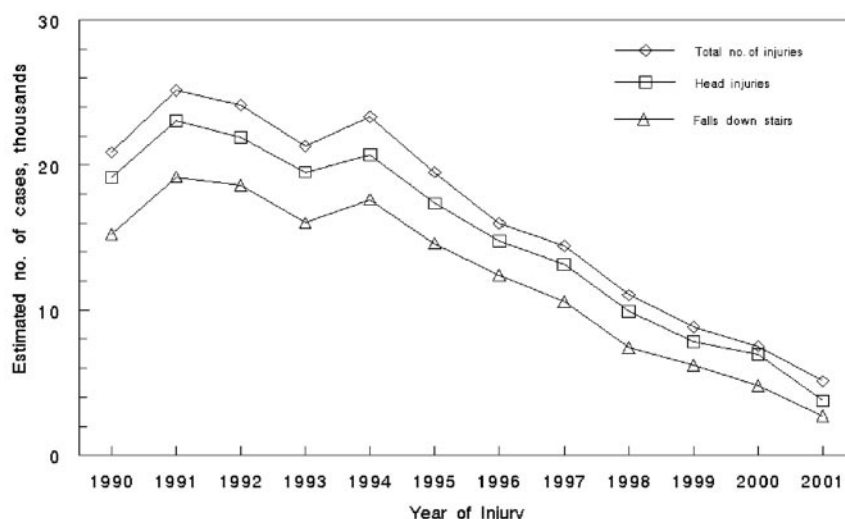


TABLE 1 Summary of Linear-Regression Analyses for the Number of Head Injuries, Lower Extremity Injuries, Upper Extremity Injuries, Injuries to Other Regions of the Body, and Falls Down Stairs in an Infant Walker and Total Number of Infant Walker-Related Injuries, Per Year: 1990 to 2001

Variable	P	r	Slope (95% CI)
Head injuries	<.01	.994	−2320 (−2570 to −2070)
Lower extremity injuries	.70	.162	8 (−41 to 57)
Upper extremity injuries	.01	.828	−91 (−153 to −30)
Injuries to other body regions	.01	.816	−136 (−233 to −40)
Falls down stairs	<.01	.994	−2089 (−2324 to −1854)
Total no. of injuries	<.01	.991	−2529 (−2868 to −2190)

quently, accounting for 91% of the injuries in our study. Skull fractures and falls down stairs in an infant walker were significantly associated with hospital admission in the present study, as well as in studies that were conducted by others.^{6,16} Most (99%) of the injuries occurred at home.

Injury-prevention theory dictates that the most effective prevention strategies are those that do not require frequent human action and vigilance.⁴⁷ Consistent with this theory, the results of this study demonstrate that the “passive,” or automatic, protection provided by infant walker redesign was effective in reducing the number of infant walker-related injuries, in contrast to previous “active” prevention approaches. Before 1994, active injury-prevention strategies primarily were used. Active strategies require human action and vigilance for protection to occur. Examples of these strategies include public awareness campaigns; anticipatory guidance by health care providers; and warning labels on infant walkers that advise adult supervision during walker use and use of barriers, such as stair gates, to prevent infant walker-related injuries. Before 1994, the number of infant walker-related injuries remained relatively constant at ~23 000 cases per year despite these ongoing preven-

tion efforts. Then, starting in 1994, new passive injury-prevention strategies became available to prevent infant walker-related injuries. Passive strategies provide automatic prevention without requiring action on the part of the caregiver or the child for protection to occur. The 2 major passive injury-prevention strategies that were initiated during the 12-year study period were (1) introduction of stationary activity centers into the marketplace in 1994 as alternatives to mobile infant walkers and (2) a revision to the infant walker voluntary standard, applicable to walkers that were manufactured after June 30, 1997, requiring walkers to meet 1 of 2 standards aimed at preventing falls down stairs in an infant walker.³⁹ There was a significant decrease in the number of injuries that were caused by falls down stairs in infant walkers and in the number of infant walker-related head injuries from 1994 to 2001. These decreases were associated with an overall decrease in the total number of infant walker-related injuries during the same period.

The parallel decreases in the total number of infant walker-related injuries, infant walker-related head injuries, and falls down stairs in an infant walker (Fig 4) are consistent with the child’s tendency to remain in the walker when the walker falls down stairs, thus leaving the head exposed and vulnerable to impact with other objects.²³ The thorax, abdomen, and lower extremities are relatively protected by the walker frame in a fall down stairs; however, the upper extremities still may be exposed.⁶ In this study, the number of injuries to regions of the body other than the head remained relatively unchanged during the study period. This is consistent with the observed disproportionately larger decrease in stairway fall-related injuries compared with injuries that were associated with other mechanisms.

Study results argue for the effectiveness of the 2 passive injury-prevention strategies introduced during the study period, suggesting that both were associated

with the observed decrease in the number of infant walker-related injuries. The marked decline in injuries after the 1994 introduction of stationary activity centers suggests an effect of this walker alternative. The influence of the revised voluntary standard can be seen since its implementation in 1997 with the disproportionate decline in stairway fall-related injuries compared with infant walker-related injuries that are caused by other mechanisms (Fig 2). If the continued decline in infant walker-related injuries after 1997 were attributable to a general decrease in the use of mobile walkers with an associated increase in the use of stationary activity centers, then one would have expected a proportionally similar decline in infant walker-related injuries that were caused by all mechanisms. However, the decrease in infant walker-related injuries was seen primarily for injuries that were caused by stairway falls, which was the objective of the performance modifications in the revised voluntary standard.

According to the CPSC,⁴⁸ the decrease in infant walker-related injuries from 1995 to 2000 cannot be attributed to a decrease in births or a decrease in infant walker sales during this 6-year period. However, DiLillo et al¹² found that use of 1 brand of stationary activity center, the Exersaucer, increased steadily from 1994 to 1999, whereas infant walker use decreased during the same period. This is an indication that parents may be choosing to use stationary activity centers instead of mobile infant walkers. To help determine the effectiveness of the revised voluntary infant walker standard, CPSC staff conducted two 6-month special studies of infant walker-related incidents from November 1, 1999, through April 30, 2000, and November 1, 2000, through April 30, 2001, to identify the types of walkers that were involved in reported stairway fall incidents.³⁸ The results of those studies indicated that most of the recent stairway fall incidents involved older walkers that did not meet the revised ASTM F977 standard. In addition, the CPSC received 2 reports of infant walker-related deaths in 2001.³⁸ Both deaths resulted from head injuries that were sustained during falls down stairs in a walker. The walkers that were involved in these incidents were also older-style walkers that did not meet the revised standard. Not everyone believes that the revised standard is adequate. Ridenour⁴⁹ found high failure rates of the new braking systems on walkers that were manufactured after June 30, 1997, and is concerned that parents may have a false sense of security when using these walkers.

Despite the decline in infant walker-related injuries, the American Academy of Pediatrics continues to call on the US government to ban mobile infant walkers.⁵⁰ In 2004, the Canadian government banned infant walkers in Canada and prohibited their importation.⁵⁰⁻⁵² Infant walkers are regulated by the Canadian Hazardous Product Act and, therefore, may not be imported, sold, or advertised in Canada. Inspectors have the power to seize

new or used walkers. Consumers and retailers could face fines of up to \$100 000 or 6 months in jail if found in possession of infant walkers.⁵¹

Although the introduction of stationary activity centers into the marketplace in 1994 and the 1996 revision to ASTM voluntary standard F977 were associated with a decrease in the number of infant walker-related injuries that were treated in US EDs, infant walker-related injuries are still occurring. Concerns have been raised about the efficacy of the braking systems on walkers that were manufactured after June 30, 1997, and some parents have admitted to removing these braking systems,⁵³⁻⁵⁵ thereby defeating the passive injury-prevention system afforded them by the new walker design. Infant walkers serve no essential purpose. Infant walkers do not help a child learn to walk, and, in fact, they can delay normal motor and mental development.^{2,4,9,56,57} Safer alternatives to mobile infant walkers, such as stationary activity centers, are readily available and can provide many of the same benefits that parents perceive infant walkers to provide.¹² Therefore, the US government should follow the lead of the Canadian government and ban the sale, importation, and advertisement of mobile infant walkers in the United States to prevent additional infant walker-related injuries from occurring to young children.

Limitations of Study

This study has several limitations. First, exposure data, such as the number of hours that children spent in infant walkers, were unavailable; therefore, the rate of infant walker-related injuries could not be calculated. Second, study findings demonstrate a temporal association between the adoption of passive injury-prevention strategies and a decrease in the number of infant walker-related injuries but cannot prove causality. Finally, this study may underestimate the actual number of infant walker-related injuries, because only injuries that were treated in an ED are reported. Many injuries are not treated in EDs but instead are treated by children's caregivers, at a private physician's office, or at other non-ED health care facilities or do not receive medical treatment at all.

Model for Injury Prevention

The results of this study demonstrate that the passive protection that was provided by infant walker redesign and the introduction of stationary activity centers into the marketplace were effective in reducing the number of infant walker-related injuries, in contrast to previous active prevention approaches. This success mirrors achievements in control of other public health problems, such as infectious diseases. For example, infectious diarrheal morbidity and mortality were controlled in the United States not by relying on individuals to boil their water each time before use but by installing potable

water and sewer systems, thus providing passive protection by designing the problem out of the environment. Redesign of infant walkers, including removal of the wheels, effectively removes the threat of injury from the child's environment without relying on adult supervision each time a walker is used.

Too often, what has been learned from the control of infectious diseases during the past 150 years is ignored when implementing injury-prevention strategies. The focus has been on admonishing parents to be careful and supervise their children closely rather than on implementation of passive protection measures. The "bigger picture" lesson to be learned from the success in controlling infant walker-related injuries is that we must use the same types of strategies to control injuries that have been successful against other public health problems such as infectious diseases. We must use passive protections against injury to prevent this leading public health threat to US youths. The success in prevention of infant walker-related injuries should be used as a model for other injury-prevention efforts.

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