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Pediatric Genitourinary Injuries in the United States from 2002 to 2010

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Abbreviations and Acronyms

ED = emergency department
GU = genitourinary
NEISS = National Electronic Injury Surveillance System
US = United States

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Purpose: We describe the epidemiological features of pediatric genitourinary injuries, and determine the products and events that may predict an increased risk of genitourinary injury during childhood.

Materials and Methods: The National Electronic Injury Surveillance System was queried to identify children 18 years or younger who sustained genitourinary injuries and presented to emergency departments in the United States between 2002 and 2010. Demographics and injury characteristics of these children were analyzed. Analyses were performed with adjustments for sample weighting and the stratified survey design. All data are reported as national estimates along with 95% confidence intervals.

Results: Based on 10,286 actual cases, an estimated 252,392 children (95% CI 205,579–299,194) sustained genitourinary injuries during the 9-year study period. Children 4 to 7 years old were most frequently injured (36.8% of all injuries), followed by those 8 to 11 years old (20.6%). Girls comprised 55% of the injured children. The yearly incidence of genitourinary injuries was stable across the period studied. The most commonly injured organs were female external genitalia (37.7%), penises (21.6%) and testicles (12%). Genitourinary injuries were most commonly associated with sporting and exercise equipment (35.7%), furniture (15.5%) and clothing items (11.9%). Of the patients 91% were treated at the emergency department and discharged home.

Conclusions: Genitourinary injuries in children result in approximately 28,000 emergency department visits yearly. Efforts should be made to decrease the risk of genitourinary injuries in children by promoting the use of protective gear and safer product selection for those at greatest risk for injury.

Key Words: consumer product safety, pediatrics, urogenital system, wounds and injuries

INJURIES in children are often associated with consumer products or specific activities.^{1–4} The goal of injury prevention research is to identify products and situations that pose the greatest risk of injury to a particular cohort.^{5,6} Genitourinary injuries are of particular interest in children, given the implications regarding future reproductive health and the sensitive physical and psychological nature of the injuries. The etiol-

ogy and severity of pediatric genitourinary injuries are diverse and range from mild contact dermatitis of the external genitalia to major renal trauma.

Previous studies of GU injuries have been limited in scope to a specific product,^{7–9} or conducted using a sample of patients primarily selected from trauma centers, which would select for more severe injuries.¹⁰ We hypothesized that characterizing GU in-

juries using a sample representative of all children presenting to hospital associated EDs would identify children at greatest risk for GU injury, and the products and situations most likely to result in injury. We sought to characterize pediatric GU injuries using a nationally representative sample of children 18 years or younger. The specific aim of this study was to determine the products and events that may predict increased risk of GU injury during childhood.

METHODS

Data Source

The National Electronic Injury Surveillance System prospectively collects data on patients presenting to hospital EDs in the US and its territories with an injury. NEISS obtains these data from a sample of approximately 100 hospitals of different sizes, including 8 pediatric hospitals, with at least 6 beds providing continuous 24-hour emergency care. This database, which is operated by the US Consumer Product Safety Commission, is a stratified probability sample validated to produce national estimates of all patients who present to US EDs with an injury. Patients with injuries due to automobiles, motorcycles, trains, boats or planes are not included in NEISS.

Patient age, race, gender, type of injury, locale where injury occurred, disposition from the ED and product(s) involved are abstracted from the ED records by NEISS coders. Additionally a brief narrative description of the injury is included in the data set. Secondary and tertiary level review (eg followup telephone interviews with the patient and on-site investigations of the place of injury) and quality control occurs after the data are sent to the Consumer Product Safety Commission.¹¹

Variables

The NEISS database was queried to identify all subjects 18 years or younger who sustained GU injuries from 2002 to 2010. Subjects with suspected sexual abuse were excluded. The aforementioned NEISS variables were included in the analysis. Age was analyzed as a continuous and categorical variable. When analyzed as a categorical variable, age ranges were 0 to 12 months, 13 months to 3 years, 4 to 7 years, 8 to 11 years, 12 to 15 years and 16 to 18 years. These categories were chosen as they approximated stages of childhood (ie infant, toddler, kindergartener/early school age, prepubescent, adolescent and youth). Race was categorized according to the US Census categories. Disposition was grouped into 6 categories, ie treated and released, treated and transferred, treated and admitted, observed in the ED, left without being seen or against medical advice, and fatality.

Three authors (GET, HSB, PBF) reviewed the narratives, and 2 new variables were identified and abstracted, ie mechanism of injury and specific GU organ injured. Mechanism of injury was classified into 6 categories, ie fall; lifting an object; "catch injury" (eg zipper injury of the penis); topical application; stepping, climbing or jumping over an object and other. "Other" mechanisms included various injuries such as a baseball striking the external

genitalia and slamming the penis in the toilet seat. Specific GU organs identified and included in analysis were penis, scrotum, testicle and/or epididymis, urethra, external female genitalia, bladder, kidney, adrenal gland and ureter. Further anatomical subclassification of external female genitalia (eg labia, introitus) could not be performed, given the granularity of anatomical descriptions in the narratives.

Additionally the narratives were reviewed and the type of product associated with the injury, if applicable, was identified. Each product was then grouped into a product category (eg playground equipment, clothing item). This step was done to increase the specificity of the NEISS generated and validated product codes, and to improve the ability to identify GU injuries associated with types of consumer products.

Statistical Analysis

All analyses were adjusted for sample weighting and the stratified survey design.¹² All data are reported as national estimates along with 95% confidence intervals unless they are specified as being actual unweighted case numbers. Analyses were performed using Stata®, version 12. This study was exempt from institutional review board approval.

RESULTS

Demographic Features

An estimated 394,542 people sustained GU injuries between 2002 and 2010, of which 252,392 (64%) were children. When stratified by age, 4 to 7-year-old children were most frequently injured (36.8% of all pediatric injuries), followed by 8 to 11-year-old children (20.6% of all pediatric injuries). After age 7 years boys sustained proportionally more injuries than girls (fig. 1). Infants and youths 16 to 18 years old sustained 8.9% and 9.4% of injuries during the study period, respectively, which were the fewest number of injuries for all of the age cohorts. Girls sustained 132,002 injuries (55.3%, 95% CI 105,359–158,646) during the period studied.

The yearly incidence of GU injuries was stable across the period studied (range 25,399 to 33,163). The highest number of injuries per month occurred in May, June and July, which was nearly double the number of those occurring between December and February. For 40% of the injured population race was recorded as "unknown" or "other." Among children in whom race and ethnicity were recorded 113,275 injuries (44.9%, 95% CI 84,400–142,149) occurred in whites and 36,930 (14.6%, 95% CI 84,400–142,149) in blacks. Of the patients 92% (231,978, 95% CI 189,474–274,482) were treated in the ED and discharged home. Another 4% (10,405, 95% CI 7,194–13,615) were admitted and 3% (6,850, 95% CI 5,022–8,678) were transferred elsewhere. Those who were admitted or transferred were older (mean age 15.7 years) than those discharged from the ED ($p < 0.01$). The remaining 1% left the ED without being seen or against medical advice.

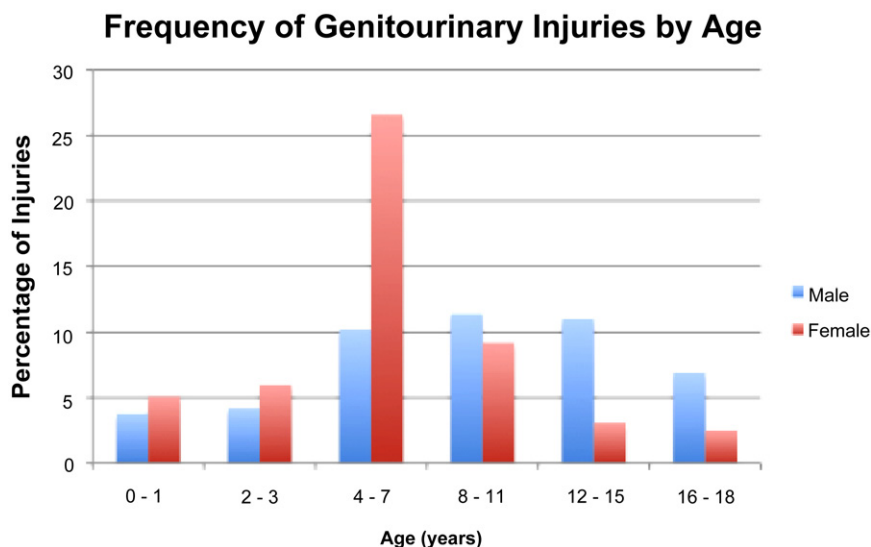


Figure 1. Prevalence of genitourinary injuries by age

Mechanism and Types of Injury

The most commonly injured organs were female external genitalia, penises and testicles (see table). When penis, testicular and scrotal injuries were grouped together and analyzed as “male external genitalia,” these injuries accounted for 98,559 of pediatric GU injuries (41.6%). Male and female external genitalia injuries combined made up 187,712 of the 252,391 injuries (79.3%). Kidney injuries accounted for 8,249 of the overall injuries (3.5%) but were found in 25.7% of those children requiring admission or transfer to another hospital.

The most common diagnoses were contusions (35.5%) and lacerations (32.9%). Fall was the most common mechanism of injury (114,017, 95% CI 93,254–134,781), accounting for 45.2% of the reported injuries. Other mechanisms of injury accounted for 32.2% of the injuries.

Association between Injuries and Consumer Products

Genitourinary injuries were most commonly associated with sporting equipment (35.7%), furniture (15.5%) and clothing items (11.9%). Bicycles were the product most often associated with GU injuries. During the period studied an estimated 32,356 children (95% CI 27,798–37,213) sustained GU injuries due to bicycles (fig. 2), of whom 44% (14,265) were girls. Overall, bicycles accounted for 13% of all GU injuries and more than a third of all sports related injuries. Climbing equipment, such as monkey bars, was the second most frequent cause of injury. As with bicycles, most of these injuries were straddle injuries. Zippers were the clothing item most commonly associated with an injury. There were 9,054 injuries (95% CI 5972–12,136) caused by zippers,

which accounted for 3.6% of pediatric GU injuries. Mean age of boys who sustained such injuries was 10.6 years. A similar number of boys (9,697, 3.8% of all injuries) sustained injuries from the toilet seat falling on the penis.

The majority of injuries to female external genitalia were straddle type injuries (mean patient age 12.6 years, 95% CI 10.9–14.4). The products most commonly associated with female straddle injuries were bicycles, chairs and swimming pool decks.

DISCUSSION

To our knowledge this is the first comprehensive analysis of GU injuries in children presenting to US hospital EDs. Each year approximately 28,000 children present to the ED with GU injuries. This rate is similar to the yearly incidence of pediatric injuries associated with in-line skates and with baby walkers before 1992. Injuries associated with these products decreased significantly after the American Academy of Pediatrics issued recommendations to wear protective gear during in-line skating and the Consumer Product Safety Commission strengthened safety standards for baby walkers, respectively.^{13,14} We observed that the yearly incidence of GU injuries was similar throughout the 9-year study period. This stability suggests that preventive measures to decrease the risk of GU injury have not been identified or have not yet impacted the number of GU injuries sustained each year.

We identified epidemiological characteristics associated with pediatric GU injuries. Children were more likely to sustain injuries during the summer than in the winter. Girls sustained more overall injuries than did boys. However, boys consistently

Genitourinary injuries by body part and injury type treated in United States EDs from 2002 to 2010

	Reported Cases 2002–2010	National Estimate 2002–2010	95% CI	Weighted Proportion (%)
Genitourinary organ injured:				
Female genitalia:				37.7
Bicycle	357	8,997	6,684–11,310	
Chair/sofa	258	6,496	5,010–7,982	
Overall	3,534	89,153	68,211–110,094	
Penis/male urethra:				22.8
Toilet seat	348	9,461	7,214–11,707	
Zipper	330	8,954	5,880–12,029	
Overall	1,989	53,980	41,802–66,157	
Scrotum/testicle/epididymis:				20
Bicycle	297	7,901	6,301–9,502	
Football	89	2,358	1,561–3,154	
Overall	1,780	47,522	37,615–57,428	
Pelvic GU injury not otherwise specified:				12
Bicycle	266	6,448	4,829–8,067	
Climbing bars	152	3,666	2,488–4,845	
Overall	1,812	28,335	19,519–37,151	
Genitalia not otherwise specified:				3.8
Bicycle	51	1,230	649–1,810	
Chair/sofa	32	755	328–1,181	
Overall	372	8,929	6,211–11,647	
Kidney:				3.5
Bicycle	40	1,210	683–1,737	
Skiing*	29	874	0–1,756	
Overall	270	8,249	6,025–10,474	
Bladder:*				0.1
Bicycle	5	150	0–336	
Trampoline	2	70	0–208	
Overall	11	335	0–670	
Adrenal:*				Less than 0.1
Window	3	21	0–55	
Stairs	2	16	0–47	
Overall	7	59	6–113	
Ureter:*				Less than 0.1
Trampoline	1	7	0–19	
Overall	1	7	0–19	
Mechanism of injury:				
Fall	4,677	114,017	93,254–134,781	45.2
Step or jump over	325	9,083	6,628–11,537	3.6
Lifting	71	2,022	1,317–2,727	0.8
Catch injury	401	12,512	8,712–16,312	5
Topical	1,545	33,385	25,415–41,355	13.2
Other	3,290	81,365	66,576–96,153	32.2

For each organ the 2 products/activities most commonly associated with injury to that organ are shown.

* Number of overall injuries was too small to allow reliable estimation.

sustained proportionally more injuries than girls after age 7 years. We hypothesize this shift may be due to older boys engaging in greater risk taking behavior. We observed, as have others, that GU injuries are usually treated in the ED and seldom require admission or transfer to another, presumably specialty care, hospital.¹⁵ Compared to the overall sample, patients who were admitted or transferred to another hospital were older and approximately 25% had kidney injuries. Children who sustained renal trauma were more likely to require hospitalization than those with other GU injuries.

In our study we observed a lower incidence of major renal injury than have others.^{16–19} This find-

ing is likely due to differences in the sample population studied and possibly the exclusion of patients with injuries due to automobiles and motorcycles. These prior studies were derived from trauma center databases, which receive more severely injured patients than general hospitals and often exclude those patients not admitted to the hospital. Conversely NEISS is a nationally representative sample of emergency visits for almost all types of injuries. Therefore, it is likely that genital contusions are more likely to occur than major renal injury.

We observed that GU injuries are commonly associated with certain consumer products. Each year approximately 1,100 boys catch the penis or scrotum

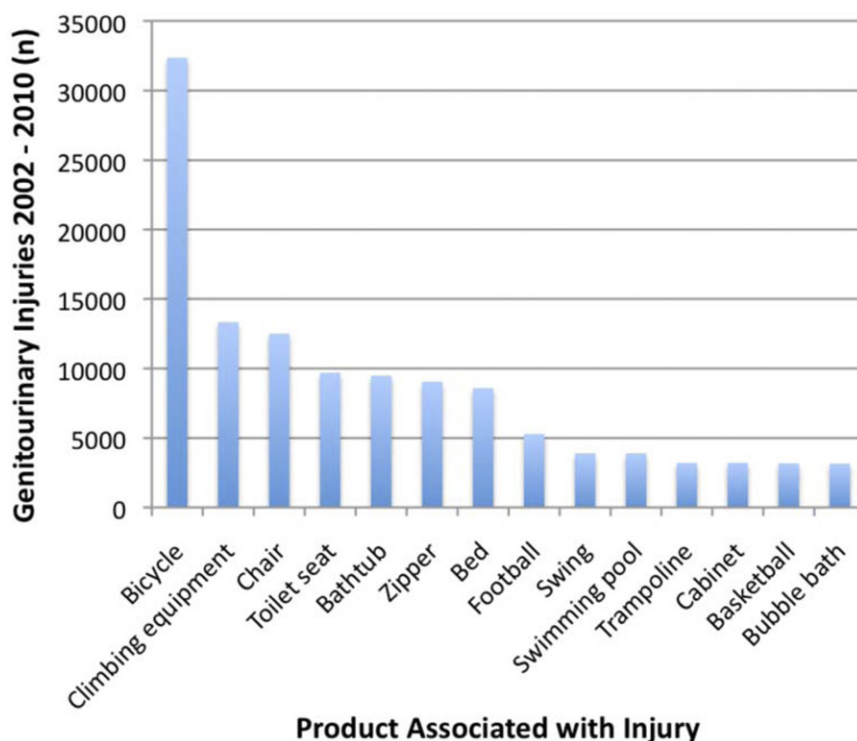


Figure 2. Consumer products most commonly associated with pediatric genitourinary injuries. Types of products most commonly associated with injuries were sports equipment, furniture and clothing. Bicycles accounted for 13% of all genitourinary injuries.

in a zipper. Zipper injuries to the male external genitalia accounted for 4 times the number of all injuries caused by backpacks, which have been identified as an item worthy of injury prevention initiatives.²⁰ Zipper injuries most often occurred in pre-pubescent boys, which is consistent with previous single institution series.^{21,22} The number of these injuries could be greatly reduced if boys at greatest risk for zipper related scrotal or penile injuries wore jeans with snaps or buttons. A similar number of injuries occurred due to the toilet seat falling on the penis. Toilet seats that slowly lower to a horizontal position or have a larger gap between the overlying seat and toilet rim may prevent these injuries.

Bicycles were the product most often associated with pediatric GU injuries. Most bicycle injuries were due to a straddle mechanism. Although most children who sustain these injuries are discharged from the ED, we believe that such bicycle associated GU injuries should be a focus of injury prevention. However, we recognize there are limited resources for injury prevention programs and there are many other injuries, such as concussion, that pose a public health hazard.²³ Therefore, we do not advocate that new bicycle injury prevention programs be developed. Rather, we believe that our observations can be used to strengthen and expand existing bicycle injury prevention efforts, such as the American Academy of Pediatrics bicycle safety program. Prior studies have

shown that of patients who sustained traumatic injuries from bicycles none was wearing protective gear.²⁴ Simple preventive measures such as ensuring a proper fit for the bicycle and using protective gear (eg soft pads for the top tube of a bike) when riding may decrease the incidence and severity of GU injuries.

The approach of strengthening current injury prevention efforts to emphasize GU safety is also applicable for other sports injuries. Our observations support advocating for using appropriate protective gear and reinforcing extant recommendations such as limiting body checking during hockey.²⁵ We hope that increased compliance with these recommendations may further decrease unintentional sports related GU injury. However, we acknowledge that nearly all protective gear worn in sports and recreation has no testing or evaluation standards.²⁶ Shoulder pads and so-called hip and kidney pads are not regulated and may in some cases give a false sense of protection. Additionally, although we believe that many GU injuries are preventable, we acknowledge that some GU injuries cannot be realistically reduced through the implementation of preventive measures. The significant number of injuries associated with pieces of furniture are likely due to “kids being kids” and climbing on or jumping over the piece of furniture.

This is the first known study to investigate the epidemiology of GU injuries sustained by children

who present to hospital EDs representative of the wide variety of hospitals that comprise the delivery of emergency health care in the US. Its strengths include using a large, nationally representative sample and a time frame that spans nearly a decade to estimate the prevalence of pediatric GU injuries. Nevertheless, limitations to the study exist. Most significantly, insight into the details of the injury, such as specific product (eg brand), circumstances surrounding the injury (eg whether the injury occurred associated with product malfunction or through normal use) and specifics regarding the injury (eg method of treatment), is limited by the information included in the NEISS data set. Further investigation into the circumstances and products identified as having a high association with GU injuries at a local level may help provide greater clarity into how these injuries occur and facilitate development of specific risk reduction strategies. Secondly, children who sustain GU injuries due to automobiles or motorcycles and those who present to their primary pediatrician or an

urgent care center with an injury are not captured by NEISS. Therefore, it is likely that this study underestimates the true incidence of pediatric GU injuries and may underestimate minor and some major injuries.

Finally, this study does not provide an estimate of the cost associated with these injuries. Determining the direct and indirect costs of disease and injury will become increasingly important to develop cost-effective models for injury treatment and prevention. Further investigation into how to best implement prevention measures will assist in the development of educational programs and policies aimed at preventing GU injuries in children.

CONCLUSIONS

Genitourinary injuries in children account for approximately 28,000 ED visits yearly. Efforts should be made to decrease the risk of genitourinary injuries in children by promoting the use of protective gear and safer product selection for those at greatest risk for injury.

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EDITORIAL COMMENT

We encourage children to be active because of health benefits. Increased activity increases a variety of risks. The genitourinary literature focuses on catastrophic injuries, ie loss of kidney, testicle or ovary (references 10 and 26 in article). While informative, this approach may result in underreporting of less severe injuries. The NEISS data from about 100 hospitals with 24-hour emergency rooms may provide a more complete picture. As expected, bicycling was the most commonly associated activity (reference 9 in article). The number of female external genitalia injuries is surprising. Perhaps selection bias is at work. A hematoma to the external genita-

lia of a girl may not be as familiar to the primary care provider as a boy getting hit in the perineum, leading to greater ER referrals. The role of protective equipment remains unclear. Except for helmets, there are no evaluation standards. Untested advice such as “soft pads for the top tube of a bike” may give a misguided sense of safety.

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REPLY BY AUTHORS

Participation of children in physical activity must be encouraged, given the unabated epidemic of childhood obesity. The risk of serious disease associated with obesity, such as diabetes, coronary disease and hypertension, undoubtedly outweighs the risk of sustaining a genitourinary injury from participating in fun and beneficial activities such as bicycling.

The question then becomes how to best decrease the risk of injuries sustained from activities that either should not be discouraged or cannot be re-

stricted. We believe that increasing use of simple pieces of equipment (eg a padded top tube) or alternative appliances (eg slow descent toilet seat) simply makes sense. These measures may reduce the risk of injury and are unlikely to have any deleterious consequences. However, ultimately our observations indicate areas of potential injury prevention rather than providing definitive solutions. Studies on specific interventions to decrease genitourinary injuries are needed.