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Epidemiology of Pediatric Holiday-Related Injuries Presenting to US Emergency Departments

AUTHORS: Anthony D'Ippolito,^a Christy L. Collins, MA,^a and R. Dawn Comstock, PhD^{a,b,c}

^aResearch Institute at Nationwide Children's Hospital, Center for Injury Research and Policy, Columbus, Ohio; and ^bDepartment of Pediatrics, College of Medicine, and ^cDivision of Epidemiology, College of Public Health, Ohio State University, Columbus, Ohio

KEY WORDS

holiday, injury, pediatric, epidemiology, National Electronic Injury Surveillance System

ABBREVIATIONS

ED—emergency department
CPSC—Consumer Product Safety Commission
NEISS—National Electronic Injury Surveillance System
IPR—injury proportion ratio
CI—confidence interval

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Address correspondence to Christy L. Collins, MA, Center for Injury Research and Policy, Research Institute at Nationwide Children's Hospital, 700 Children's Dr, Columbus, OH 43205.

E-mail: christy.collins@nationwidechildrens.org

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WHAT'S KNOWN ON THIS SUBJECT: Although research has evaluated injury risks associated with specific holidays, no study has directly compared injury patterns and risk factors across major holidays. Such comparisons can drive the development of targeted preventive measures to minimize the occurrence of holiday injuries.



WHAT THIS STUDY ADDS: This study, the first to directly compare injuries sustained on 8 common holidays, found that although people participate in unique activities during specific holidays, the greatest proportion of injuries that were associated with the holidays were not holiday-specific.

abstract

OBJECTIVE: The objective of this study was to calculate injury rates and describe the epidemiology of holiday-related injuries among children who were aged ≤ 19 years and presented to US emergency departments (EDs) from 1997 through 2006.

METHODS: Data on holiday-related injuries obtained from the US Consumer Product Safety Commission's National Electronic Injury Surveillance System were analyzed.

RESULTS: From 1997 through 2006, an estimated 5 710 999 holiday-related injuries sustained by children who were aged ≤ 19 years presented to US EDs. The greatest number of injuries occurred on Labor Day followed by Memorial Day, Fourth of July, and Halloween. Children who were younger than 5 years sustained a greater proportion of injuries than other age groups. The face, finger/hand, and head were the most commonly injured body parts. Lacerations, contusion/abrasions, fractures, and sprain/strains were the most common diagnoses. Overall, the majority of injuries that occurred on holidays were classified as sports and recreation-related. In addition, home structure-related and home furnishing-related injuries were prevalent. Injuries that were associated with fireworks were more likely to occur on the Fourth of July than any other holiday, yet fireworks accounted for only a small proportion of Fourth of July injuries.

CONCLUSIONS: Most injuries that were sustained on holidays and required ED treatment were not holiday-specific but were associated with more general activities. Parents should be aware that holidays present a risk not only for holiday-specific injuries but also for more general, "everyday" injuries. *Pediatrics* 2010;125:931–937

Holidays create an atmosphere of excitement, jubilation, and, often times, unfortunately, recklessness. The varied activities in which people participate during holiday seasons create environments in which injuries can easily occur. Visits to new locations, the introduction of new activities, decorations, etc, coupled with the possible reduction in supervision of children during holiday celebrations may lead to an increase in injuries among children.

Although previous research evaluated injury risks associated with specific holidays, no study has directly compared injury patterns and risk factors across major holidays. Many studies have investigated the occurrence of fireworks-related injuries on the Fourth of July.¹⁻⁶ Previous studies have also focused on the risk for lacerations to the hand while carving Halloween pumpkins^{7,8} and pediatric pedestrian fatalities during Halloween-related activities.⁹ Studies focused on the Christmas season have investigated eye injuries from Christmas trees,¹⁰ Christmas ornament aspirations,¹¹ ingestion of decorative and toxic plants such as mistletoe (*Phoradendron serotinum*),¹² and falls associated with decorations.¹³ Another study examined the risk for travel-related injuries on Thanksgiving.¹⁴ Thus far, research in the area of holiday-related injuries has been limited to such studies of single holidays and/or specific types of injuries.

The objective of this study was to describe the epidemiology of pediatric holiday-related injuries that were treated in US emergency departments (EDs) from 1997 through 2006, comparing holiday-specific patterns. Such comparisons can drive the development of targeted preventive measures to minimize the occurrence of holiday injuries.

METHODS

Data were obtained from the US Consumer Product Safety Commission (CPSC) National Electronic Injury Surveillance System (NEISS), which collects information on individuals who are treated for injuries in a nationally representative stratified probability sample of 98 US hospital EDs, including 8 children's hospitals.¹⁵ The NEISS data set, which is updated daily, provides patient demographic information as well as specific information about the injury and injury event for each patient who presents for treatment. Statistical weights provided by the CPSC are applied to the NEISS sample data for calculation of national estimates of the number of injuries.¹⁵

All injuries that were treated in EDs that participated in NEISS from 1997 through 2006 and occurred among children who were aged ≤ 19 years from 2 days before through 2 days after New Year's, Easter, Memorial Day, Fourth of July, Labor Day, Halloween, Thanksgiving, and Christmas were included in this study. A 5-day period was used because people do not always celebrate holidays on the actual day of the holiday or may participate in extended celebrations. Variables of interest were age, gender, holiday during which an injury occurred, injury diagnosis, body part injured, injury disposition, and the CPSC product code associated with the injury. Age was categorized into 4 groups on the basis of child development milestones and US Census Bureau data: < 5 years of age, 5 to 9 years of age, 10 to 14 years of age, and 15 to 19 years of age. Individual product codes were categorized into general classifications such as sports and recreation (eg, football, basketball, soccer), home structures (eg, floors, counter tops, doors), and home furnishings (eg, chairs, tables, beds), as well as into more specific classifications such as stairs/ramps/

landings/floors, and beds/mattresses/pillows according to CPSC guidelines. This study was approved by the institutional review board at Nationwide Children's Hospital.

Data analyses were conducted using SPSS 15 (SPSS Science Inc, Chicago, IL) with the Complex Samples module while adjusting for sample weights and the stratified survey design as recommended by the CPSC to produce national injury estimates.¹⁵ All data presented represent national injury estimates unless otherwise stated. Injury rates were calculated by using annual population estimates from the US Census Bureau.¹⁶ Statistical analyses included the χ^2 test with Yates' correction and linear regression. Injury proportion ratios (IPRs) with 95% confidence intervals (CIs) and P values were used to assess the magnitude and direction of associations. CIs not including 1.0 and $P < .05$ were considered statistically significant. The following is an example of an IPR calculation comparing the proportion of children who were younger than 5 years and sustained a holiday-related head injury to the proportion of children who were aged ≥ 5 and sustained a holiday-related head injury:

$$\text{IPR} = \frac{\text{(national estimated \# of children <5 with holiday-related head injury / national estimated \# of total injuries sustained by children <5)}}{\text{(national estimated \# of children \geq 5 with holiday-related head injury / national estimated \# of total injuries sustained by children \geq 5)}}$$

RESULTS

Injury Rate

Among children who were aged ≤ 19 years, an estimated 5 710 999 holiday-related injuries presented to US EDs from 1997 through 2006. Holiday-related injuries ranged from 542 379 in 1997 to 568 467 in 2006 with a peak of 597 642 in 2001. Overall, the number of injuries sustained during holidays

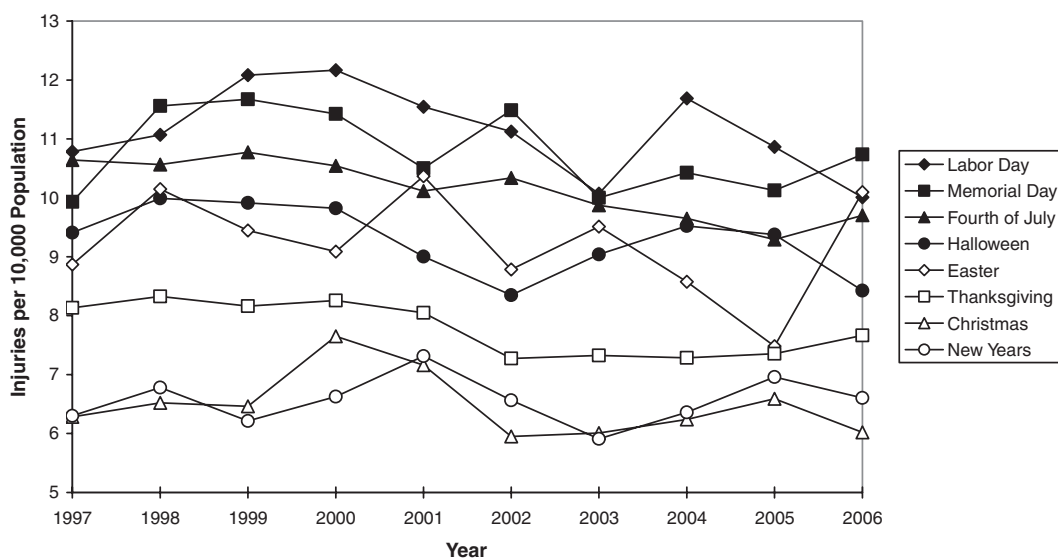


FIGURE 1

Nationally estimated number of holiday-related injuries among children who were aged ≤ 19 years and treated in US EDs from 1997 through 2006 per 10 000 US population by holiday and year.

from 1997 through 2006 decreased, although this decrease was not significant ($P = .61$). Holidays with the highest number of injuries per year were Labor Day, Memorial Day, Fourth of July, and Halloween. The holiday with the highest number of injuries, Labor Day ($n = 890\,756$), ranged from 83 156 in 1997 to 82 172 in 2006 with a peak of 95 552 in 2000. Christmas, the holiday with the least injuries, ranged from 48 427 in 1997 to 49 394 in 2006 with a peak of 60 067 in 2000. The only holiday with a significant change over time was Fourth of July, with injuries decreasing significantly ($P = .021$). Labor Day, Memorial Day, Fourth of July, and Halloween also had the most injuries per 10 000 US population (Fig 1).

Demographics

Table 1 provides proportions of holiday-related injuries by gender, age group, body part injured, injury diagnosis, and injury disposition. Overall, 62.4% of injuries were sustained by boys, and although injuries were distributed fairly evenly across age groups, the greatest proportion of injuries were sustained by children who

were younger than 5 years (29.1%). The mean age of children who sustained a holiday-related injury was 8.9 years (SD: 5.4 years; range: 1 month to 19 years). The most common diagnoses were lacerations (29.2%), contusion/abrasions (18.3%), fractures (15.1%), and sprain/strains (13.0%). The body parts most commonly injured were the face (15.7%), finger/hand (15.5%), and head (13.3%). The majority of injuries to the face were lacerations (65.9%). Among head injuries, the most common diagnoses were lacerations (33.1%), internal organ injury (32.3%), and contusions/abrasions (17.6%), with 10.3% of all head injuries diagnosed as concussions. Among hand/finger injuries, the most common diagnoses were lacerations (36.6%), fractures (18.7%), and contusions/abrasions (15.6%).

With regard to age, the most common diagnoses among children who were younger than 5 and children who were aged 5 to 9 years were lacerations (37.0% and 35.9%, respectively) and contusions/abrasions (18.0% and 17.7%, respectively). The most com-

mon diagnoses among children who were aged 10 to 14 were fractures (21.9%) and lacerations (20.6%), and the most common diagnoses among children who were aged 15 to 19 were sprains/strains (25.5%) and lacerations (22.0%). Children who were younger than 5 years sustained a greater proportion of head (21.9%) and face (27.4%) injuries than children who were aged ≥ 5 years (9.7% and 10.9%, respectively; IPR: 2.25 [95% CI: 2.16–2.35; $P < .001$] and IPR: 2.51 [95% CI: 2.41–2.61; $P < .001$], respectively). The most commonly injured body part among children who were aged 10 to 14 (19.5%) and children who were aged 15 to 19 (22.1%) was the finger/hand.

Of all holiday-related injuries seen in US EDs from 1997 through 2006, 96.8% required only treatment and release and 1.7% required hospitalization of the patient. An estimated 1712 (0.03%) deaths resulted from holiday-related injuries, which were based on 60 actual deaths. Among injuries that resulted in death, the most common diagnoses were submersion/drowning

TABLE 1 Characteristics of Holiday-related Injuries Among Children Who Were Aged ≤19 Years and Presenting to US EDs From 1997 through 2006, Overall and by Holiday

Variable	Overall	Holiday, %							
		New Year's	Easter	Memorial Day	Fourth of July	Labor Day	Halloween	Thanksgiving	Christmas
Total	<i>n</i> = 5 710 999	<i>n</i> = 525 097	<i>n</i> = 738 570	<i>n</i> = 862 609	<i>n</i> = 811 288	<i>n</i> = 890 756	<i>n</i> = 742 026	<i>n</i> = 621 938	<i>n</i> = 518 715
Gender									
Male	62.4	61.9	60.8	61.4	62.3	63.8	64.3	62.1	61.6
Female	37.6	38.1	39.1	38.6	37.7	36.1	35.7	37.9	38.4
Age, y									
<5	29.1	22.0	29.2	27.5	30.5	26.0	27.7	34.5	37.0
5–9	23.2	24.5	25.0	25.1	26.2	22.7	18.7	20.9	21.8
10–14	27.5	28.0	27.7	29.1	25.1	29.7	30.3	24.1	23.7
15–19	20.2	25.5	18.1	18.4	18.2	21.6	23.2	20.4	17.5
Body part ^a									
Face	15.7	15.5	16.0	15.6	15.9	13.3	15.3	17.7	17.8
Finger/hand	15.5	16.1	15.0	14.7	13.8	14.8	17.6	16.5	16.6
Head	13.3	12.3	14.0	12.8	12.7	12.9	13.2	14.4	14.4
Ankle	6.1	6.3	6.8	6.6	4.6	6.2	7.5	6.1	4.5
Wrist	5.1	5.8	5.1	5.2	4.3	6.2	5.1	4.3	4.8
Diagnosis ^a									
Laceration	29.2	30.5	28.5	28.0	31.4	26.3	26.3	31.2	34.4
Contusion/abrasion	18.3	16.3	19.4	19.1	18.3	19.1	19.3	16.6	16.3
Fracture	15.1	16.4	15.6	15.7	12.8	16.5	14.9	14.8	13.8
Sprain/strain	13.0	13.5	13.4	13.3	9.3	15.1	16.2	12.5	10.0
Concussion	1.4	1.4	1.3	1.4	1.1	1.6	1.6	1.3	1.2
Disposition ^a									
Treated/released	96.8	96.6	96.9	96.7	96.4	96.7	97.2	97.1	96.8
Admitted	1.7	1.7	1.8	1.7	1.8	1.8	1.6	1.5	1.6
Fatality/DOA	0.030	0.100	0.030	0.030	0.100	0.003	0.030	0.030	0.030

DOA indicates dead on arrival.

^a Only the most common categories (and concussion for diagnosis) are included.

(*n* = 18 [30.0%]) and cardiac/respiratory arrest (*n* = 12 [20.0%]), with the most common body parts injured being >50% of the body (*n* = 46 [76.7%]) and the head (*n* = 9 [15.0%]). Nearly half of all deaths (*n* = 29 [48.3%]) occurred among children who were younger than 5 years. The greatest proportion of deaths occurred on the Fourth of July (*n* = 13 [21.7%]) and New Year's (*n* = 9 [15.0%]).

Differences by Holiday

As shown in Table 1, boys sustained a greater proportion of injuries than did girls during each holiday; however, there were small injury pattern differences across holidays by age group. On Easter, Fourth of July, Thanksgiving, and Christmas, children who were younger than 5 years sustained the greatest proportion of injuries (29.2%, 30.5%, 34.5%, and 37.0%, respectively). On New Year's, Memorial Day, Labor

Day, and Halloween, children who were aged 10 to 14 years sustained the greatest proportion of injuries (28.0%, 29.1%, 29.7%, and 30.3%, respectively). On New Year's, 15- to 19-year-olds had a significantly greater proportion of injuries compared with all other holidays (*P* < .001 for each holiday).

Among the various body parts injured, injuries to the face accounted for the greatest proportion of injuries on Easter (16.0%), Memorial Day (15.6%), Fourth of July (15.9%), Thanksgiving (17.7%), and Christmas (17.8%). Finger/hand injuries accounted for the greatest proportion of injuries on New Year's (16.1%), Labor Day (14.8%), and Halloween (17.6%). Of the finger/hand injuries sustained on Halloween, 33.3% were lacerations and 20.1% were fractures. On Christmas, eye injuries accounted for 1.7% of the total injuries. Among the 5 most common injury diagnoses, lacerations accounted

for the greatest proportion of injuries for each holiday, ranging from 26.3% of all injuries on Labor Day and Halloween to 34.4% of injuries on Christmas. On Christmas, aspirations and ingestions accounted for 0.2% and 1.3% of injuries, respectively. Disposition was similar across holidays, with the vast majority of injuries being treated in the ED and released.

Related Product Codes

Overall, the majority of injuries that occurred on holidays were classified by the CPSC product codes as sports and recreation-related (41.6%). In addition, 19.9% of holiday-related injuries were home structure-related and 16.1% were home furnishing-related. For each holiday, sports and recreation was the most common product classification, ranging from 29.4% of injuries on Christmas to 49.0% of injuries on Labor Day. A greater propor-

tion of holiday-related injuries among children aged 5 to 9 years (43.5%; IPR: 4.03 [95% CI: 4.01–4.04; $P < .001$]), 10 to 14 years (62.8%; IPR: 5.82 [95% CI: 5.79–5.84; $P < .001$]), and 15 to 19 years (58.4%; IPR: 5.41 [95% CI: 5.38–5.43; $P < .001$]) were sports and recreation-related than among children who were younger than 5 years (10.8%). Conversely, a greater proportion of holiday-related injuries among children who were younger than 5 years were related to home furnishings (31.3%) than among children aged 5 to 9 (16.2%; IPR: 1.94 [95% CI: 1.93–1.95; $P < .001$]), 10 to 14 (6.1%; IPR: 5.05 [95% CI: 5.02–5.08; $P < .001$]), and 15 to 19 (6.0%; IPR: 5.26 [95% CI: 5.22–5.30; $P < .001$]).

More specifically, stairs/ramps/landings/floors (9.2%), bicycles (6.2%), football (4.6%), and basketball (4.5%) were the CPSC product codes associated with the greatest proportion of injuries that occurred during holidays. Table 2 shows the product codes that were most frequently associated with holiday-related injuries by holiday. On New Year's, Easter, Thanksgiving, and Christmas, stairs/ramps/landings/floors were associated with the greatest proportion of injuries (9.9%, 9.3%, 11.0%, and 11.6%, respectively). On Memorial Day and Fourth of July, bicycles were associated with the greatest proportion of injuries (8.9% and 8.6%, respectively). Football was associated with the most injuries on Labor Day (11.3%) and Halloween (11.8%). Injuries that were associated with fireworks were more likely to occur on the Fourth of July than on any other holiday (IPR: 5.94 [95% CI: 5.90–5.97; $P < .001$]), yet fireworks accounted for only 2.9% of the injuries that occurred in the 5-day period around the Fourth of July and for only 6.2% of the injuries that occurred on the actual Fourth of July holiday (Table 2). When comparing the 5-day period around the holiday

TABLE 2 Most Common Specific Products Associated With Holiday-related Injuries Among Children Who Were Aged ≤ 19 Years and Presented to US EDs from 1997 through 2006

Holiday	Most Common Products	5-Day Holiday Period, %	Day of Holiday, %
New Year's	Stairs/ramps/landings/floors	9.9	10.3
	Snow skiing	6.8	6.0
	Basketball	5.2	2.9
	Bed/mattresses/pillows	4.7	4.8
	Bicycles	3.8	3.8
	Skating, all kinds	3.2	3.9
Easter	Stairs/ramps/landings/floors	9.3	9.9
	Bicycles	6.8	6.8
	Basketball	5.2	4.3
	Baseball/softball	4.8	3.0
	Playground equipment	4.4	3.9
	Bed/mattresses/pillows	4.0	4.4
Memorial Day	Tables	3.2	4.0
	Bicycles	8.9	8.7
	Stairs/ramps/landings/floors	7.8	7.5
	Baseball/softball	5.7	3.9
	Basketball	5.2	4.8
	Playground equipment	4.9	5.2
Fourth of July	ATVs, mopeds, minibikes, etc	2.9	4.2
	Bicycles	8.6	7.7
	Stairs/ramps/landings/floors	7.8	7.4
	Swimming	6.8	8.7
	Baseball/softball	3.7	2.5
	Playground equipment	3.7	3.9
Labor Day	Fireworks	2.9	6.2
	Football	11.3	8.4
	Bicycles	9.2	10.2
	Stairs/ramps/landings/floors	7.7	8.4
	Playground equipment	4.2	4.1
	Bed/mattresses/pillows	4.0	4.0
Halloween	Football	11.8	11.4
	Stairs/ramps/landings/floors	10.2	11.8
	Basketball	5.0	3.9
	Bed/mattresses/pillows	4.1	4.3
	Chairs/sofas/sofa beds	3.4	3.7
	Playground equipment	3.4	2.7
Thanksgiving	Bicycles	3.1	3.8
	Stairs/ramps/landings/floors	11.0	11.0
	Basketball	5.9	2.5
	Bed/mattresses/pillows	5.7	6.8
	Football	4.9	5.9
	Chairs/sofas/sofa beds	4.5	4.4
Christmas	Tables	4.4	5.5
	Stairs/ramps/landings/floors	11.6	12.5
	Bed/mattresses/pillows	5.5	4.6
	Snow skiing	5.1	2.9
	Tables	4.4	4.7
	Cutlery/knives	4.2	7.8
	Chairs/sofas/sofa beds	4.1	4.8

and the actual holiday, the product codes that were most frequently associated with holiday-related injuries were similar (Table 2).

DISCUSSION

From 1997 to 2006, an estimated 5 710 999 children presented to US EDs

with holiday-related injuries. This study, the first to directly compare injuries sustained on 8 common holidays, found that although people often participate in unique activities during each specific holiday, the greatest proportion of injuries that were associated with the holidays examined in this

study were not holiday-specific. Instead, the most common holiday-related injuries were associated with common product codes and activities, including stairs/ramps/landings/floors and sports and recreation activities. Traditionally, injury prevention efforts have focused on educating parents and children about holiday-specific injury risks such as fireworks on Fourth of July and costumes on Halloween; however, findings from this study suggest that holiday injury prevention efforts that focus on general risk factors in addition to holiday-specific risks could be expected to have a greater impact on decreasing pediatric injury rates in the United States.

Researchers have examined injury risks associated with specific holidays, including fireworks on Fourth of July,¹⁻⁶ eye injuries and aspirations/ingestions on Christmas,¹⁰ and hand lacerations on Halloween.^{7,8} Similar to previous research, we found that fireworks-related injuries were more likely to occur on the Fourth of July than on any other holiday; however, fireworks were associated with only 2.9% of injuries during the 5-day period around the Fourth of July, whereas bicycles were associated with 8.6% of injuries. Even when comparing the actual day of the holiday, the proportion of bicycle-related injuries (7.7%) was greater than the proportion of fireworks-related injuries (6.2%). We also found that eye injuries and aspirations/ingestions did occur on Christmas; however, these injuries accounted for only a small proportion (1.7% and 1.5%, respectively) of Christmas-related injuries. The greatest proportion of injuries that occurred on Christmas was associated with stairs/ramps/landings/floors and bed/mattresses/pillows. Also consistent with previous research, we found that on Halloween, 17.6% of inju-

ries were to the finger/hand and that 33.3% of those finger/hand injuries were lacerations. Although some of those lacerations to the finger/hand were most likely a result of the sometimes difficult maneuvers needed to carve pumpkins,^{7,8} a much higher proportion of injuries that occurred on Halloween were associated with sports, including football and basketball, than with knives. From an injury prevention standpoint, future efforts should include a focus on developing ways to prevent the more common general injuries that occur on holidays in addition to the less frequent holiday-specific injuries.

In addition, on the basis of the findings of this study, future injury prevention efforts should target Labor Day and Memorial Day. Although these holidays are typically not the focus of efforts to prevent holiday-related injuries, this study found that they have the highest rates of injury of all holidays. A possible explanation for these high injury rates is that both Labor Day and Memorial Day are celebrated when the weather is warm. People are more likely to engage in outdoor physical activity during these holidays than during Christmas or New Year's, when the weather is cold. An increased participation in physical activity increases the risk for injury. This is supported by the most common product codes for Labor Day and Memorial Day, which are bicycles and football—both outdoor physical activities. These 2 holidays also mark the beginning and end of “traditional” summer in the United States. At the beginning of summer, children may be more engaged in outdoor physical activities after being confined indoors during the winter. At the end of summer, children may be participating in the last outdoor physical activities before returning to school.

Overall, children who were younger than 5 years were most likely to sus-

tain holiday-related injuries. Parents should closely supervise children who are younger than 5 years on Thanksgiving and Christmas, when the proportions of injuries were significantly greater among these younger children compared with the other age groups. Parents of children aged 10 to 14 years should be aware that injury rates are higher on Labor Day and Halloween. On New Year's, those aged 15 to 19 years had a significantly greater proportion of injuries compared with all other holidays. This may be because these adolescents are beginning to participate in more adult behaviors when celebrating the new year. Such observations may assist public health efforts to prevent both general and holiday-specific injuries through targeted prevention programs.

As with most studies, this study has limitations. One is that CPSC's NEISS database provides national injury estimates from actual cases that are presented to select US EDs and thus does not account for less severe injuries that may have been untreated or treated outside an ED. The findings of this study are therefore underestimations of the actual incidence of holiday-related injuries; however, injuries that require ED care are important both clinically and economically. Furthermore, because of the religious and social diversity in the United States, all children who were aged ≤ 19 years may not have participated in each holiday. To help reduce this limitation, only the most common US holidays were included in the study. Another limitation is that the NEISS database does not capture automobile-related injuries, which may result in our study's actually underestimating the incidence of holiday-related injuries. Despite these limitations, the NEISS data set provides the only nationally representative sample of holiday-

related injuries in the United States and descriptions of patterns of injuries that are based on this stable long-term database yielded important information.

CONCLUSIONS

More than 500 000 injuries are sustained by children who are aged ≤ 19 years during the major US holidays each year. There have traditionally been efforts by physicians, public health officials, and the media to em-

phasize preventing holiday-specific injuries; however, this study found that injuries that occur during holidays were more commonly associated with general rather than holiday-specific activities. Thus, we must not only work to prevent injuries that are specific to a given holiday but also continue efforts to prevent “everyday” injuries. Parents must continue to be watchful for injury risks,¹⁷ even in the excitement of holiday celebration, and adolescents should be cautioned against

becoming reckless because of the holiday atmosphere. Through combined efforts to prevent injuries from both general and holiday-specific risks, rather than focusing only on holiday-specific risks, the rate of pediatric injuries could be reduced.

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