

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Parent Education by Maternity Nurses and Prevention of Abusive Head Trauma

Robin L. Altman, Jennifer Canter, Patricia A. Patrick, Nancy Daley, Neelofar K. Butt
and Donald A. Brand

Pediatrics 2011;128:e1164; originally published online October 24, 2011;
DOI: 10.1542/peds.2010-3260

The online version of this article, along with updated information and services, is
located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/128/5/e1164.full.html>

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2011 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



Parent Education by Maternity Nurses and Prevention of Abusive Head Trauma



WHAT'S KNOWN ON THIS SUBJECT: Approximately 20 per 100 000 infants per year experience abusive head injuries resulting from shaking, typically triggered by a caregiver's inability to stop the infant's crying. Hospital-based parent education immediately after the infant's birth has shown promise as a prevention strategy.



WHAT THIS STUDY ADDS: Results of this study provide strong corroborating evidence that a low-cost prevention program delivered by maternity nurses can substantially reduce newborns' risk of sustaining an abusive head injury resulting from shaking during the first year of life.

abstract

FREE

OBJECTIVE: A consortium of the 19 community hospitals and 1 tertiary care children's hospital that provide maternity care in the New York State Hudson Valley region implemented a program to teach parents about the dangers of shaking infants and how to cope safely with an infant's crying. This study evaluated the effectiveness of the program in reducing the frequency of shaking injuries.

METHODS: The educational program, which was delivered by maternity nurses, included a leaflet explaining abusive head trauma ("shaken baby syndrome") and how to prevent it, an 8-minute video on the subject, and a statement signed by parents acknowledging receipt of the information and agreeing to share it with others who will care for the infant. Poisson regression analysis was used to compare the frequency of shaking injuries during the 3 years after program implementation with the frequency during a 5-year historical control period.

RESULTS: Sixteen infants who were born in the region during the 8-year study period were treated at the children's hospital for shaking injuries sustained during their first year of life. Of those infants, 14 were born during the 5-year control period and 2 during the 3-year postimplementation period. The decrease from 2.8 injuries per year (14 cases in 5 years) to 0.7 injuries per year (2 cases in 3 years) represents a 75.0% reduction ($P = .03$).

CONCLUSIONS: Parent education delivered in the hospital by maternity nurses reduces newborns' risks of sustaining an abusive head injury resulting from shaking during the first year of life. *Pediatrics* 2011;128:e1164–e1172

AUTHORS: Robin L. Altman, MD,^{a,b} Jennifer Canter, MD, MPH,^{a,b} Patricia A. Patrick, DrPH,^{c,d} Nancy Daley, RNC, BSN, MSN,^e Neelofar K. Butt, MD,^{a,b} and Donald A. Brand, PhD^{c,f}

^aDepartment of Pediatrics and ^dSchool of Health Sciences and Practice, New York Medical College, Valhalla, New York; ^bMaria Fareri Children's Hospital, Westchester Medical Center, Valhalla, New York; ^cOffice of Health Outcomes Research, Winthrop University Hospital, Mineola, New York; ^eWestchester County Health Department, New Rochelle, New York; and ^fDepartment of Preventive Medicine, School of Medicine, Stony Brook University, Stony Brook, New York

KEY WORDS

shaken baby syndrome, nonaccidental head injury, abusive head injury, child abuse, injury prevention

ABBREVIATION

ICD-9—International Classification of Disease, Ninth Edition

Dr Butt's current affiliation is School of Health Sciences and Practice, New York Medical College, Valhalla, NY.

This work was presented at the 2010 Annual Symposium on Health Care Services in New York: Research and Practice (poster), November 3, 2010, New York, NY; and the 2011 joint meeting of the Pediatric Academic Societies and Asian Society for Pediatric Research, May 3, 2011, Denver, CO.

www.pediatrics.org/cgi/doi/10.1542/peds.2010-3260

doi:10.1542/peds.2010-3260

Accepted for publication Aug 8, 2011

Address correspondence to Robin L. Altman, MD, Department of Pediatrics, New York Medical College, 312 Munger Pavilion, Valhalla, NY 10595. E-mail: robin_altman@nycmc.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

Copyright © 2011 by the American Academy of Pediatrics

FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

Abusive head trauma resulting from shaking, also known as shaken baby syndrome, is the most common cause of traumatic death for children younger than 1 year.¹ Between 17 and 25 infants per 100 000 sustain such head injuries,^{2,3} of which approximately one-fourth prove fatal and two-thirds cause neurologic sequelae.⁴ These sequelae include brain damage, mental retardation, epilepsy, blindness, and learning disabilities, necessitating medical, rehabilitation, and educational services over many years. If the child survives, then the mean lifetime costs of acute and chronic care may exceed \$10 million.⁵

For every child who sustains serious injuries as a result of shaking, another 150 children may be shaken without detection.⁶ The person most likely to shake an infant is the father or a male surrogate.⁷ Shaking typically is triggered by the caregiver's inability to stop the infant from crying.⁸ To prevent such injuries, a consortium of 20 hospitals in the New York State Hudson Valley region initiated a prevention program to teach parents about the dangers of shaking an infant and how to cope safely with an infant's crying. The program was designed to educate parents at the moment of greatest potential impact, that is, in the hospital shortly after the birth of their infant.⁹ This report describes this program and its effect on the frequency of shaking injuries in the region.

METHODS

Program Description

The Hudson Valley region encompasses 7 counties north of New York City and has a total population of 2.1 million representing a broad demographic and socioeconomic spectrum. The region contains 19 community hospitals with maternity services and 1 tertiary care, academic teaching hospital, which together account for

~25 000 births per year. The hospitals range in size from 68 to 635 beds and have ~300 to 2600 deliveries per year. In 2005, these 20 hospitals formed a consortium, led by faculty members from the department of pediatrics at the academic teaching hospital (Drs Altman and Canter), to implement the Hudson Valley Shaken Baby Prevention Initiative.

The program consisted of a leaflet explaining abusive head trauma and how to prevent it (designed specifically for the initiative, in English and Spanish), a previously produced 8-minute video,¹⁰ and a brief, self-administered questionnaire containing the following commitment statement: "I know that shaking a baby is dangerous and I agree to share this knowledge with others." The concept and structure of the program were inspired by a hospital-based initiative that had been implemented several years earlier in another region of the state.⁹ Administrative and financial support was provided by the New York State Office of Children and Family Services. During its initial 3 years, the Hudson Valley program cost approximately \$4.50 per newborn. Because this amount includes program development and set-up costs, the ongoing marginal costs per newborn should decrease.

Maternity nurses were responsible for administering the program by instructing parents to read the leaflet, to watch the video, and to acknowledge the commitment statement with their signatures. To prepare for this role, nursing staff members at each hospital received on-site training from the project's clinical coordinator (Ms Daley), including information about abusive head injury resulting from shaking, its relationship to infant crying, and safe coping strategies for parents. Several of the hospitals already had various abusive head injury prevention programs in place, but all of them

opted to undergo standardized staff training and to substitute the initiative's educational program and material. The program was introduced at the hospitals between January 1, 2005, and April 30, 2005, and was fully operational at all 20 sites by May 1, 2005.

The initiative was coordinated from the Maria Fareri Children's Hospital at Westchester Medical Center (Valhalla, NY). Westchester Medical Center, which is located 20 miles north of New York City, is the major, tertiary care, academic teaching hospital serving the lower/middle Hudson Valley region. Maria Fareri Children's Hospital is the region's only advanced pediatric referral center, housing a trauma service with a level 1 pediatric critical care unit and sponsoring a child abuse pediatrics program.

Program Evaluation

Study Design

Because the Hudson Valley region includes a single tertiary care children's hospital, most infants with suspected abusive head injuries resulting from shaking are taken or transferred to that hospital for evaluation and treatment. It follows that an increase or decrease in the frequency of such injuries observed at Maria Fareri Children's Hospital would reflect a corresponding increase or decrease in the region overall. Therefore, this frequency served as the primary outcome measure, the key indicator of the program's success. Additional outcome measures included the proportion of parents who received the educational materials in the hospital (program exposure) and the proportion of parents who, 6 months later, recalled learning about shaking injuries and indicated that the information had been helpful (perceived benefit).

Before implementing the program, project leaders decided to evaluate the primary outcome by comparing a

TABLE 1 Results of 6-Month Telephone Follow-up Survey ($N = 320$)

Question	Yes Responses, n (%)
1. While you were in the hospital after the birth of your baby, do you remember receiving information about how to care for your baby if he or she cries a lot?	283 (88.4)
What information were you given? (open-ended follow-up question after "yes" response [no choices offered])	
Video	104 (32.5)
Written material	79 (24.7)
Other information related to coping with crying ^a	36 (11.3)
Other information related to general child care	35 (10.9)
Do not recall or no response	66 (20.6)
2. Do you remember anyone speaking with you about the dangers of shaking your baby?	263 (82.2)
3. Do you remember receiving any written material about preventing shaken baby syndrome?	284 (88.8)
4. Do you remember watching a video about shaken baby syndrome?	313 (97.8)
5. Do you remember signing a form acknowledging that you had received information about shaken baby syndrome?	303 (94.7)
6. Since you left the hospital, have you seen or received any other materials or information about shaken baby syndrome or what to do when your baby cries a lot? ^b	43 (13.4)
7. Can you think of any situation where your baby cried a lot and the information you received about shaken baby syndrome was helpful to you?	178 (55.6)
8. Have you shared the information about shaken baby syndrome with others who care for your baby?	173 (54.1)

^a Examples of information recalled are as follows. "If the baby cries a lot, walk away." "Put him down and walk away." "Don't shake—ask for help." "Put her down and vacuum to cover the noise." "Walk away and come back when you are calm." "Check the baby's needs—no shaking." "Shaking causes brain hemorrhage." "Be patient, pick them up, rock them gently, never shake them." "Walk away and leave the baby in a safe place." "Make sure anyone who cares for your baby is aware of shaken baby syndrome."

^b Sources included the following: pediatrician ($n = 15$), magazine ($n = 7$), Supplemental Nutrition Program for Women, Infants, and Children ($n = 4$), television/radio ($n = 3$), Internet ($n = 2$), brochure ($n = 2$), Early Intervention or Healthy Start program, spouse, health insurance company, Pampers/Gerber, preschool, Teenage Services Act program (for teen parents), parenting class, or unspecified source ($n = 10$).

5-year historical control period with a 3-year intervention period in a before/after study design. They also decided to exclude the phase-in period, when the program would be operational at some consortium sites but not at others. These decisions yielded control and intervention periods of January 1, 2000, through December 31, 2004, and May 1, 2005, through April 30, 2008, respectively. The excluded phase-in period spanned the 4-month interval from January 1 through April 30, 2005. Finally, a geographic control region comprising 3 nearby states was used to examine temporal trends in the frequency of shaking injuries during the 8-year study period.

Data Collection

The 1-page self-administered questionnaire, which was completed by parents in the hospital, asked who would be taking care of the infant (mother, father, grandparent, baby-sitter, day care worker, or other), who watched the video (mother, father, other, or no one), and whether the information in the video was helpful (5 choices ranging from extremely helpful to not at all

helpful). The questionnaire also asked for parents' permission for investigators to contact them in 6 months to discuss the educational materials and, if the parents agreed, requested contact information. Both parents then were asked to sign the commitment statement indicating that they understood the dangers of shaking an infant. A parent who did not watch the video was asked to sign a waiver and to provide an explanation. Parents had the choice of completing an English or Spanish version of the questionnaire (available from the authors). Staff members at each hospital mailed completed questionnaires and reported the number of live birth deliveries to the initiative's coordinating office on a monthly basis.

A random sample of parents who consented to follow-up monitoring were contacted when their infants were 6 months of age. A physician or nurse conducted a standardized telephone interview in English or Spanish, asking parents whether they recalled having learned about how to care for the infant if the infant cried a lot and

whether the information had been helpful for dealing with specific instances of inconsolable crying (Table 1) (the interview template is available from the authors). A total of 320 interviews were conducted, including 240 interviews during the first year of the initiative (1 per hospital per month) and 80 interviews during the second year (1 per hospital every 3 months).

The target population for the program evaluation included all infants born at 1 of the 20 consortium hospitals during the 5-year control period or the 3-year intervention period. A 2-step process, which was approved by the institutional review board at New York Medical College, identified patients from this target group who were treated at Maria Fareri Children's Hospital for abusive head injuries resulting from shaking. The first step identified potential shaking injuries by using inpatient diagnosis codes¹¹ recorded in the hospital's administrative database. This step produced a list of all infants younger than 12 months on the date of admission who were admitted between January 1, 2000, and April 30,

2009, and diagnosed with abusive head trauma (*International Classification of Diseases, 9th Edition* [ICD-9] code 995.55) or ≥ 2 of the following 3 conditions: retinal hemorrhage (ICD-9 code 362.81), subdural hemorrhage (ICD-9 code 432.1), or fracture of the skull, rib, or extremity (ICD-9 codes 800.00–804.99, 807.00–807.69, and 810.00–829.1). These conditions in combination strongly suggest an abusive head injury.^{1,12,13} The 12-month age limit followed from the fact that the vast majority ($\sim 90\%$) of shaking injuries occur before a child's first birthday.² The April 30, 2009, cutoff date for the database search allowed for 12 months of follow-up monitoring to identify shaking injuries among infants born during the third year of the intervention, which ended April 30, 2008.

The second step involved a detailed review of the hospital medical records for patients identified in the first step. A single independent reviewer, who was a third-year (postgraduate year 6) child abuse fellow (Dr Butt), recorded data with a standardized instrument, including date of birth, date of admission, home zip code, presenting symptoms, physical findings, results of pertinent diagnostic tests, and a description of events leading up to the injuries. The reviewer, who was not aware of how the data would be used, verified that the infant had been born during the control or intervention period and lived within the initiative's catchment area at the time of admission. If not, then the patient was excluded from the study. If the patient lived within the catchment area at the time of admission, then we assumed that he or she had been born in the same area. The reviewer confirmed the diagnosis of abusive head injury resulting from shaking only if the medical record included clear evidence of an intracranial injury together with either retinal hemorrhage or fractures,

in the absence of a medical condition or accident that could explain the injuries, or the medical record documented a credible confession. Only confirmed cases were counted in the analysis.

Inpatient data from the pediatric component of the Healthcare Cost and Utilization Project¹⁴ were used to examine temporal trends in the frequency of shaking injuries in a nearby geographic control region. These publicly available data, which were gathered every 3 years from 1997 through 2006, were derived from a systematic 80% random sample of pediatric admissions to nonfederal, acute care hospitals located in participating states. Of the 5 participating states located near New York (Massachusetts, Connecticut, New Jersey, Pennsylvania, and Maryland), we selected 3 states (Connecticut, New Jersey, and Maryland) to serve as a geographic control region because those states had not enacted legislation aimed at the prevention of abusive head injuries resulting from shaking as of April 30, 2008, the end of our study period.¹⁵ We identified children younger than 1 year who were discharged from hospitals in the 3 states with a diagnosis of abusive head trauma (ICD-9 code 995.55) in 2000, 2003, or 2006. Because the first 2 years covered 40% of our study's historical control period and the third year covered 33% of our intervention period, these hospital discharge data could be used to track the frequency of shaking injuries in this geographic control region across relevant years.

Statistical Analyses

The number of questionnaires completed in a given month divided by the number of deliveries during that month measured the extent to which the initiative's target audience had been exposed to the program; χ^2 testing was used for comparisons involv-

ing categorical questionnaire responses. A significance level of .05 was used for these and all other statistical analyses.

The number of patients treated at Maria Fareri Children's Hospital for abusive head injuries resulting from shaking during a given 12-month period served as the study's primary outcome variable. Although it is possible that the study's case ascertainment method occasionally missed an infant with a shaking injury (eg, an infant might have been referred to a hospital outside the Hudson Valley region, or to a medical examiner if the infant died at the scene with a fatal shaking injury), such undercounting would have been equally likely during the control and intervention periods. Therefore, although it is not possible to derive an absolute regional incidence from the study, it is possible to compare the relative frequency of shaking injuries in the 2 study periods. A Poisson regression analysis was used to perform the before/after comparison. A second Poisson regression analysis was used to test for temporal changes in the frequency of shaking injuries in the geographic control region.

RESULTS

Program Exposure

A total of 76 108 deliveries, that is, $\sim 25\ 000$ deliveries per year, occurred at consortium hospitals during the 3-year intervention period. On the basis of questionnaire completion, 84.5% of parents were exposed to the prevention program in year 1 (range: 69.2%–98.5% across the 20 hospitals), 88.1% in year 2 (range: 81.7%–97.7%), and 87.8% in year 3 (range: 78.1%–98.3%). This measure of exposure probably underestimates the true exposure to some degree, because parents might have received the educational materials but failed to complete a questionnaire.

TABLE 2 Characteristics of 16 Infants Born in the Hudson Valley Region Who Were Treated at Maria Fareri Children's Hospital for Abusive Head Injuries Resulting From Shaking

Age, mean \pm SD (range), mo	5.2 \pm 2.7 (2.0–10.2)
Gender, n (%)	
Male	9 (56.3)
Female	7 (43.7)
Race, n (%)	
White	4 (25.0)
Black	2 (12.5)
Unspecified	10 (62.5)
Presentation, n (%)	
Loss of consciousness	8 (50.0)
Vomiting	8 (50.0)
Lethargy	7 (43.8)
Apnea	7 (43.8)
Irritability	6 (37.5)
Limpness	6 (37.5)
Cyanosis	4 (25.0)
Cough	3 (18.8)
Seizure	3 (18.8)
Other ^a	14 (87.5)
Injuries, n (%)	
Subdural hemorrhage	14 (87.5)
Retinal hemorrhage	14 (87.5)
Skull fracture	5 (31.3)
Rib fracture	3 (18.8)
Upper extremity fracture	2 (12.5)
Lower extremity fracture	2 (12.5)
Epidural hemorrhage	1 (6.3)
Deaths, n (%)	4 (25.0)

Infants were born during the 5-year historical control period (January 1, 2000, to December 31, 2004) or the 3-year intervention period (May 1, 2005, to April 30, 2008). The 4-month intervention phase-in period (January 1 through April 30, 2005) was excluded.

^a Includes bruises ($n = 2$), shaking of extremities ($n = 2$), pallor ($n = 2$), cardiac arrest ($n = 2$), lacerated/bleeding lip, grunting, nasal flaring, weakness, increase in head circumference, labored breathing, oral thrush, tense anterior fontanelle, and subconjunctival hemorrhage.

Of 65 663 questionnaires completed during the 3-year period (86.4% in English and 13.6% in Spanish), 94.9% contained the signature of ≥ 1 parent or guardian, acknowledging that he or she understood the dangers of shaking an infant, and 41.9% contained 2 signatures. The questionnaires yielded the following data on who watched the video: both parents, 39.9%; mother only, 45.1%; father only, 0.5%, neither parent, 14.5%. Of those who watched the video, 73.1% reported that it was extremely or very helpful. Among those who did not watch the video, 26.2% explained that they had already watched

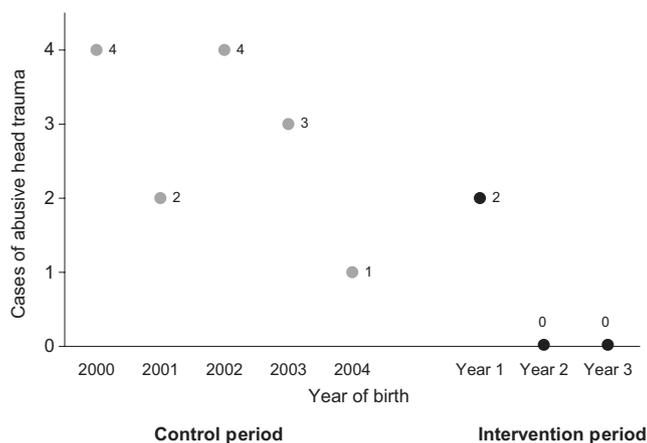


FIGURE 1

Numbers of infants born in the Hudson Valley region who were treated at Maria Fareri Children's Hospital for abusive head injuries resulting from shaking, according to year of birth. A total of 16 cases of abusive head injuries resulting from shaking were treated: 14 during the 5-year historical control period (2.8 cases per year) and 2 during the 3-year intervention period (0.7 cases per year). The 75% reduction in annual frequency of cases is statistically significant ($P = .03$). The 4-month intervention phase-in period (January 1 through April 30, 2005) was excluded. Year 1, year 2, and year 3 refer to consecutive 12-month intervals beginning May 1, 2005. Gray and black dots denote cases from the control and intervention periods, respectively. The control period was from January 1, 2000, through December 31, 2004 ($N = 14$); the intervention period was from May 1, 2005, through April 30, 2008 ($N = 2$).

it with a previous birth, 8.9% that the video had been unavailable because of broken equipment, and 7.4% that they were already aware of the dangers of shaking an infant.

Perceived Benefit

A total of 53.6% of parents who completed the questionnaire agreed to be contacted in 6 months for a follow-up telephone interview; 75.9% of Spanish-speaking parents agreed, compared with 50.4% of English-speaking parents ($P < .01$). A total of 320 interviews were conducted (90.3% in English and 9.7% in Spanish) with parents of infants born during the first 2 years of the initiative (Table 1). When asked whether they remembered receiving information about "how to care for your baby if he or she cries a lot," 88.4% of parents (283 of 320 parents) said yes. When asked whether they specifically remembered watching a video about shaking injuries, 97.8% of parents (313 of 320 parents) answered yes. When asked whether they could think of any situation in which the infant cried a lot and the educational in-

formation was helpful, 55.6% of parents (178 of 320 parents) answered yes.

Effect on Frequency of Shaking Injuries

A total of 16 infants born between January 1, 2000, and April 30, 2008, in the Hudson Valley region were treated at Maria Fareri Children's Hospital for shaking injuries sustained during their first year of life (Table 2). Of those, 14 infants were born during the 5-year control period and 2 infants during the 3-year intervention period (Fig 1); no cases occurred during the excluded phase-in period. Therefore, the frequency of injuries decreased from 2.8 cases per year (14 cases in 5 years) to 0.7 cases per year (2 cases in 3 years), a 75.0% reduction ($P = .03$), whereas the annual birth rate in the region remained virtually identical throughout the 8 years.¹⁶ In contrast, the annual frequency of shaking injuries in Connecticut, New Jersey, and Maryland did not change appreciably over time (17, 24, and 20 cases in 2000, 2003, and 2006, respectively; $P = .93$)

on the basis of hospital discharge data from the geographic control region.

DISCUSSION

What Causes an Adult to Shake an Infant?

Shaking occurs most often in response to inconsolable crying. A survey of 1142 mothers found that 12% of the 130 mothers who reported that their infants cried inconsolably had used shaking as a soothing technique, compared with 4% of the remaining mothers ($P < .001$).¹⁷ In addition, perpetrator confessions provide direct testimony.¹⁸ In 1 study, 5 of 7 people who admitted shaking an infant cited crying or screaming as the trigger.¹⁹ In another study of 32 infant deaths caused by abuse, 58% of the perpetrators reported that the infant's crying triggered the fatal outburst.⁸ Finally, the age-specific incidences of abusive head injuries resulting from shaking exhibit a pattern similar to the normal infant crying curve, which is a graph showing the number of hours per day an infant cries as a function of age.²⁰ Significant crying and the appearance of shaking injuries both start at 2 to 3 weeks, have clear peaks, and then decrease to relatively stable low levels by ~36 weeks, which continue through the first year of life. The similarity of the patterns suggests a causal link.

Normal infants average 2 to 3 hours of crying per day during the first 3 months of life.²¹ Caregivers typically interpret crying as an expression of a need (eg, hunger, wet diaper, or fatigue) and expect the infant to calm down when the need is met. Unfortunately, some parents may perceive inconsolable crying as an indication of parental inadequacies and may shake their infants out of frustration, helplessness, or even anger. This behavior may reinforce itself if the infant quiets down while sleeping off the concussive effects of shaking. In fact, up to 45% of

infants with diagnosed abusive head injuries resulting from shaking have evidence of previous shaking episodes, which probably resulted in milder symptoms that did not initially indicate a serious head injury.^{22,23} A pair of randomized controlled trials showed that educational materials can help mothers recognize appropriate and inappropriate responses to crying.^{24,25}

Effective Prevention

The Hudson Valley Shaken Baby Prevention Initiative was inspired by the success of a prevention program implemented in 1998 in another region of the state.⁹ That program, which involved 16 hospitals in an 8-county region of western New York, recognized that, to be most effective, prevention should begin in the hospital soon after delivery, when parents are focused on their new infant and have not yet faced crying sessions at home that could trigger a shaking response.²⁰ During the 5.5 years after program implementation, shaking injuries in the region served by the hospitals decreased by 47%.⁹

Fathers and male surrogates are nearly 5 times as likely as mothers to shake an infant.⁷ On the basis of our parent survey, only 40.4% of fathers watched the educational video, compared with 85.0% of mothers; therefore, finding better ways to reach male caretakers should be a priority.

If a parent education program that costs \$4.50 per newborn prevents 2 abusive head injuries in a given year in a region with 25 000 annual births and if the lifetime cost of acute and chronic care for each victim would have totaled \$10 million,⁵ then the \$112 500 cost of preventing those injuries ($\$4.50 \times 25\,000$) represents <1% of the \$20 million it would have cost to care for the victims. Rather than spending money to save lives, such a program saves money and saves lives.

Statewide Expansion

In 2008, the New York State Office of Children and Family Services enlisted leaders of the Hudson Valley and western New York initiatives to oversee a statewide expansion. This expansion, the New York Shaken Baby Prevention Program,²⁶ was established in response to a 2004 state legislative mandate to provide parent education about the dangers of shaking an infant in all maternity services throughout the state.²⁷ The state's 154 hospitals that provide maternity care account for 250 000 deliveries per year (Fig 2).^{28,29}

Study Limitations

The introduction of a regional, hospital-based, parent education program in the Hudson Valley was followed by a decrease in the frequency with which shaking injuries were diagnosed at the region's single tertiary care children's hospital. Although the frequency of those injuries decreased, it is not possible to be absolutely certain that the educational program was the cause of the decrease. Uncertainty about the cause-effect relationship is an inherent limitation of a before/after study design, but the absence of changes over time in 3 nearby states without similar prevention programs lends support to a cause-effect interpretation.

Several consortium hospitals had instituted their own prevention programs before joining the Hudson Valley Initiative in 2005. Those programs biased the before/after analysis against showing an effect, and the observation of an effect despite that bias strengthens the study results.

From the observed reduction in the frequency of shaking injuries at Maria Fareri Children's Hospital, we inferred a parallel reduction in the overall frequency of such injuries in the region. Our attempts to derive absolute regional incidence statis-

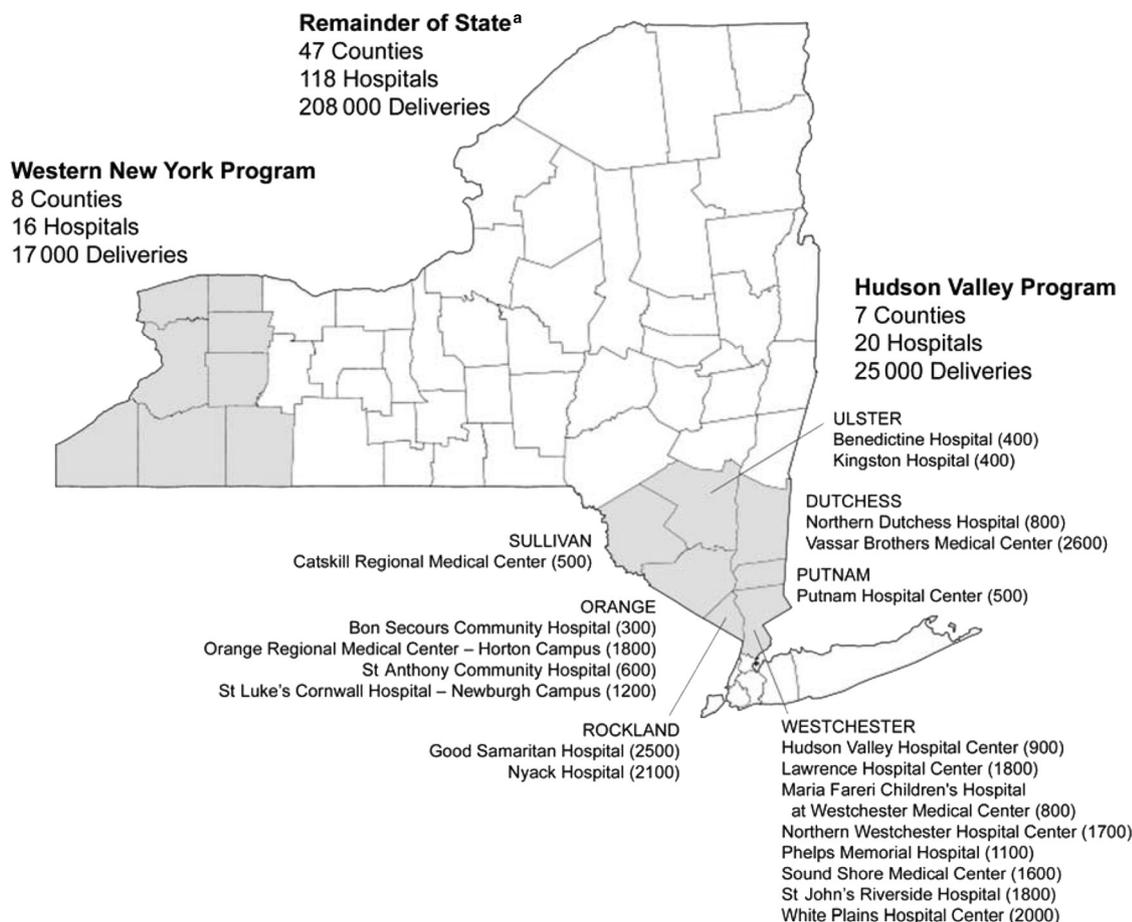


FIGURE 2

Annual numbers of deliveries and number of hospitals that provide maternity care in New York State. The success of 2 regional initiatives for the prevention of abusive head injuries resulting from shaking, involving the Hudson Valley and western New York, prompted a statewide expansion to all 154 hospitals that provide maternity care and account for 250 000 deliveries per year. For each hospital in the Hudson Valley region, the approximate annual number of deliveries is shown in parentheses. ^a Unshaded regions.

tics from county and state agencies were hampered by inconsistent methods for the recording of such injuries. County district attorneys' and medical examiners' offices do not use specific codes to identify abusive head injuries resulting from shaking, and the record-keeping system maintained by New York State Child Protective Services does not separate shaking injuries from other types of child abuse. Instead, such injuries are placed in a category labeled "choking, strangulation, and shaking in ages 0 to 18 years." Establishing effective regional and statewide systems to track shaking injuries must be a priority.

CONCLUSIONS

This investigation strongly corroborates evidence from an earlier regional program evaluation indicating that parent education, delivered in the hospital by maternity nurses, reduces a newborn's risk of sustaining an abusive head injury resulting from shaking during the first year of life.⁹ The success of the 2 regional programs prompted a statewide expansion, and it is reasonable to assume that similar programs in all states would decrease the nationwide incidence of shaking injuries. Several states besides New York have already taken steps to adopt such programs.³⁰ Given the potentially

devastating consequences of these injuries, the high societal costs, the program's effectiveness, and the trivial per-patient program costs, the most important issue left to debate is the best way to achieve broad implementation.

ACKNOWLEDGMENTS

The educational program is funded, in part, through the William B. Hoyt Children and Family Trust Fund, which is administered under the New York State Office of Children and Family Services.

We are grateful for the assistance of Mary Gionta (Children's and Women's Physicians of Westchester), who

served as the administrative assistant; Jan Mittan (formerly of the Children's Hospital Foundation at Westchester Medical Center), who served as the financial administrator for the initiative; Sandy Ermo for providing data entry; and Doris Rivera, MD (Maria Fareri Children's Hospital), and Susanna Miccoli, RN (Children's and Women's Physicians of Westchester), for conducting follow-up telephone interviews with parents. We acknowledge the tireless support and guidance that

we received from Judith Richards (New York State Office of Children and Family Services) and the members of the Hudson Valley Initiative oversight committee, including Darryl Gibbs, founder of the Cynthia Gibbs Foundation, and George Lithco, founder of the SKIPPER Foundation. We also acknowledge the inspiration and mentorship we received from Mark Dias, MD, leader of the western New York program, and Kim Smith, RN, and Kathy deGuehery, RN, the

program's clinical coordinators. We thank Michael Gewitz, MD (Maria Fareri Children's Hospital), for his undying support and mentorship and Kara Bennorth (Westchester Medical Center) for her time, creativity, and generous support for the development of all aspects of the program. Finally, we gratefully acknowledge the commitment and effort of the maternity nurse managers and staff nurses at the participating hospitals, who gave life to this program.

REFERENCES

1. Bechtel K, Stoessel K, Leventhal JM, et al. Characteristics that distinguish accidental from abusive injury in hospitalized young children with head trauma. *Pediatrics*. 2004;114(1):165–168
2. Keenan HT, Runyan DK, Marshall SW, Nocera MA, Merten DF, Sinal SH. A population-based study of inflicted traumatic brain injury in young children. *JAMA*. 2003;290(5):621–626
3. Barlow K, Minns R. Annual incidence of shaken impact syndrome in young children. *Lancet*. 2000;356(9241):1571–1572
4. Chiesa A, Duhaime AC. Abusive head trauma. *Pediatr Clin North Am*. 2009;56(2):317–331
5. New Zealand Press Association. Cost of injuries to children high, ACC tells committee. *National Business Review*. August 20, 2009. Available at: www.nbr.co.nz/article/cost-injuries-children-high-acc-tells-committee-108574. Accessed October 4, 2011
6. Theodore AD, Chang JJ, Runyan DK, Hunter WM, Bangdiwala SI, Agans R. Epidemiologic features of the physical and sexual maltreatment of children in the Carolinas. *Pediatrics*. 2005;115(3). Available at: www.pediatrics.org/cgi/content/full/115/3/e331
7. Starling SP, Holden JR, Jenny C. Abusive head trauma: the relationship of perpetrators to their victims. *Pediatrics*. 1995;95(2):259–262
8. Brewster AL, Nelson JP, Hymel KP. Victim, perpetrator, family, and incident characteristics of 32 infant maltreatment deaths in the United States Air Force. *Child Abuse Negl*. 1998;22(2):91–101
9. Dias MS, Smith K, deGuehery K, Mazur P, Li V, Shaffer ML. Preventing abusive head trauma among infants and young children: a hospital-based, parent education program. *Pediatrics*. 2005;115(4). Available at: www.pediatrics.org/cgi/content/full/115/4/e470
10. Junior League of St Paul. *Portrait of Promise: Preventing Shaken Baby Syndrome* [DVD]. Postpartum Education Version. St Paul, MN: Midwest Children's Resource Center; 2005
11. Commission on Professional and Hospital Activities. *Annotated ICD-9-CM International Classification of Diseases, Ninth Revision, Clinical Modification*. Ann Arbor, MI: Edward Brothers; 1986
12. Duhaime AC, Alario AJ, Lewander WJ, et al. Head injury in very young children: mechanisms, injury types, and ophthalmologic findings in 100 hospitalized patients younger than 2 years of age. *Pediatrics*. 1992;90(2):179–185
13. Duhaime AC, Christian CW, Rorke LB, Zimmerman RA. Nonaccidental head injury in infants: the "shaken baby syndrome." *N Engl J Med*. 1998;338(25):1822–1829
14. Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project. Overview of the Kids' Inpatient Database (KID). Available at: www.hcup-us.ahrq.gov/kidoverview.jsp. Accessed October 4, 2011
15. National Conference of State Legislatures. Shaken baby syndrome prevention legislation. Available at: www.ncsl.org/?tabid=17669. Accessed October 4, 2011
16. New York State Department of Health. Vital statistics of New York State. Available at: www.nyhealth.gov/nysdoh/vital_statistics. Accessed October 4, 2011
17. van der Wal MF, van den Boom DC, Pauw-Plomp H, de Jonge GA. Mothers' reports of infant crying and soothing in a multicultural population. *Arch Dis Child*. 1998;79(4):312–317
18. Starling SP, Patel S, Burke BL, Sirotnak AP, Stronks S, Rosquist P. Analysis of perpetrator admissions to inflicted traumatic brain injury in children. *Arch Pediatr Adolesc Med*. 2004;158(5):454–458
19. Biron D, Shelton D. Perpetrator accounts in infant abusive head trauma brought about by a shaking event. *Child Abuse Negl*. 2005;29(12):1347–1358
20. Barr RG, Trent RB, Cross J. Age-related incidence curve of hospitalized shaken baby syndrome cases: convergent evidence for crying as a trigger to shaking. *Child Abuse Negl*. 2006;30(1):7–16
21. Lucassen PLBJ, Assendelft WJJ, van Eijk JTM, Gubbels JW, Douwes AC, van Geldrop WJ. Systematic review of the occurrence of infantile colic in the community. *Arch Dis Child*. 2001;84(5):398–403
22. Ewing-Cobbs L, Kramer L, Prasad M, et al. Neuroimaging, physical, and developmental findings after inflicted and noninflicted traumatic brain injury in young children. *Pediatrics*. 1998;102(2):300–307
23. Jenny C, Hymel KP, Ritzen A, Reinert SE, Hay TC. Analysis of missed cases of abusive head trauma. *JAMA*. 1999;281(7):621–626
24. Barr RG, Rivara FP, Barr M, et al. Effectiveness of educational materials designed to change knowledge and behaviors regarding crying and shaken-baby syndrome in mothers of newborns: a randomized, controlled trial. *Pediatrics*. 2009;123(3):972–980
25. Barr RG, Barr M, Fujiwara T, Conway J, Catherine N, Brant R. Do educational materials change knowledge and behaviour about crying and shaken baby syndrome? A randomized controlled trial. *CMAJ*. 2009;180(7):727–733
26. New York Shaken Baby Prevention Program. New York Shaken Baby Prevention Program. Available at: www.preventsbs.com. Accessed October 4, 2011

27. New York State Department of Health. New York State Public Health Law: § 2803-j, Information for Maternity Patients. Available at: www.health.state.ny.us/facilities/hospital/maternity/public_health_law_section_2803-j.htm. Accessed October 4, 2011
28. New York State Department of Health. Hospitals or extension clinics with maternity service. Available at: http://hospitals.nyhealth.gov/browse_search.php?rt=48&form=SERVICE. Accessed October 4, 2011
29. National Center for Health Statistics. Births: final data for 2006. *Natl Vital Stat Rep.* 2009;57(7): 1–104
30. National Center on Shaken Baby Syndrome. State legislation. Available at: www.dontshake.org/sbs.php?topNavID=254&subNavID=318. Accessed October 4, 2011

Parent Education by Maternity Nurses and Prevention of Abusive Head Trauma

Robin L. Altman, Jennifer Canter, Patricia A. Patrick, Nancy Daley, Neelofar K. Butt
and Donald A. Brand

Pediatrics 2011;128:e1164; originally published online October 24, 2011;

DOI: 10.1542/peds.2010-3260

Updated Information & Services	including high resolution figures, can be found at: http://pediatrics.aappublications.org/content/128/5/e1164.full.html
References	This article cites 18 articles, 11 of which can be accessed free at: http://pediatrics.aappublications.org/content/128/5/e1164.full.html#ref-list-1
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Office Practice http://pediatrics.aappublications.org/cgi/collection/office_practice
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://pediatrics.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://pediatrics.aappublications.org/site/misc/reprints.xhtml

PEDIATRICS is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. PEDIATRICS is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2011 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 0031-4005. Online ISSN: 1098-4275.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

