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Estimated Number of Injuries and Reported Deaths Associated with Inflatable Amusements, 2003–2013

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Executive Summary

This report provides information about the estimated number of injuries associated with inflatable amusements in the years 2003-2013. The report also contains information about fatality cases associated with inflatable amusements for the same time period.

Some of the main findings in this report are:

- There were an estimated 113,272 emergency department-treated injuries associated with inflatable amusements in the years 2003-2013.
- More than 90 percent of the estimated injuries associated with inflatable amusements were linked to moon bounces.
- There was a statistically significant increasing linear trend of yearly estimates for emergency department-treated injuries associated with inflatable amusements.
- Sixty-one percent of the estimated injuries in the years 2011-2013 were in the 4 to 15 years age group.
- Most of the injuries were to the limbs, with leg and arm injuries accounting for 66 percent.
- There were 12 deaths reported to CPSC involving inflatable amusements that occurred in the years 2003-2013.

Overview

This report contains information about injuries and fatalities associated with inflatable amusements. For this report, "inflatable amusements" are defined as air-filled structures for recreational use, made of flexible fabric, kept inflated by continuous air flow by one or more blowers, and rely upon air pressure to maintain their shape.[1] The most common form of inflatable amusement is the "moon bounce," also known as "bounce house" or "space walk," which is a square structure surrounding an area meant to be jumped up and down on. Other inflatable amusements include slides, obstacle courses, and games.

From 2003 through 2013, an estimated 113,272 emergency department-treated injuries associated with inflatable amusements occurred. The 95 percent confidence interval (C.I.) for this estimate is 68,781−157,763, based on a coefficient of variance (C.V.) of 0.2004. Out of the estimated 113,272 emergency department-treated injuries associated with inflatable amusements, an estimated 31,069 (or 27%) occurred in the years 2003−2007, and an estimated 82,203 (or 73%) occurred in the years 2008−2013. The 95 percent C.I. for the 2003−2007 estimate is 13,732–48,406, based on a C.V. of 0.2847.[2] The 95 percent C.I. for the 2008−2013 estimate is 53,588–110,818, based on a C.V. of 0.1776. The average annual estimated number of emergency department-treated injuries associated with inflatable amusements from 2011 through 2013 is 16,903. Of the estimated 113,272 emergency department-treated injuries in 2003−2013, an estimated 104,875 (or 93%) were associated with moon bounces. The 95 percent confidence interval for this estimate is 60,927−148,823, based on a C.V. of 0.2138. An estimated 28,338 emergency department-treated injuries associated with moon bounces (or 27%) occurred in the years 2003−2007; and an estimated 76,536[3] (or 73%) occurred in the years 2008−2013. The 95 percent C.I. for those estimates are: 11,308–45,368, based on a C.V. of 0.3066 for 2003−2007, and 48,274–104,798, based on a C.V. of 0.1884 for 2008−2013. The average annual estimated number of emergency department-treated injuries associated with moon bounces for 2011 through 2013 is 15,815.

Annual Injury Estimates

Yearly estimates of emergency department-treated injuries associated with inflatable amusements were generated for 2003 through 2013. Yearly estimates for all inflatable amusements are shown in Table 1, and yearly estimates for moon bounces are shown in Table 2. The yearly estimates are also plotted with their 3-year moving averages in Figure 1 (all inflatables) and Figure 2 (moon bounces).

[1] This definition of "inflatable amusements" was developed by CPSC's Hazard Analysis staff, in conjunction with subject matter experts from Engineering Sciences, Health Sciences, Compliance, and the Office of the General Counsel.

[2] O'Brien C. *Estimated Number of Injuries and Reported Deaths Associated with Inflatable Amusements, 2003-2007*. U.S. Consumer Product Safety Commission, July, 2009.

[3] The estimates may not match the sum of annual totals, due to rounding.

Table 1: Estimated Emergency Department-Treated Injuries for Inflatable Amusements, 2003–2013

Year	Observations	Estimate	95% C.I	C.V.
2013	582	17,377	11,781–22,973	0.1643
2012	608	18,841	11,629–26,053	0.1953
2011	521	14,492	9,246–19,738	0.1847
2010	477	13,470	9,027–17,913	0.1683
2009	367	10,554	6,011–15,097	0.2196
2008	297	7,470	3,959–10,981	0.2398
2007	319	8,348	4,488–12,208	0.2359
2006	246	5,938	2,661–9,215	0.2815
2005	209	5,371	1,971–8,771	0.3229
2004	202	6,101	2,250–9,952	0.3220
2003	163	5,311	1,711–8,911	0.3458
Total	3,991	113,272	68,781–157,763	0.2004

Source: National Electronic Injury Surveillance System (NEISS), September 2014
The estimates may not sum to the totals due to rounding.

Table 2: Estimated Emergency Department-Treated Injuries for Moon Bounces, 2003–2013

Year	Observations	Estimate	95% C.I.	C.V.
2013	551	16,342	10,942–21,742	0.1686
2012	575	17,557	10,537–24,577	0.2040
2011	485	13,547	8,298–18,796	0.1977
2010	448	12,573	8,135–17,011	0.1801
2009	338	9,920	5,399–14,441	0.2325
2008	276	6,598	3,194–10,002	0.2632
2007	290	7,297	3,681–10,913	0.2528
2006	227	5,474	2,253–8,695	0.3002
2005	197	5,133	1,721–8,545	0.3391
2004	184	5,412	1,608–9,216	0.3586
2003	150	5,022	1,418–8,626	0.3661
Total	3,721	104,875	60,927–148,823	0.2138

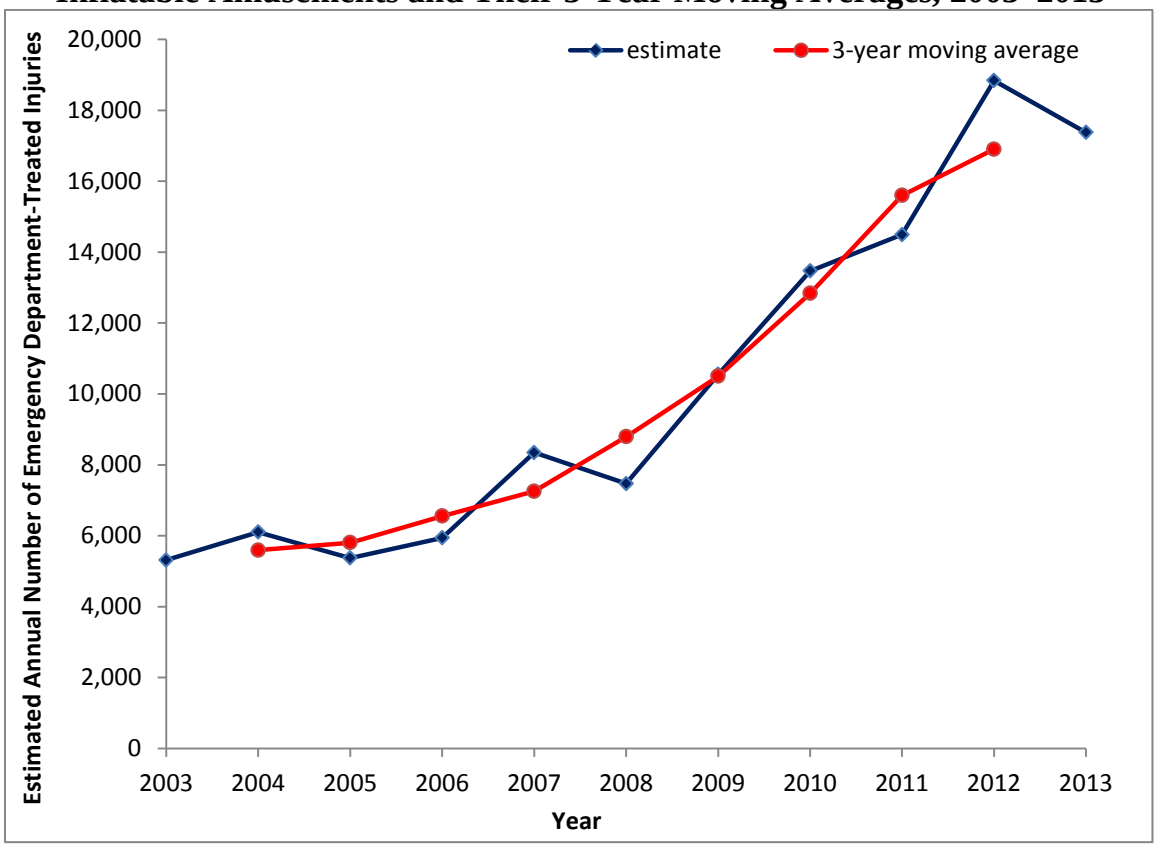
Source: National Electronic Injury Surveillance System (NEISS), September 2014
The estimates may not sum to the totals due to rounding.

The estimated coefficients of variation for the yearly estimates are lower in more recent years than in the earlier years. The high variance of the estimates in the years 2003−2006 appeared to be due to the clustering of incidents, with one of the hospitals in the sample located near an

amusement park comprised completely of inflatable amusements, and a few hospitals located near fairgrounds, thus having more incidents during the operations of state or country fairs.

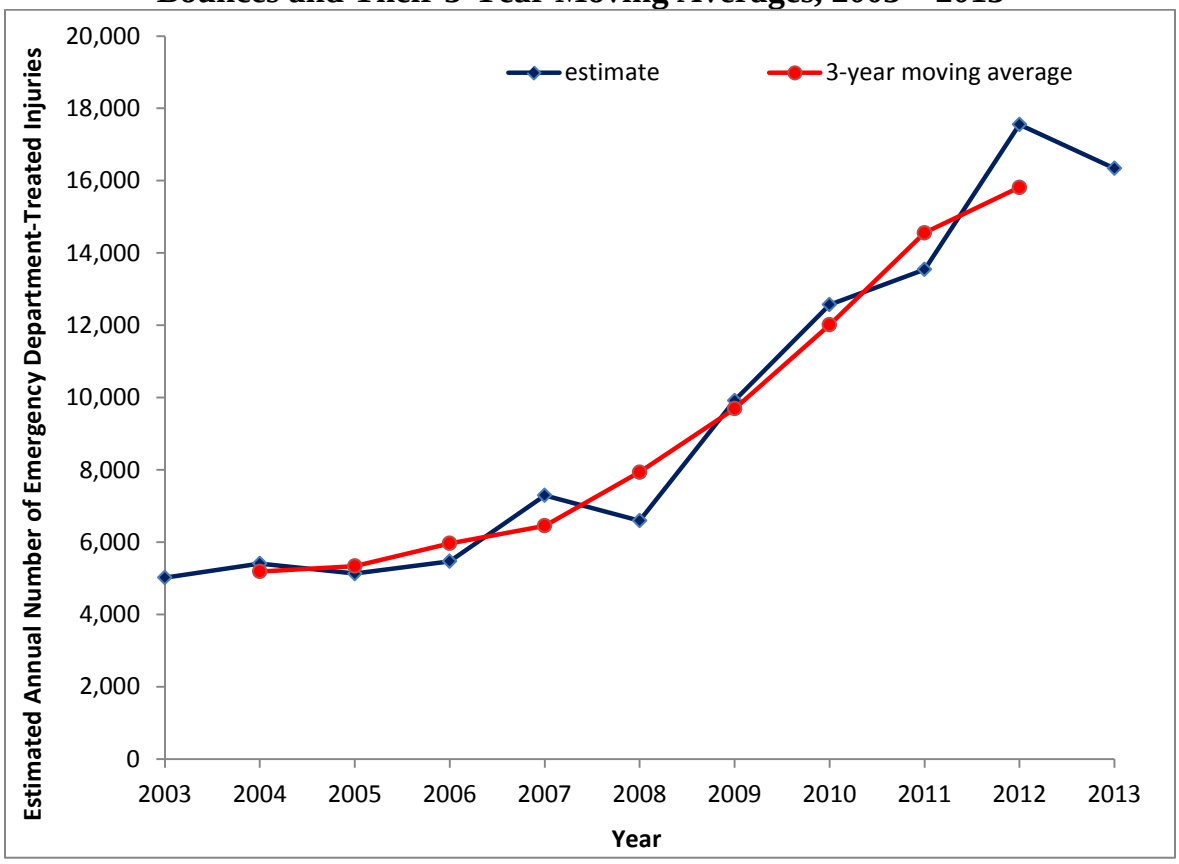
The 3-year moving averages for inflatable amusements (see Figure 1) and moon bounces (see Figure 2) have risen consistently between 2003 and 2013. Both the yearly estimates for all inflatables and for moon bounces were analyzed for the existence of a trend. Both sets of estimates showed a statistically significant increasing linear trend, with injuries increasing over the period studied. The p-value for all inflatable amusements was 0.0073. The p-value for moon bounces was 0.0107. It is unknown at this time whether the increase in the linear trend is due to increasing exposure (*e.g.*, a growing number of inflatables with same utilization rate) or a rise in the injury rate.

Figure 1: Estimated Annual Emergency Department-Treated Injuries for Inflatable Amusements and Their 3-Year Moving Averages, 2003–2013



Source: National Electronic Injury Surveillance System, September 2014

Figure 2: Estimated Annual Emergency Department-Treated Injuries for Moon Bounces and Their 3-Year Moving Averages, 2003 – 2013



Source: National Electronic Injury Surveillance System, September 2014

Injury Estimates by Category

The incidents involving inflatable amusements were categorized by location of the incident, age of the victim, body part injured, injury diagnosis, and disposition. The estimated number of emergency department-treated injuries was calculated for each category for 2011–2013 and is presented in Tables 3 – 7. Table 5 provides estimated average annual injury rates per million population for each age category.

Table 3: Estimated Emergency Department-Treated Injuries for Inflatable Amusements by Location Category, 2011–2013

	Moon Bounce		All Inflatables	
Location	**Estimate**	**% Total**	**Estimate**	**% Total**
Commercial (non-home)	20,934	44%	23,089	46%
Residential	10,764	23%	10,871	21%
Not Stated	15,748	33%	16,750	33%
Total	47,446	100%	50,709	100%

Source: National Electronic Injury Surveillance System, September 2014
The estimates may not sum to the totals due to rounding.

The percentage of the estimated incidents associated with inflatable amusements was more than twice as high in commercial areas compared to residential areas (46% versus 21%). The location of the incident was not stated in 33 percent of the cases.

Table 4: Estimated Emergency Department-Treated Injuries for Inflatable Amusements by Age Category, 2011–2013

	Moon Bounce		All Inflatables	
Age	**Estimate**	**% Total**	**Estimate**	**% Total**
0 to 4	12,989	27%	13,651	27%
5 to 14	28,761	61%	30,809	61%
15 and up	5,697	12%	6,249	12%
Total	47,446	100%	50,709	100%

Source: National Electronic Injury Surveillance System, September 2014
The estimates may not sum to the totals due to rounding.

The estimated emergency department-treated injuries for inflatable amusements by age category are shown in Table 4. Sixty-one percent of the estimated injuries were in the 5 to 14 age group, and 88 percent of the estimated injuries involved children under the age of 15.

Table 5: Estimated Annual Average Emergency Department-Treated Injury Rates per Million Population for Inflatable Amusements by Age Category, 2011–2013

Age	Moon Bounce	All Inflatables
0 to 4	217	228
5 to 14	233	250
15 and up	8	8
Total	50	54

Sources: National Electronic Injury Surveillance System, September 2014; U.S. Census Bureau

The estimated annual average emergency department-treated injury rates per million population for inflatable amusements by age category are shown in Table 5. While 12 percent of the injuries were in the 15 and older age category, Table 5 shows that the injury rate for that age category is much lower relative to the other age categories due to the large population of the open-ended 15 and up age category.

Table 6: Estimated Emergency Department-Treated Injuries for Inflatable Amusements by Body Part Injured, 2011–2013

	Moon Bounce		All Inflatables	
Body Part	Estimate	% Total	Estimate	% Total
Leg/Foot	15,990	34%	17,359	34%
Arm/Hand	15,138	32%	16,103	32%
Head/Face	7,134	15%	7,444	15%
Other	5,835	12%	6,144	12%
Torso	3,350	7%	3,659	7%
Total	47,446	100%	50,709	100%

Source: National Electronic Injury Surveillance System, September 2014
The estimates may not sum to the totals due to rounding.

The estimated emergency department-treated injuries for inflatable amusements by body part injured are shown in Table 6. Most of the injuries were to the limbs, with leg and arm injuries together accounting for 66 percent of the estimated injuries for both the moon bounce and all inflatable amusements.

Table 7: Estimated Emergency Department-Treated Injuries for Inflatable Amusements by Injury Diagnosis, 2011–2013

	Moon Bounce		All Inflatables	
Diagnosis	**Estimate**	**% Total**	**Estimate**	**% Total**
Fracture	12,928	27%	14,089	28%
Strain/Sprain/Dislocation	12,813	27%	13,798	27%
Contusion/Abrasion/Laceration	11,311	24%	11,842	23%
Other/Not Stated	10,394	22%	10,980	22%
Total	47,446	100%	50,709	100%

Source: National Electronic Injury Surveillance System, September 2014
The estimates may not sum to the totals due to rounding.

The estimated emergency department-treated injuries for inflatable amusements by injury diagnosis are shown in Table 7. The most common injuries were fractures (28%) and strains, sprains, dislocation (27%), followed by contusion, abrasion, or laceration (23%).

The estimated emergency department-treated injuries for inflatable amusements cannot be provided by disposition due to small sample sizes in some categories. For both moon bounce and all inflatable associated injuries, 96 percent of the estimated emergency department-treated injuries were treated and released; 3 percent were hospitalized; and 1 percent left against medical advice or did not state a disposition.

Deaths

CPSC staff is aware of 12 deaths involving inflatable amusements from January 2003 through December 2013. Four involved a moon bounce-style inflatable amusement; seven involved a non-moon-bounce inflatable; and one involved an unspecified inflatable amusement.

The four deadly incidents linked to moon bounce-style inflatables were associated with head and neck injuries (2), suffocation (1), and drowning (1). In 2009, a 50-year-old male was doing flips on bounce equipment. He fell backward and suffered fatal head and neck injuries. In 2010, a 33-year-old female landed on her head and neck when jumping in a bounce house. In another deadly incident in 2010, a 2-year-old male suffocated in an inflatable bounce house after a 3-year-old girl unplugged the motor attached to the inflatable. In 2012, an 11-year-old male fell into a lake while playing in an inflatable bounce house that was offshore.

There were five deaths involving inflatable slides. In 2003, a 15-year-old male fell from an inflatable slide at a high school wellness event. He suffered a traumatic brain injury and died 4 days later. The slide was part of a larger obstacle course inflatable amusement. In 2004, an 18-year-old male fell from an inflatable slide at a high school prom party. He sustained a closed-head injury. There was no indication that the slide was part of a larger inflatable amusement. In 2008, a 28-year-old female was doing somersaults on an inflatable slide when she suffered a fatal blunt traumatic cervical spine injury. In 2010, a 2-year-old male was found floating face down in an in-ground swimming pool. It is believed that he fell down from an inflatable slide to the

swimming pool. One more fatal incident in 2010 involving an inflatable slide occurred when a 54-year-old male was struck by the large inflatable slide in a public place. The victim died of a pulmonary embolism.

One of the deaths involved an inflatable rock climbing wall. In 2005, a 24-year-old female fell 15 to 20 feet from an inflatable rock climbing wall at a music festival. Her legs and backside reportedly hit the inflatable base of the inflatable amusement, but then her upper body fell back and her head hit the surrounding pavement.

One death involved an inflatable "king of the hill" amusement. The amusement consisted of a rounded, inflated hill, surrounded by an inflated fence. Two adults who were playing in the amusement fell out of it through a gap in the surrounding inflated fence. They struck a 3-year-old male who was standing near the amusement, knocking him down. The child's head struck the floor, and he died as a result of his injuries.

The death that involved an unspecified inflatable amusement occurred in 2010. A 5-year-old male hit his head on concrete after falling from the unspecified inflatable amusement.

Appendix: Methodology

The National Electronic Injury Surveillance System (NEISS) is a probability sample of approximately 100 U.S. hospitals having 24-hour emergency departments (EDs) and more than six beds. NEISS collects injury data from these hospitals. Coders in each hospital code the data from the ED record and the data is then transmitted electronically to CPSC. Because NEISS is a probability sample, each case collected represents a number of cases (the case's *weight*) of the total estimate of injuries in the United States. Different hospitals carry different weights, based on stratification by their annual number of emergency department visits (Schroeder and Ault, 2001).

A coefficient of variation is the ratio of the standard error of the estimate (*i.e.*, variability) to the estimate itself. This is generally expressed as a percent. A C.V. of 10 percent means the standard error of the estimate equals 0.1 times the estimate. Large C.V.s alert the reader that the estimate has considerable variability. This is often due to a small sample size.[4] Estimates and confidence intervals are usually not reported, unless the number of cases is 20 or more, the estimate is greater than 1,200, and the C.V. is less than 33 percent.

Injury rates per million population are based on U.S. Census Bureau intercensal population estimates for the resident U.S. population. These were downloaded from http://www.census.gov/popest/national/.

[4] Schroeder T, Ault K. *The NEISS Sample (Design and Implementation)*. U.S. Consumer Product Safety Commission. 2001.

CPSC staff did a broad survey of the NEISS data and found potential inflatable amusement-related incidents in 10 different product codes. These 10 codes are listed in Table 8. These 10 product codes were searched for incidents containing one of the following keywords: air, balloon, blow, bounce, inflate, jump, or space. The words were shortened for the actual search to include different forms of words (such as inflated vs. inflatable) and observed misspellings of the words (such as "bouce house" or "mook walk"). Individual product code searches did not use words directly related to the product code (such as "balloon" for product code 1347: Balloons). The keywords excluded for each product code are also shown in Table 8.

This report is focused on amusements requiring continuous air pressure to maintain their form. However, there are similar, but smaller versions of these inflatable amusements that are inflated once and maintain their form by retaining the air from the initial inflation. These smaller versions were excluded as out of scope for the purposes of this report. Often there was not enough information in the data to determine whether the product involved used continuous air pressure. In general, indications of a larger product were assumed to be indicators of continuous air pressure. When there was no information about size, then home use of the product *for certain product codes* was assumed to be an indicator of smaller size, and thus lack of continuous air pressure. Whether home use was included for cases with no clear indication of size or inflation method is also included in Table 8.

Table 8: Product Codes with Possible Inflated Amusement-Related Incidents

Product Code	Description	Home Use Included	Keywords Excluded
1233	Trampolines	No	jump
1242	Slides or sliding boards (excluding swimming pool slides)	No	
1244	Monkey bars, playground gyms, or other playground climbing apparatus	No	
1258	Mountain climbing (activity, apparel, or equipment)	Yes	
1293	Amusement attractions	Yes	
1325	Inflatable toys	No	air, blow, inflate
1347	Balloons (toy)	No	air, balloon, blow, inflate
3219	Other playground equipment	Yes	
3277	Exercise equipment	Yes	jump
5004	Toys, other or not specified	No	

The definition of "inflatable amusement" and the methodology described in this section were developed by CPSC's Hazard Analysis staff, in conjunction with subject matter experts from Engineering Sciences, Health Sciences, Compliance, and the General Counsel's office.