

# Injuries Associated With Bottles, Pacifiers, and Sippy Cups in the United States, 1991–2010



**WHAT'S KNOWN ON THIS SUBJECT:** Previous research on injuries related to bottle, pacifier, and sippy cup use has largely focused on case reports of infant injuries or fatalities attributed to pacifiers or pacifier parts causing asphyxiation or to bottle warming causing burns.



**WHAT THIS STUDY ADDS:** This study is the first to use a nationally representative sample to investigate the range of injuries requiring emergency department visits associated with bottles, pacifiers, and sippy cups among children aged <3 years.

## abstract

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**OBJECTIVE:** To describe the epidemiology of injuries related to bottles, pacifiers, and sippy cups among young children in the United States.

**METHODS:** A retrospective analysis was conducted by using data from the National Electronic Injury Surveillance System for children <3 years of age treated in emergency departments (1991–2010) for an injury associated with a bottle, pacifier, or sippy cup.

**RESULTS:** An estimated 45 398 (95% confidence interval: 38 770–52 026) children aged <3 years were treated in emergency departments for injuries related to these products during the study period, an average of 2270 cases per year. Most injuries involved bottles (65.8%), followed by pacifiers (19.9%) and sippy cups (14.3%). The most common mechanism was a fall while using the product (86.1% of injuries). Lacerations comprised the most common diagnosis (70.4%), and the most frequently injured body region was the mouth (71.0%). One-year-old children were injured most often. Children who were aged 1 or 2 years were nearly 2.99 times (95% confidence interval: 2.07–4.33) more likely to sustain a laceration compared with any other diagnosis. Product malfunctions were relatively uncommon (4.4% of cases).

**CONCLUSIONS:** This study is the first to use a nationally representative sample to examine injuries associated with these products. Given the number of injuries, particularly those associated with falls while using the product, greater efforts are needed to promote proper usage, ensure safety in product design, and increase awareness of American Academy of Pediatrics' recommendations for transitioning to a cup and discontinuing pacifier use. *Pediatrics* 2012;129:1104–1110

**AUTHORS:** Sarah A. Keim, PhD, MA, MS,<sup>a,b,c</sup> Erica N. Fletcher, MPH,<sup>d</sup> Megan R. W. TePoel, MS,<sup>a</sup> and Lara B. McKenzie, PhD, MA<sup>b,c,d</sup>

<sup>a</sup>Center for Biobehavioral Health, The Research Institute at Nationwide Children's Hospital, Columbus, Ohio; <sup>b</sup>Department of Pediatrics, The Ohio State University, College of Medicine, Columbus, Ohio; <sup>c</sup>Division of Epidemiology, The Ohio State University, College of Public Health, Columbus, Ohio; and <sup>d</sup>Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital, Columbus, Ohio

### KEY WORDS

bottles, emergency department, falls, injury, National Electronic Injury Surveillance System, pacifiers, sippy cups

### ABBREVIATIONS

AAP—American Academy of Pediatrics  
CI—confidence interval  
CPSC—Consumer Product Safety Commission  
ED—emergency department  
NEISS—National Electronic Injury Surveillance System  
OR—odds ratio

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Address correspondence to Sarah A. Keim, PhD, MA, MS, The Research Institute at Nationwide Children's Hospital, 700 Children's Dr, Columbus, OH 43205. E-mail: sarah.keim@nationwidechildrens.org

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The vast majority of US infants are introduced to a pacifier, almost all are fed from a bottle for at least some daily feedings by 12 months of age, and sippy cups are the norm for toddlers' drinks.<sup>1–3</sup> In addition to delivering nutrition, bottles and sippy cups provide convenience for families, and these products can help soothe a fussy child. Pacifiers also seem to reduce the risk of sudden infant death syndrome.<sup>4</sup> However, occasional published reports of pacifier- or bottle-related injuries have appeared since the 1950s.<sup>5,6</sup> Previous case reports have generally focused on rare instances of airway obstruction by nipples, pacifier parts, or whole pacifiers or burns from bottle warming.<sup>7–11</sup> Injuries such as lacerations and soft tissue injuries have not been commonly reported although they may affect more children.<sup>12,13</sup> Product design improvements have been made to address safety concerns, including adding air holes and increasing pacifier size to prevent choking.<sup>14</sup> As evidenced by the >16 million pacifiers and 1 million sippy cups that have been recalled by the US Consumer Product Safety Commission (CPSC) since 1991, bottles, pacifiers, and sippy cups are not always as safe as parents believe.<sup>15</sup>

Previously published studies about these injuries have been limited to case reports; no studies have estimated the frequency or types of injuries related to bottles, pacifiers, and sippy cups. To the best of our knowledge, this is the first nationally representative study to examine the epidemiology of injuries to young children associated with these products and treated in emergency departments (EDs) in the United States. The goal of this research was to educate parents, other caregivers, and health professionals about these injuries; help improve product design; highlight existing recommendations; and ultimately prevent these injuries.

## METHODS

### Data Source

Data for patients who were treated between January 1, 1991, and December 31, 2010, were obtained through the National Electronic Injury Surveillance System (NEISS) operated by the US CPSC.<sup>16</sup> The NEISS provides data on consumer product–related and sports-related injuries treated in US EDs. Data come from a network of ~100 hospitals, representing a stratified probability sample of 6100 hospitals with  $\geq 6$  beds and a 24-hour ED, including urban, suburban, rural, and children's hospitals. Data collected by the NEISS are weighted to yield national injury estimates. The NEISS was established in 1972 and revised in 1978, 1990, and 1997. At sampled hospitals, ED medical charts are viewed by professional NEISS coders, and data regarding patients' age and gender, injury diagnosis, body part injured, locale where the injury occurred, product(s) involved, and disposition from the ED, as well as a narrative describing the incident, are recorded. Data from the US Census Bureau were used to calculate injury rates per 10 000 children <3 years of age.<sup>17</sup>

### Case Selection Criteria

All NEISS cases identified by using NEISS product codes for baby bottles (code 1509), pacifiers (code 1525), and sippy cups (key word search “sip” from tableware and accessories; code 0474) for patients <3 years old were reviewed ( $n = 2283$ ). Inclusion and exclusion criteria and variable categories were developed after review of a subset of narratives. Case narratives were reviewed to ensure that they involved a product of interest; ambiguous narratives and a subset of narratives were reviewed by  $\geq 1$  other author, and consensus was reached. A total of 889 cases were excluded because the narratives revealed that the product was miscoded (eg, patient reached for a pacifier and

received a splinter) or the patient was not using the product (eg, sibling threw a bottle at the patient). All 7 fatalities were excluded; 6 involved aspirating liquid, 1 involved strangulation by a rope on a pacifier. The final number of actual cases was 1357.

### Variables

Patients were categorized according to age (<1, 1, and 2 years of age) for analyses. Locale (location where the injury occurred) was categorized (home or other). The gender variable was used as in the NEISS. The body parts injured were grouped according to region, in categories of mouth, head (including head, neck, face, ears, and eyes), and other (including upper and lower arm, hand, finger, elbow, wrist, shoulder, upper and lower leg, foot, toe, ankle, knee, upper and lower trunk, hip, pubic region, internal injuries, and the NEISS codes for “25%–50% of the body” and “all parts of body”). Diagnosis was grouped according to injury type, in categories of soft tissue injuries (including contusions, abrasions, and hematomas), lacerations (including lacerations, punctures, and avulsions), dental injuries, and other (including dislocation, foreign body, internal injury, hemorrhage, fracture, strain or sprain, concussions, thermal burns, scald burns, and other). Disposition was categorized as hospitalized (ie, admitted or transferred) or not hospitalized (ie, treated and released, held for observation, left against medical advice). Case narratives were used to generate 1 new variable: mechanism of injury (fall or other). The other category included product malfunctions (eg, pacifier tip came off and choked patient) and burns (eg, heated liquid in bottle burned the patient).

### Statistical Analyses

Data were analyzed by using SAS 9.2 survey procedures (SAS Institute, Inc, Cary, NC). A sample weight was

assigned to each case by the CPSC on the basis of the inverse probability of selection, and weights were used to generate national estimates. Bivariate comparisons were conducted by using Rao-Scott design-adjusted  $\chi^2$  tests, and the strength of association was assessed by using odds ratios (ORs). Logistic regression models were used to produce adjusted ORs. Intercensal population estimates used to calculate rates from 1991 to 2009 were derived from the US Census Bureau.<sup>17,18</sup> (No rate could be calculated for 2010 because population estimates were unavailable.) Trend significance of the numbers of product-related injuries over time was analyzed by using linear regression. Statistical significance was assessed by using  $\alpha = .05$ . All statistical analyses accounted for the complex sampling frame of the NEISS.<sup>16</sup> National estimates were based on weighted data for 1357 patients <3 years of age and treated for injuries related to the use of bottles, pacifiers, and sippy cups. All data reported in this article are national estimates unless specified as unweighted cases. The Nationwide Children's Hospital institutional review board approved this study.

## RESULTS

An estimated 45 398 children (95% confidence interval [CI]: 38 770–52 026) <3 years of age were treated in EDs for injuries related to the use of bottles, pacifiers, and sippy cups from 1991 to 2010 (Table 1), an average of 2270 cases per year. The majority of injuries involved 1-year-old children (66.4%) and boys (61.2%). Most injuries (95.9%) occurred at home, and most children (98.8%) were not hospitalized. The rate of injuries in children <3 years of age decreased 41.0%, from 2.65 per 10 000 in 1991 to 1.88 per 10 000 children in 2009 (Fig 1).

## Products

Bottles accounted for 65.8% of the injuries, followed by pacifiers (19.9%)

**TABLE 1** Characteristics of Bottle-, Pacifier-, and Sippy Cup–Related Injuries Treated in US EDs (1991–2010)

Characteristic	Actual <sup>a</sup>	National Estimate (%) <sup>a</sup>	95% CI
Total	1357	45 398	38 770–52 026
Age			
<1 y	301	9675 (21.3)	7709–11 640
1 y	881	30 139 (66.4)	25 538–34 740
2 y	175	5584 (12.3)	4139–7030
Gender			
Male	830	28 235 (62.2)	23 920–32 549
Female	527	17 163 (37.8)	14 297–20 029
Mechanism of injury			
Fall	1150	39 100 (86.1)	33 103–45 097
Other	207	6298 (13.9)	4977–7619
Injured body region			
Mouth	958	32 161 (71.0)	27 252–37 071
Head, face, or neck	270	8877 (19.6)	7101–10 653
Other <sup>b</sup>	128	4290 (9.5)	3261–5319
Injury diagnosis			
Laceration <sup>c</sup>	897	31 954 (70.4)	27 231–36 677
Soft tissue injury <sup>d</sup>	172	6010 (13.2)	4624–7397
Dental injury	115	2392 (5.3)	1625–3160
Other	172	5036 (11.1)	3654–6417
Disposition			
Hospitalized <sup>e</sup>	19	—	—
Not hospitalized	1325	44 536 (98.8)	37 985–51 680
Locale			
Home	940	32 938 (95.9)	27 420–38 455
Other	47	1396 (4.1)	818–1974
Product categories			
Bottle	825	29 885 (65.8)	25 245–34 525
Pacifier	301	9030 (19.9)	7108–10 935
Sippy cup	231	6483 (14.3)	4454–8512

<sup>a</sup> Some categories do not total 1357, 45 398, or 100% because of rounding. Values were missing for actual numbers of: injured body region ( $n = 1$ ), injury diagnosis ( $n = 1$ ), disposition ( $n = 13$ ), and locale ( $n = 370$ ).

<sup>b</sup> Other body parts include upper and lower arm, hand, finger, elbow, wrist, shoulder, upper and lower leg, foot, toe, ankle, knee, upper and lower trunk, hip, pubic region, internal injuries, and the NEISS codes for “25%–50% of the body” and “all parts of body.”

<sup>c</sup> Laceration includes laceration, avulsion, and puncture.

<sup>d</sup> Soft tissue injury includes contusion, abrasion, and hematoma.

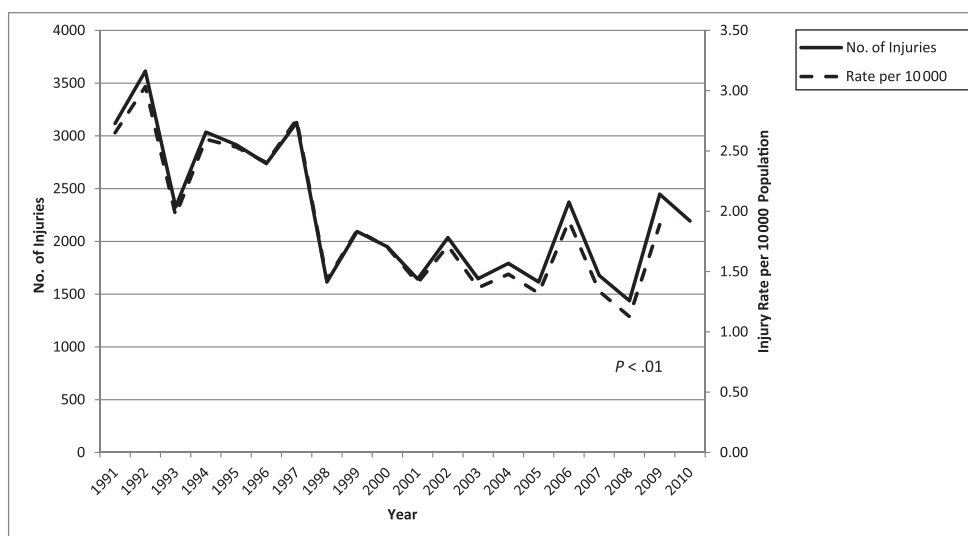
<sup>e</sup> Too few cases to provide a national estimate.

and sippy cups (14.3%). These data varied according to age, reflecting the developmental stages between birth and age 3 years (Fig 2). Almost all injuries to children <1 year of age occurred while the child was using a bottle (57.5%) or pacifier (33.8%). Sippy cup injuries to children <1 year of age were too rare ( $n = 14$ ) to provide a national estimate.<sup>19</sup> Children <1 year of age, compared with 1- and 2-year-olds, were 3.04 times (95% CI: 1.97–4.72) more likely to have an injury associated with a pacifier. However, injuries associated with pacifiers remained prevalent among the oldest children as well (18.1% of injuries

among 2-year-olds). Injuries associated with sippy cups were more likely (OR: 1.90 [95% CI: 1.18–3.08]) among children who were 2 years of age compared with children who were 1 year of age.

## Body Part/Region and Diagnosis/Type of Injury

The most commonly injured body parts/regions were the mouth (71.0%) followed by the head, face, or neck (19.6%). Injuries to other parts of the body were less frequent among children who were 1 and 2 years of age (5.8% of injuries to 1-year-olds compared with 20.3% of injuries to children <1 year of age).

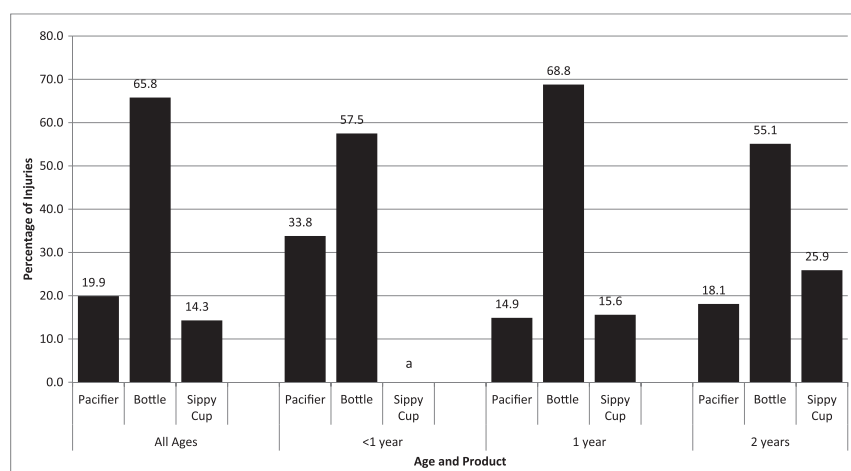
**FIGURE 1**

Number of bottle-, pacifier-, and sippy cup–related injuries and prevalence per 10 000 US children, 1991 to 2010. Prevalence per 10 000 US children  $\leq 2$  years of age based on intercensal population estimates.<sup>17,18</sup> Estimate not available for 2010.

Mouth, head, face, and neck injuries were more predominant (94.2%) among children who were 1 year old. The most common diagnoses were lacerations (70.4%). Children aged  $\geq 1$  year, compared with children  $< 1$  year of age, were 2.99 (95% CI: 2.07–4.33) times more likely to sustain a laceration. Although lacerations were the predominant diagnosis across all products, pacifiers were associated with a higher likelihood of soft tissue injuries (OR: 1.86 [95% CI: 1.12–3.10]) and dental

injuries (OR: 3.25 [95% CI: 1.75–6.04]) than bottles or sippy cups. The other diagnosis category included 1321 cases of aspirations and ingestions (95% CI: 706–1935), 1895 burns (95% CI: 1250–2539), and 1821 miscellaneous diagnoses such as fractures and dislocations (95% CI: 1121–2520). More than one-half of other diagnoses occurred among children  $< 1$  year of age (55.2%). After adjusting for age (in years) in logistic models, injuries associated with sippy cups were 2.23 times

more likely than bottles (95% CI: 1.41–3.51) and 2.75 times more likely than pacifiers (2.75; 95% CI: 1.48–5.11) to produce a head, face, or neck injury. Pacifier injuries were more likely to injure the mouth than bottles (1.67; 95% CI: 1.01–2.74) or sippy cups (2.31; 95% CI: 1.23–4.36). Boys were more likely than girls to experience a laceration than any other diagnosis (OR: 1.35 [95% CI: 1.00–1.82]), whereas girls were more likely (OR: 2.16 [95% CI: 1.13–4.12]) to sustain a dental injury than another diagnosis.

**FIGURE 2**

Percent of injuries involving pacifiers, bottles, and sippy cups according to age among US children ages 0 to 2 years, 1991 to 2010. <sup>a</sup>Injuries from sippy cups in the  $< 1$ -year-old age group were too rare to provide reliable national estimates.

### Mechanism of Injury

Falls were the most common mechanism of injury. Most occurred when using a bottle (64.7%); however, pacifiers (19.3%) and sippy cups (15.9%) were commonly involved. When compared with children  $< 1$  year of age, 1-year-old children were 7.62 times (95% CI: 4.84–12.02) more likely to fall, whereas 2-year-old children were less likely than 1-year-olds to fall but 4 times (OR: 4.00 [95% CI: 2.13–7.50]) times more likely than infants. Boys and girls were equally likely to be involved in a fall versus another mechanism (OR: 1.03 [95% CI: 0.70–1.50]). Among the other mechanisms of injury,



product malfunction was the most common and was involved in 4.4% of total cases ( $n = 1977$ ; 95% CI: 1305–2648]); 95.1% of these resulted in aspiration or ingestion of a portion of the product.

## DISCUSSION

During the 20-year period, 45 398 cases of injuries related to bottles, sippy cups, and pacifiers were treated in US EDs. Although there have been a handful of studies (primarily case reports), several of which report deaths,<sup>7–13,20</sup> there have been no published studies using a nationally representative sample to describe these injuries, despite the fact that most young children use all of these products. To the best of our knowledge, this is the first study to report national estimates, rates, and trends of these injuries. The 2194 cases in 2010 reflect a 29.6% decrease since 1991. This trend was largely driven by a decrease in bottle-related injuries over time; we speculate that either bottles were involved in fewer or less serious injuries or fewer children used bottles over time (because they transitioned increasingly earlier to a sippy cup or cup or because more children were breastfed or breastfed longer). However, we were unable to explore this finding because we did not have comparable data on injuries treated outside EDs or the prevalence of product use.

Previous case reports have focused mostly on infants. However, we found that approximately two-thirds of injuries occurred at age 1 year, when children have transitioned to unsteady walking and are prone to falls. The fewest injuries occurred at age 2 years, reflecting either children's increasing control over their mobility or fewer children using these products. Most injuries were the result of falls while using the product, and most falls resulted in lacerations or contusions to

the mouth and face or dental injuries, which suggests that children were walking or running with the product in their mouth.

The injuries reported here were severe enough to require an ED visit, but very few were fatal. Some previous case reports have focused on fatalities from airway obstruction by pacifiers or parts<sup>7,10,11,21</sup>; we observed no such cases.

The US CPSC issued a requirement for pacifiers in 1978 primarily intended to protect infants from choking or suffocating, although it does require that pacifiers not have sharp edges.<sup>14</sup> The CPSC has recalled >16 million pacifiers since 1991 that failed to meet the requirement.<sup>15</sup> Most recalled products posed a risk of choking or ingestion from small parts, although 140 000 recalls were due to the potential for asphyxiation from the absence of ventilation holes in pacifier shields. The CPSC has recalled >1 million sippy cups for reasons including risk of choking, laceration, or poisoning from cup materials. No bottles have been recalled since 1991. In addition to the CPSC, the American Academy of Pediatrics (AAP) has released pacifier safety information for parents focused on preventing aspiration or ingestion of pacifiers or small pieces and strangulation from pacifier strings.<sup>22</sup> It does not address other types of injuries or bottles or sippy cups.

The relative prominence of falls versus other mechanisms of injury (which were predominantly product malfunctions) and the small number of aspiration or ingestion cases in this data set suggest that most pacifier, bottle, and sippy cup injuries are not due to defective products. Instead, most injuries occur as a result of the use of these products during developmental periods when children are most susceptible to falls. Currently, few formal recommendations exist for what ages

children should discontinue using these products, and it is unclear whether existing recommendations were developed to prevent these injuries. The AAP recommends pacifier use during infancy to help prevent sudden infant death syndrome.<sup>4</sup> Recommendations for discontinuing pacifier use focus on preventing otitis media after 6 months of age and preventing changes in dental occlusion in children still using a pacifier after 3 years of age.<sup>23,24</sup> The American Academy of Pediatric Dentistry (AAPD) and the AAP have issued recommendations about transitioning directly from a bottle to a lidless cup by 12 months of age to prevent dental caries.<sup>25–27</sup>

Despite this guidance, use of these products remains common through at least age 2 years. An Arizona study reported that >45% of children 13 to 24 months and 43% of children 25 to 36 months of age were current bottle users. A recent Canadian study reported that 86% of children 1 to 2 years of age were current sippy cup users.<sup>2</sup> In line with these studies, we found that most bottle-related injuries occurred at age 1 year (69.9%). However, 10.4% of bottle injuries were to children aged 2 years, and more than one-half of the injuries to 2-year-olds were bottle related, providing support for the AAPD/AAP guidelines to transition to a lidless cup by 12 months of age. The fairly high prevalence of pacifier use after infancy seems to explain the persistence of pacifier injuries with age. The Infant Feeding Practices Study II reported 39.4% of infants 12 months of age had used a pacifier in the previous 7 days.<sup>28</sup> The UK Avon Longitudinal Study of Pregnancy and Childhood found that 18.3% were still using a pacifier at age 36 months.<sup>29</sup> Although pacifier injuries made up a larger proportion of injuries to infants than to other age groups (33.8% of injuries to infants compared with 18.1% to 2-year-olds), more

1-year-olds had an injury while using a pacifier than infants (4534 vs 3475). This study underestimates the total number of injuries because the sample includes only injuries treated in US EDs. Overall, the number of injuries reported was small compared with the numbers of injuries for this age group reported to be related to cribs, bassinets, and playpens or household cleaning products, for example.<sup>30,31</sup> It is likely that many more less-severe injuries occur that are cared for by parents or health care providers outside EDs. Second, NEISS data are restricted by the limited detail in ED records. Only narratives that clearly indicated the child was using the product were included, which perhaps contributed to an underestimate. Third, without a comparison group of injuries unrelated to these

products, it is not possible to determine how the diagnoses or body regions affected differ from other injury situations. In addition, we were not able to assess which product characteristics were most involved in these injuries. The strength of this study is that it is the first to use a nationally representative sample to examine injuries related to bottles, pacifiers, and sippy cups spanning 20 years.

## CONCLUSIONS

Bottle-, pacifier-, and sippy cup–related injuries, particularly those from falls while using the product, are an important source of injury for young children. Children who are just learning to walk and run are at the highest

risk of these injuries. Despite a downward trend, there were 2194 injuries treated in EDs in 2010, indicating a need for further research into the nature of these injuries and prevention strategies. Parents might consider the potential for injury in deciding when to help their child give up the pacifier and transition to a cup. Encouraging children to remain seated while drinking may also reduce injury risk. Closer adherence to existing recommendations of the AAP regarding age-appropriate use of these products may help prevent injuries.

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**RECOVERY TIMES:** *At dinner the other night, my wife and I were talking with our neighbor about marathon running. She is an avid runner, and ran in the Boston Marathon. When I asked her if she planned to run another marathon this year she replied that it takes too long to recover and that she would not compete in another for a long time. However, my wife's sister, roughly the same age and also an avid runner, will compete in six marathons this year. How is it that one avid runner can only compete in one marathon each year while another can compete in six? As reported in The New York Times (Health: March 19, 2012), how long it takes to recover from a marathon or any other strenuous exercise is not known and is dependent on a host of factors including the mental state of the runner. A popular theory is that the recovery time in days is equal to the number of miles run (e.g., it will take 20 days to fully recover from a 20 mile running race). However, this is not based on any scientific studies and seems mostly discredited by the athletic community. One of the challenges is defining what recovery means. Recovery can mean absence of soreness, replenishment of muscle glycogen, return to peak performance, or even psychological well-being. No benchmarks for any of these exist. We do know that athletes who consume carbohydrates or a bit of protein after exercise seem to replenish muscle glycogen stores with 24 hours or so. Most muscle soreness resolves within a week. However, muscle soreness that prevents exercise leads to deconditioning so that it takes additional time to be able to return to the same performance level. For others, the emotional toll can exceed the physiologic one. Many elite marathoners only run one or two marathons a year as it can take months to recover from the effort. The reasons for the apparent difference in recovery times between my neighbor and sister-in-law may lie in their reason for running in the first place. My neighbor, having met the time she wanted, feels that the pain associated with marathons outweighs any potential joy. My sister-in-law, however, runs to prove something to herself and her family so she will be on the roads within days of finishing the marathon.*

*Noted by WVR, MD*

## Injuries Associated With Bottles, Pacifiers, and Sippy Cups in the United States, 1991–2010

Sarah A. Keim, Erica N. Fletcher, Megan R. W. TePoel and Lara B. McKenzie

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