

FIXED-SITE AMUSEMENT RIDE INJURY SURVEY, 2015 UPDATE

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Preface

This report presents the results of work done by the National Safety Council (NSC), Research and Statistical Services Group, under contract to the International Association of Amusement Parks and Attractions. It includes estimates by the Council for calendar years 2003 through 2015. The Council's work is an extension of, but independent of, the estimates made for 2001-2002 by Heiden Associates, which are included here for reference and reported more fully in the June/July 2003 issue of *Injury Insights* (Heiden & McGonegal, 2003).

FIXED-SITE AMUSEMENT RIDE INJURY SURVEY, 2015 UPDATE

Since 2001 the International Association of Amusement Parks and Attractions (IAAPA) has sponsored an annual survey to collect and analyze ride, attendance, and patron injury data from facilities that operate fixed-site amusement rides. The IAAPA survey was undertaken to gain perspective on fixed-site amusement ride injuries in the United States. The surveys include amusement and theme parks, tourist attractions, and family entertainment centers. The results of these surveys are presented below.

A total of 413 U.S. fixed-site amusement facilities were invited to participate in the 2015 survey of patron injuries. This total represents a 2% increase from the 405 facilities invited to participate the previous year and was the result of a detailed review of the IAAPA membership roster and market research activities conducted by IAAPA. All facilities received an initial survey packet and a follow-up postcard via mail, while non-respondents received an additional follow-up postcard and contact via email. In addition, IAAPA member facilities also received follow-up calls from IAAPA staff or board members urging participation. Facilities were asked to report attendance and ridership as well as the number of patron injuries. This survey process resulted in a total of 160 parks providing attendance-based data and 154 parks providing ridership-based data. Of these, 84 parks provided both attendance and ridership data. Compared to 2014, participation increased 9% among parks providing attendance data and 12% among parks providing ridership data (see "Survey Response" and "2003-2015 Methodology" below for more details). Parks participating in the 2015 study represent approximately 67% of total U.S. estimated attendance and 71% of the total estimated rides taken.

Separate attendance-based and ridership-based analyses were performed. Not all facilities were able to report both attendance and ridership and therefore there were differences in the selection of facilities used in each analysis. Table 1 presents the attendance-based estimates of ride related injuries for all U.S. parks compared to ridership-based estimates of ride related injuries for the period 2003-2015. The difference between the two injury estimates has varied from as little as four in 2014 to as much as 355 in 2007. In 2015, the attendance-based injury estimate of 1,502 was 6 injuries less than the ridership-based estimate of 1,508 injuries.

Table 1. Attendance-Based vs. Ridership-Based Injury Estimates, 2003-2015

Year	Attendance-Based		Ridership-Based		Difference between attendance-based and ridership-based injury count
	Estimated Annual Number of Ride-Related Injuries	Injuries per Million Attendance	Estimated Annual Number of Ride-Related Injuries	Injuries per Million Patron-Rides	
2003	2,044	7.0	1,954	1.0	+90
2004	1,637	5.2	1,648	0.9	-11
2005	1,783	5.2	1,713	0.9	+70
2006	1,797	6.6	1,546	0.9	+251
2007	1,664	4.6	1,309	0.7	+355
2008	1,523	4.7	1,343	0.8	+180
2009	1,181	4.4	1,086	0.6	+95
2010	1,299	4.4	1,207	0.7	+92
2011	1,204	4.3	1,415	0.8	-211
2012	1,424	4.6	1,347	0.9	+77
2013	1,356	4.7	1,221	0.9	+135
2014	1,150	3.8	1,146	0.7	+4
2015	1,502	4.8	1,508	0.8	-6

Source: National Safety Council estimates based on annual fixed-site amusement ride injury surveys.

Confidence intervals were developed for the estimated 2015 fixed-site amusement ride injury rates for parks in the United States. Confidence intervals were first developed separately for each park type. Composite confidence intervals for the attendance and ridership rates were then estimated through weighted averages. The confidence intervals along with exposure estimates were then used to estimate the likely range of injuries experienced in 2015. The confidence intervals provided below assume a Poisson distribution of the data instead of the normal bell-shaped curve often used in statistics. The Poisson distribution is used in the medical and epidemiological fields to model events, particularly uncommon events like injuries and illnesses. This distribution is not symmetric about its mean and so the associated confidence intervals are not symmetric (the upper limit is slightly farther from the estimate than is the lower limit). Comparing previous injury and rate estimates to this year’s confidence intervals shows that that the 2015 attendance-based injury count estimate is consistent with 2013, 2012, 2010, 2008, 2007, and 2004 estimates. The 2015 attendance-based rate estimate is consistent with all prior years except for 2014, 2006, and 2003. The 2015 ridership-based injury count estimate is consistent with all previous estimates except for 2014, 2013, 2010, 2009, and 2003. Finally, the 2015 ridership-based rate estimate is consistent with all previous estimates.

95% Confidence Intervals of Injury Rates and Counts Assuming a Poisson Distribution

	Attendance Based Estimates		Ridership Based Estimates	
	Injuries per Million Attendance	Injury Count	Injuries per Million Attendance	Injury Count
Upper Confidence Limit	5.5	1,757	1.0	1,751
Estimated Value	4.8	1,502	0.8	1,508
Lower Confidence Limit	4.2	1,288	0.7	1,300

Compared to 2014, the number of patron-injuries in 2015 increased. Attendance-based estimates show a 31% increase while ridership-based estimates show a 32% increase. However, because both attendance and ridership levels increased in 2015, the attendance-based injury rate increased 26% to 4.8 injuries per million attendees, while the ridership-based rate increased 14% to 0.8 per million riders. Figures 1 and 2 below illustrate the longer term injury and injury rate trends for both the attendance- and ridership-based estimates. As can be seen, both estimate procedures show marked decreases in the number of patron-injuries since 2003. However, ridership-based injury rates have demonstrated less improvement than have attendance-based rates. Attendance-based and ridership-based injury estimates also show the following differences:

Attendance-based:

- The estimated injury total and injury rate were up in 2015 compared to 2014 (1,502 vs. 1,150 injuries and 4.8 vs. 3.8 injuries per million attendees, respectively).
- Compared to 2003, the estimated number of injuries in 2015 was down 26%, while the injury rate per million attendees was down 31%.

Ridership-based:

- The estimated injury total was up 32% in 2015 compared to 2014 (1,508 vs. 1,146 injuries), while the injury rate per million patron-rides was up 14% (0.8 vs. 0.7).
- Compared to 2003, both the estimated number of injuries and the injury rate per million patron-rides in 2015 were down—by 23% and 20%, respectively.

Figure 1.

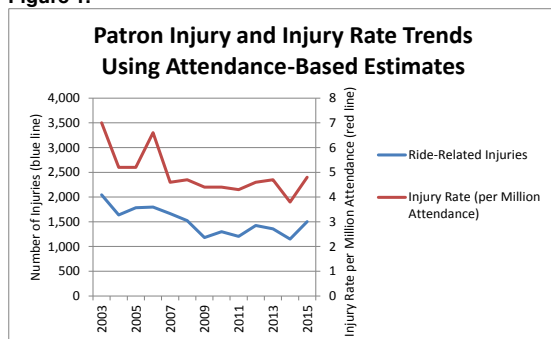
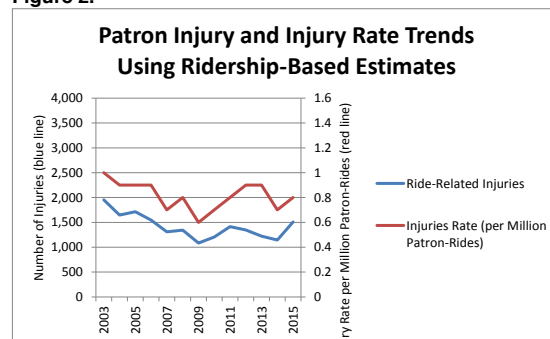


Figure 2.

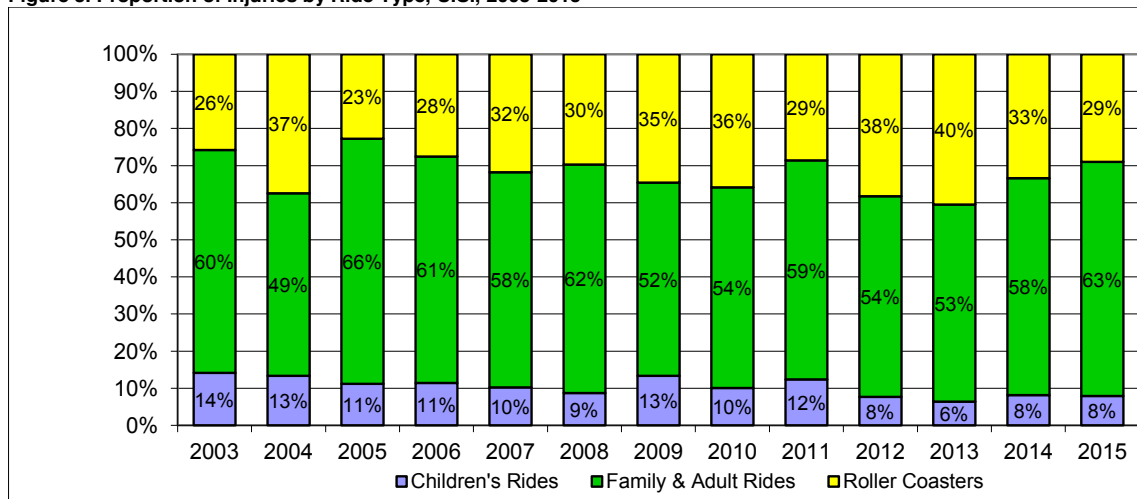


The distributions of injuries by ride type and injury severity for 2015 obtained from the ridership-based estimates were similar to the distributions obtained from the attendance-based for total injuries, serious injuries, and other injuries. The largest portion of injuries for both sets of estimates took place on family and adult rides, followed by roller coasters and children’s rides. However, the portion of injuries by injury severity on children’s rides for “other injuries” and “total injuries” was higher in the attendance-based analysis compared to the ridership-based analysis, while for family and adult rides the proportions were higher in the ridership-based analysis. For roller coasters, the proportion of other and total injuries was nearly identical in both analyses. For serious injuries, the portion of injuries on children’s rides was higher in the ridership-based analysis, while for roller coasters the portion was higher in the attendance-based analysis. For family and adult rides, the proportion of serious injuries was nearly identical in both analyses.

Ridership-based rates are perhaps a more appropriate measure of exposure to risk than attendance-based rates because injuries on rides are the outcome of interest. Parks with similar attendance may have much different ridership numbers because of differences in the number and kinds of amusement rides provided. **The results discussed in the remainder of the report are based on the ridership analysis, which is shown in Table 2 on pages 6-7.**

As shown in Figure 3, about 63% of the injuries in 2015 occurred on family and adult rides compared to 58% in 2014, 53% in 2013, and 54% in 2012. The overall number of injuries on family and adult rides in 2014 was up 42% compared to 2014, increasing from 670 to 952. The number of injuries on children’s rides increased from 94 in 2014 to 119 in 2015, but the overall proportion of injuries on children’s rides decreased 4% -- from 8.2% to 7.9%. The overall number of injuries on roller coasters increased from 383 in 2014 to 437 in 2015, an increase of 14.1%. The proportion of injuries on roller coasters also decreased from 33.4% of the injuries in 2014 to 29.0% of the injuries in 2015.

Figure 3. Proportion of Injuries by Ride Type, U.S., 2003-2015



Source: National Safety Council estimates based on annual fixed-site amusement ride injury surveys.

The overall injury rate increased from 0.73 injuries per million patron-rides in 2014 to 0.84 in 2015. The injury rate per million patron-rides in 2015 was 0.9 for family and adult rides, 1.0 for roller coasters, and 0.4 for children’s rides.

Total ride injuries are comprised of events involving getting in/out of the ride and those events resulting from ride motion. A secondary analysis was conducted to gain a better understanding of the prevalence of injuries resulting from ride motion events. The 1.0 per million injury rate on roller coasters decreases to 0.8 per million rides when counting only those incidents due to ride motion. The overall 0.9 per million injury rate for family and adult rides decreases to 0.6 per million rides due to ride motion, and the 0.4 per million injury rate for children’s rides decreases to 0.2 per million rides due to ride motion.

About 5.5% of the injuries were reported to be “serious,” meaning an injury resulting in immediate admission and hospitalization in excess of 24 hours for purposes other than medical observation. The remaining 94.5% were reportable injuries that were other than serious. The proportion of injuries that were serious in 2015 was down about 43% from the proportion in

2014 and was the lowest since 2011 when it was at 4.3%. The rate of serious injuries per million patron-rides was 0.05 in 2015—a decrease of 29% from 2014.

Table 2. Summary of Estimated Fixed-Site Amusement Ride-Related Injuries, U.S., 2003-2015 (based on ridership)

Year	Characteristic	Injuries by Ride Type				Injuries by Severity		
		Total	Children's Rides	Family and Adult Rides	Roller Coasters	Total	Serious Injuries	Other Reportable Injuries
2003	Estimated Number of Injuries	1,954	277	1,173	504	1,954	106	1,848
	Percent	100.0%	14.2	60.1	25.8	100.0%	5.4	94.6
	Injuries per Million Patron-rides	1.0	1.2	1.0	1.0	1.0	0.1	1.0
2004	Estimated Number of Injuries	1,648	219	806	613	1,648	132	1,516
	Percent	100.0%	13.3	49.5	37.2	100.0%	8.0	92.0
	Injuries per Million Patron-rides	0.9	1.0	0.8	1.2	0.9	0.1	0.8
2005	Estimated Number of Injuries	1,713	192	1,131	390	1,713	132	1,582
	Percent	100.0%	11.2	66.0	22.8	100.0%	7.7	92.3
	Injuries per Million Patron-rides	0.9	0.8	1.0	0.9	0.9	0.1	0.9
2006	Estimated Number of Injuries	1,546	177	943	426	1,546	135	1,411
	Percent	100.0%	11.4	61.0	27.6	100.0%	8.7	91.3
	Injuries per Million Patron-rides	0.9	0.7	0.9	1.0	0.9	0.1	0.8
2007	Estimated Number of Injuries	1,309	134	759	416	1,309	35	1,274
	Percent	100.0%	10.2	58.0	31.8	100.0%	2.7	97.3
	Injuries per Million Patron-rides	0.7	0.5	0.7	0.9	0.7	0.02	0.7
2008	Estimated Number of Injuries	1,343	117	827	399	1,343	80	1,264
	Percent	100.0%	8.7	61.5	29.7	100.0%	5.9	94.1
	Injuries per Million Patron-rides	0.8	0.6	0.8	1.0	0.8	0.05	0.7
2009	Estimated Number of Injuries	1,086	145	565	375	1,086	65	1,021
	Percent	100.0%	13.4	52.1	34.5	100.0%	6.0	94.0
	Injuries per Million Patron-rides	0.6	0.6	0.5	0.9	0.6	0.04	0.6
2010	Estimated Number of Injuries	1,207	122	652	433	1,207	59	1,148
	Percent	100.0%	10.1	54.0	35.9	100.0%	4.9	95.1
	Injuries per Million Patron-rides	0.7	0.5	0.6	1.0	0.7	0.03	0.7
2011	Estimated Number of Injuries	1,415	175	836	405	1,415	61	1,355
	Percent	100.0%	12.3	59.0	28.6	100.0%	4.3	95.7
	Injuries per Million Patron-rides	0.8	1.0	0.8	1.0	0.8	0.04	0.8
2012	Estimated Number of Injuries	1,347	104	728	515	1,347	91	1,256
	Percent	100.0%	7.7	54.1	38.2	100.0%	6.8	93.2
	Injuries per Million Patron-rides	0.9	0.5	0.8	1.5	0.9	0.06	0.8
2013	Estimated Number of Injuries	1,221	78	649	494	1,221	84	1,137
	Percent	100.0%	6.4	53.1	40.5	100.0%	6.9	93.1
	Injuries per Million Patron-rides	0.9	0.5	0.8	1.5	0.9	0.06	0.8

Year	Characteristic	Injuries by Ride Type				Injuries by Severity		
		Total	Children's Rides	Family and Adult Rides	Roller Coasters	Total	Serious Injuries	Other Reportable Injuries
2014	Estimated Number of Injuries	1,146	94	670	383	1,146	111	1,036
	Percent	100.0%	8.2	58.4	33.4	100.0%	9.6	90.4
	Injuries per Million Patron-rides	0.7	0.4	0.7	1.0	0.7	0.07	0.7
	Getting In/Out	0.3	0.3	0.3	0.2	0.3	0.01	0.2
	Ride Motion	0.5	0.1	0.4	0.8	0.5	0.06	0.4
2015	Estimated Number of Injuries	1,508	119	952	437	1,508	82	1,425
	Percent	100.0%	7.9	63.1	29.0	100.0%	5.5	94.5
	Injuries per Million Patron-rides	0.8	0.4	0.9	1.0	0.8	0.05	0.8
	Getting In/Out	0.2	0.2	0.3	0.2	0.2	<0.005	0.3
	Ride Motion	0.6	0.2	0.6	0.8	0.6	0.05	0.5

Source: National Safety Council estimates based on annual fixed-site amusement ride injury surveys.

Note: Totals may not equal sum of parts due to rounding.

Survey Response

Of the 413 eligible facilities with rides in 2015, a total of 170 provided some or all of the data requested (43 provided attendance data only, 37 provided ridership data only, 84 provided both attendance and ridership data, and 6 provided injury data only). The overall total for 2015 represents a 10% decrease from the previous year. The respondents used in the analyses represented about 67.0% of the estimated total annual attendance and 71.5% of the estimated total rides taken at all facilities.

The table below summarizes the number of facilities whose data were used for the attendance-based and ridership-based estimates from 2004-2015. The number of facilities used for the attendance-based estimate matched the historical high of 2013 at 160, while the number of facilities used for the ridership-based estimate exceeded the previous 2013 high by 5% at 154. It was impractical to find a single set of facilities that reported all data (attendance, ridership, and injuries) for all years as that would have reduced the reliability of the estimates.

Table 3. Number of facilities included in estimates

Year	Number of facilities used for injury estimates	
	Attendance-based	Ridership-based
2004	124	99
2005	117	90
2006	124	97
2007	125	104
2008	153	134
2009	113	105
2010	104	96
2011	117	100
2012	143	126
2013	160	147
2014	147	137
2015	160	154

National Attendance and Ridership Estimates

Based on IAAPA membership data as well as on going NSC surveillance, it is estimated that 413 facilities were in operation at the end of 2015 (see Table 4). Total U.S. attendance and ridership is estimated by inflating the reported attendance figures by the ratio of the total number of U.S. facilities to the number reporting and calculating average rides per guest figures. Using this method, it is estimated that 367.1 million people visited U.S. facilities with fixed site amusement rides and approximately 1.79 billion rides were taken in 2015.

Table 4. Estimated Number of U.S. Fixed-Site Amusement Parks with Rides, Attendance and Ridership

Year	Estimated Number of Facilities w/Rides in the U.S.	Estimated Annual Attendance (millions)	Estimated Annual Ridership (billions)
2001-2002	459	302.9	---
2003*	403	300.4	1.95
2004	403	300.0	1.81
2005	398	300.4	1.82
2006	395	291.7	1.76
2007	395	292.1	1.78
2008	422	291.2	1.70
2009	398	278.4	1.69
2010	386	290.1	1.70
2011	383	297.4	1.69
2012	373	324.1	1.51
2013	357	315.2	1.38
2014	405	366.9	1.57
2015	413	367.1	1.79

Source: 2001-2002, Heiden & McGonegal (2003). 2003-2015, National Safety Council estimates based on fixed-site amusement ride injury surveys.

*Changes in the estimating method beginning with 2003 affect comparability with the 2001-2002 survey.

2003-2015 Methodology

The National Safety Council conducted the survey using a master list of amusement/theme parks, family entertainment centers, and tourist attractions thought to have fixed-site rides. The original master list was prepared in consultation with IAAPA and Amusement Industry Consulting, Inc. A revised list of member and nonmember parks was provided this year by IAAPA. Additional parks thought to have rides that were on the previous park list were added to the IAAPA-provided list in order to have the most complete universe of parks. The survey consisted of a notification letter, a package of reporting information mailed one week later, a follow-up postcard mailed one week after the reporting package, and a final follow-up postcard mailed at the end of the response period. An additional follow-up to all non-respondents was conducted via e-mail. After the mailings and electronic follow-up, IAAPA volunteers made follow-up telephone calls and sent e-mails to non-responding IAAPA member facilities. Injury rates based on the reporting facilities were used to estimate national totals. (See also “Survey Response” above.)

2001-2002 Methodology

In 2001 and 2002 IAAPA mailed survey questionnaires to members previously identified as having fixed-site amusement rides. IAAPA retained Heiden Associates, Washington, DC, to analyze the survey results. Using the IAAPA survey results and other data, Heiden Associates estimated the number of U.S. facilities with one or more fixed-site amusement rides and the injury totals and rates.

References

Heiden, E.J., & McGonegal, S. (2003). 2001-2002 fixed-site amusement ride injury survey analysis. *Injury Insights*, June/July 2003.