

**NORTH AMERICA FIXED-SITE AMUSEMENT RIDE INJURY SURVEY,
2021 UPDATE**

**Prepared for
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Orlando, FL**

by



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Preface

This report presents the results of work done by the National Safety Council (NSC), under contract to the International Association of Amusement Parks and Attractions (IAAPA). It includes estimates by NSC for calendar years 2003 through 2021.

NORTH AMERICA FIXED-SITE AMUSEMENT RIDE INJURY SURVEY – 2021

Introduction

Since 2003, the International Association of Amusement Parks and Attractions (IAAPA) has sponsored an annual survey conducted by the National Safety Council (NSC) to collect and analyze ride, attendance, and patron injury data from facilities that operate fixed-site amusement rides. The IAAPA survey was originally undertaken to gain perspective on fixed-site amusement ride injuries in the United States. Beginning with the 2016 data year, IAAPA members in Canada were also asked to complete the ride injury survey. Because of the relatively small number of amusement facilities with fixed-site rides in Canada and their high percentage of IAAPA membership, this change effectively expanded the coverage of the data collection from the United States to all of North America. The surveys include amusement and theme parks, tourist attractions, and family entertainment centers. The results of these surveys follow.

2021 Results

A total of 484 U.S. and Canadian fixed-site amusement facilities were invited to participate in the 2021 survey of patron injuries. All facilities received an initial email survey packet in November 2021, while non-respondents received additional follow-up monthly emails through June 2022. Seasonal parks were asked to report after their operations ended for the year while year-around parks were asked to report at the end of the calendar year. IAAPA member facilities also received follow-up requests from IAAPA staff urging participation. Respondents had the option of completing the ride injury survey online or returning the completed paper version of the survey form. Facilities were asked to report attendance and ridership, as well as the number of patron injuries. A total of 238 facilities responded to the survey. Of the responses:

- 179 provided some or all of the data requested
- 48 reported having no rides or provided unusable data
- 5 reported to be closed
- 6 were unable to report either attendance or number of rides taken counts

Survey responses have recovered strongly from 2020. Because of the COVID-19 pandemic impact to the amusement industry, the number of parks providing data decreased 18% compared to 2019. Current 2021 park participation increased 47% from 2020, and 20% compared to pre-pandemic 2019. This year's survey resulted in a total of

162 parks providing attendance-based data and 150 parks providing ridership-based data. Of these, 133 parks provided both attendance and ridership data. Compared to 2020, participation increased 43% among parks providing attendance data and 95% among parks providing ridership data (see “Survey Response” and “Methodology” in this report for more details). Parks participating in the 2021 study represent approximately 52% of total North American estimated attendance and 59% of the total estimated rides taken. The majority of responding facilities are IAAPA members, with 167 (93%) coming from IAAPA members and 12 (7%) from non-members.

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 North American parks compared to ridership-based estimates of ride-related injuries for the period 2003-2021. The difference between the two injury estimates has varied from as little as 4 in 2014 to as much as 355 in 2007. In 2021, the attendance-based injury estimate of 1,281 was 57 injuries more than the ridership-based estimate of 1,224 injuries.

Table 1. Attendance-Based vs. Ridership-Based Injury Estimates, 2003-2021

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
2016*	1,197	3.9	1,253	0.8	-56
2017	1,171	3.9	1,035	0.6	+136
2018	1,256	3.7	1,289	0.8	-33
2019	1,299	3.7	1,294	0.8	5
2020**	314	2.5	341	0.6	-27
2021	1,281	3.7	1,224	0.9	+57

Source: NSC estimates based on annual fixed-site amusement ride injury surveys.

*Beginning in 2016, the ride injury survey was expanded to include both U.S. and Canadian facilities.

**Because of the COVID-19 pandemic the number of operating parks decreased, while many of the parks that did operate in 2020 did so with restricted capacity. Because of the unprecedented impact to the industry, the number of estimated injuries is down sharply. Comparison to other years is not recommended.

Confidence intervals were developed for the estimated 2021 fixed-site amusement ride injury rates for parks in North America and are presented in Table 2. 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 2021. The confidence intervals presented assume a Poisson distribution of the data instead of the normal bell-shaped curve often used in statistics. The Poisson distribution is commonly used in the medical and epidemiological fields to model events, particularly uncommon events like injuries and illnesses. Because of the industry disruptions caused by the COVID-19 pandemic in 2020, comparing 2020 to other years is not recommended. The following discussion does not include the 2020 data year. The attendance-based estimates show that the number of injuries in 2021 is statistically lower than in 2015 and from 2003 through

2008. Similarly, the 2021 attendance-based injury rate is statistically lower than in 2015 and from 2003 through 2013. The ridership-based estimates show that the number of injuries in 2021 is statistically lower than in 2015 and from 2003 through 2006. The 2021 ridership-based injury rate is statistically equivalent to the rates in 2019, 2018, 2016, 2015, from 2011 to 2013, 2008, and from 2003 to 2006. However, the 2021 ridership-based injury rate is statistically higher than the rates in 2017, 2014, 2010, 2009, and 2007.

Table 2. 95% Confidence Intervals of Injury Rates and Counts Assuming a Poisson Distribution, 2021

	Attendance Based Estimates		Ridership Based Estimates	
	Injuries per Million Attendance	Injury Count	Injuries per Million Attendance	Injury Count
Upper Confidence Limit	4.3	1,474	1.1	1,411
Estimated Value	3.7	1,280	0.9	1,224
Lower Confidence Limit	3.1	1,120	0.8	1,077

Compared to pre-pandemic 2019, the number of patron injuries in 2021 remained relatively stable. Attendance-based estimates show a 1% decrease, while ridership-based estimates show a 5% decrease. The injury rates also changed little from 2019. The attendance based injury rate remained unchanged at 3.7, while the ridership based rate increased from 0.8 to 0.9. Figures 1 through 4 illustrate the longer-term injury and injury rate trends for both the attendance- and ridership-based estimates. As can be seen, both estimating procedures show marked decreases in the number and rate of patron injuries since 2003.

Figure 1. Patron Injury Trend Using Attendance-Based Estimates*

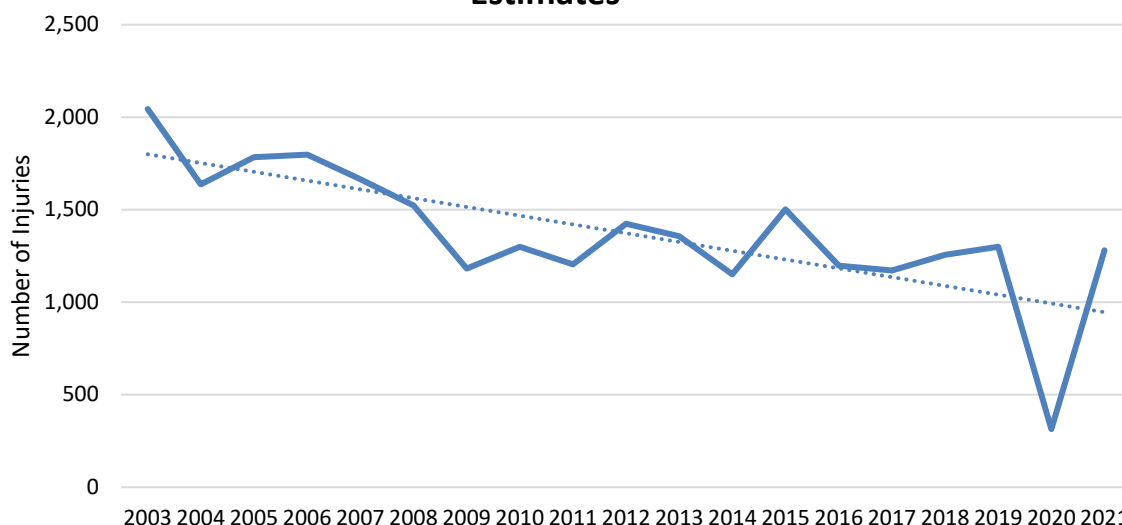


Figure 1 shows the long-term injury count trend as estimated using the attendance-based data. The downward sloping dashed trend line clearly indicates improvement. From 2003 to 2021 injuries have decreased 37% from 2,044 to 1,281 injuries.

Figure 2. Patron Injury Rate Trend Using Attendance-Based Estimates*

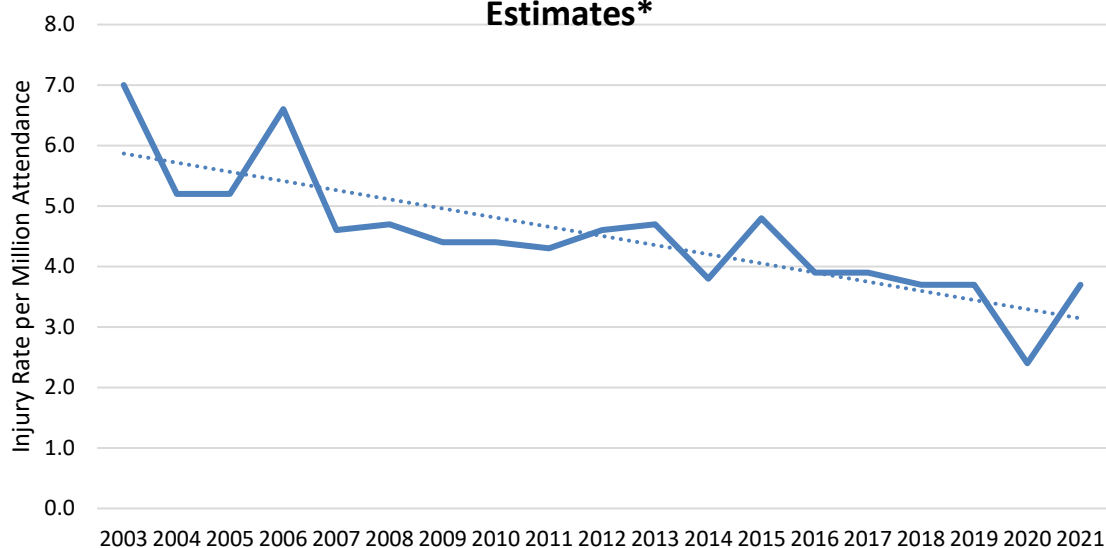


Figure 2 shows the long-term injury rate per million attendance trend. The downward sloping dashed trend line clearly indicates improvement. From 2003 to 2021, the injury rate per million attendance has decreased 47%, from 7.0 to 3.7 injuries per million attendance.

Figure 3. Patron Injury Trend Using Ridership-Based Estimates*

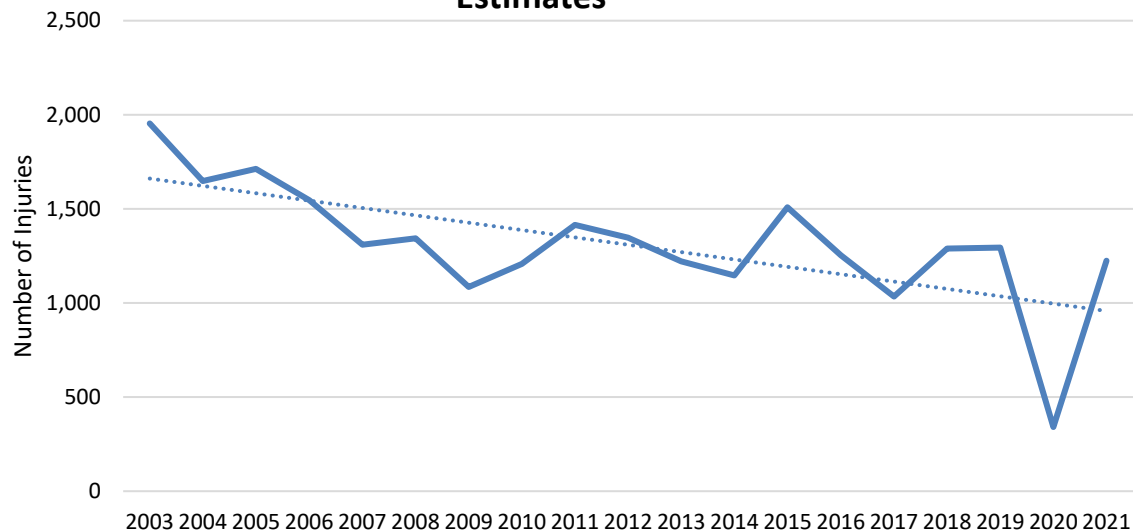
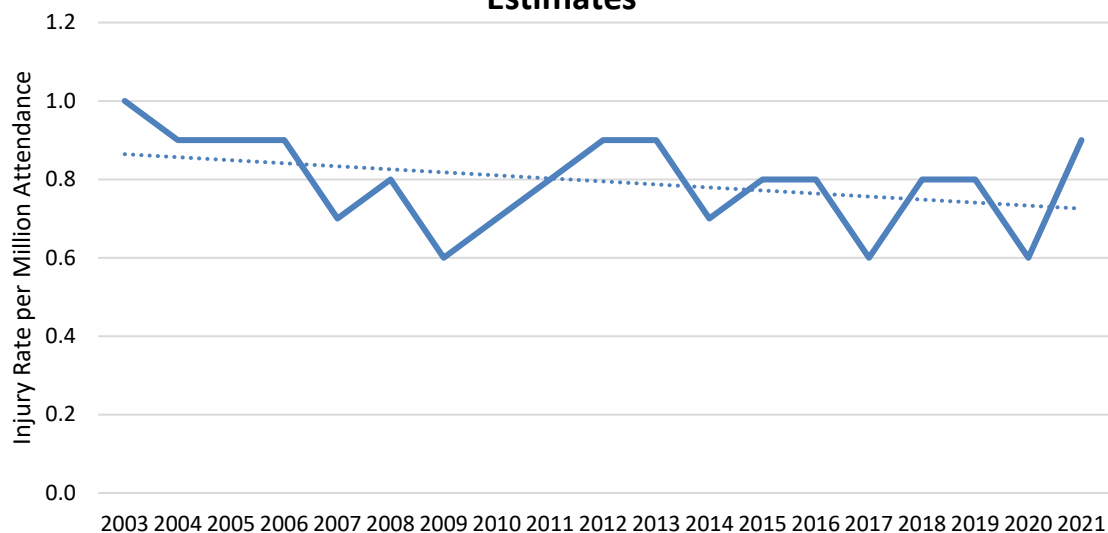


Figure 3 shows the long-term injury count trend as estimated using the ridership-based data. The downward sloping dashed trend line clearly indicates improvement. From 2003 to 2021 injuries have decreased 37%, from 1,954 to 1,224 injuries.

Figure 4. Patron Injury Rate Trend Using Attendance-Based Estimates*



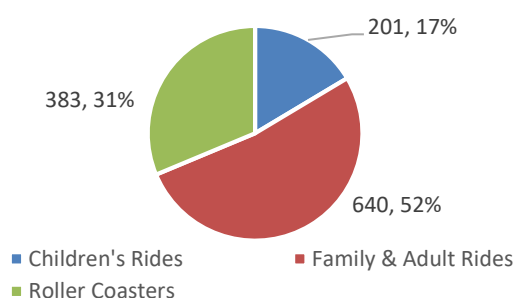
*In 2016, the survey was expanded to include both U.S. and Canadian facilities.

Figure 4 shows the long-term injury rate per million rides taken trend. The downward sloping dashed trend line indicates improvement. From 2003 to 2021, the injury rate per million rides taken has decreased 10%, from 1.0 to 0.9 injuries per million rides taken.

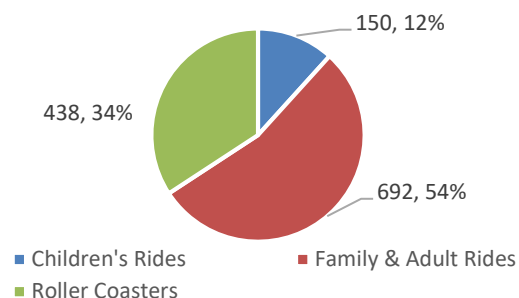
The distributions of injuries by ride type and injury severity for 2021 obtained from the ridership-based estimates were similar to the distributions obtained from the attendance-based analysis for total injuries, serious injuries, and other injuries. The largest portion of injuries for both sets of estimates took place on family and adult rides, followed by roller coasters and children's rides (Figures 5 and 6). Both estimate methods also calculated very similar percentages of serious injuries. The ridership-based method estimates that 11% of all injuries were serious, while the attendance-based estimate calculates 13% (Figures 7 and 8).

Figures 5 and 6

Distribution of Injuries by Ride Type
Ridership-Based Estimate

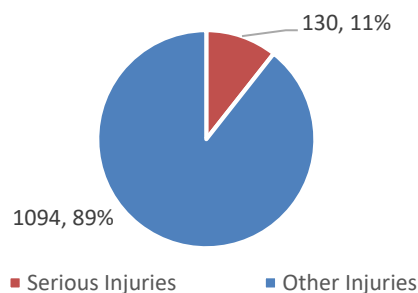


Distribution of Injuries by Ride Type
Attendance-Based Estimate

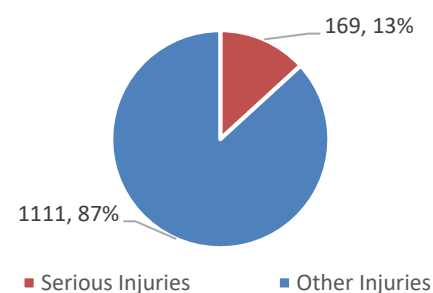


Figures 7 and 8

Distribution of Injury Severity
Ridership-Based Estimate



Distribution of Injury Severity
Attendance-Based Estimate



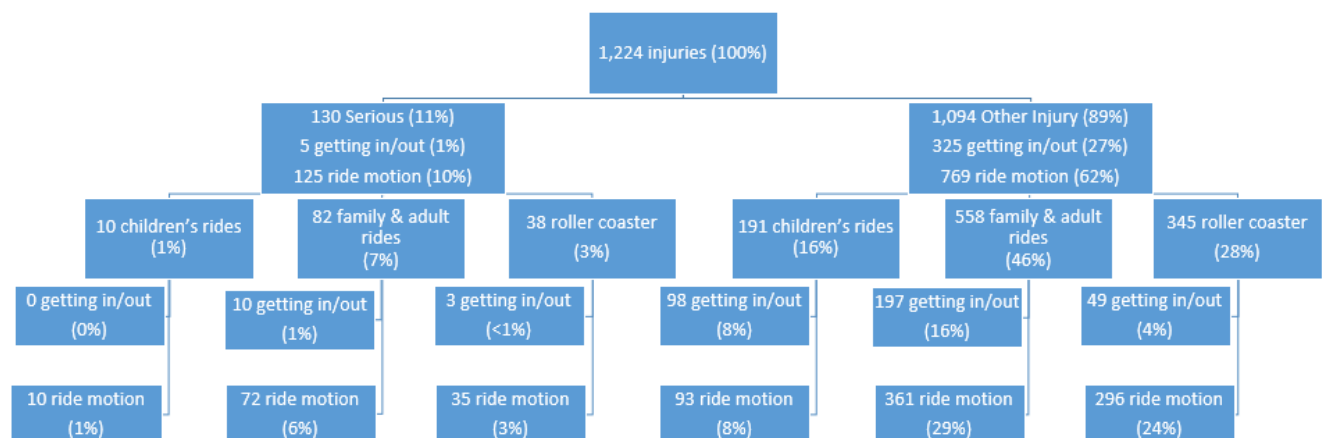
Ridership Analysis

Ridership-based rates are 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 next reflect the ridership analysis.**

Distribution of Injuries in 2021

Figure 9 summarizes the 2021 distribution of injuries in terms of severity, ride type, and location of the incident. A total of 1,224 injuries were estimated to have occurred on rides in 2021. About 11% 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 or resulted in a fatality). The remaining 89% were reportable injuries that were other than serious, but required medical treatment beyond ordinary first aid. The proportion of injuries that were serious in 2021 was down from 16% in 2020, but up from 6% in 2019. The majority of serious injuries occurred on either family and adult rides or roller coasters. The majority of other injuries also occurred on family and adult rides, followed by roller coasters. The majority of children’s ride injuries were other non-serious injuries. Most family and adult ride injuries, as well as roller coaster injuries, resulted from ride motion. In contrast, the children’s ride injuries were nearly evenly split between ride motion and getting in/out of the ride. In previous years, the majority of child injuries have related to getting in/out of the ride.

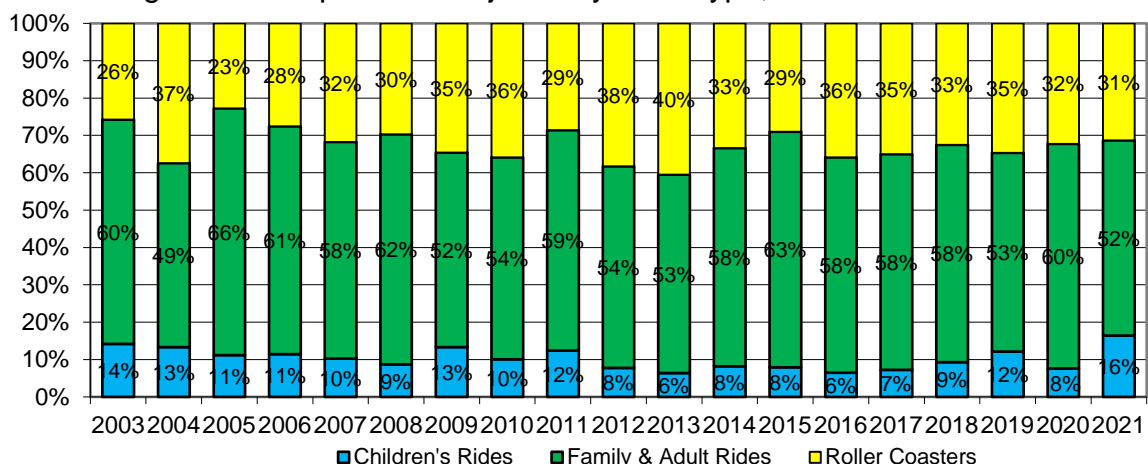
Figure 9. Distribution of ridership-based injuries by severity, ride type, and location, 2021



Historical Distribution of Injuries by Ride Type, 2003-2021

As shown in Figure 10, the proportion of injuries occurring on children’s rides increased compared to previous years. In 2021, 16% of the reported injuries occurred on children’s rides compares to 8% in 2020, 12% in 2019, and 9% in 2018. Overall in 2021, about 52% of the injuries occurred on family and adult rides, 31% on roller coasters, and 16% on children’s rides.

Figure 10. Proportion of Injuries by Ride Type, 2003- 2021*



*In 2016, the survey was expanded to include both U.S. and Canadian facilities.

Injury Rates

The overall injury rate increased from 0.8 to 0.9 injuries per million patron rides in both 2018 and 2019. Because of the industry disruptions caused by the COVID-19 pandemic in 2020, it is not recommended to compare against 2020 results. The injury rate per million patron rides in 2021 was 0.7 for family and adult rides, 0.9 for children's rides, and 1.4 for roller coasters.

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 0.9 per million injury rate on children's rides decreases to 0.4 per million rides when counting only those incidents due to ride motion. The overall 1.4 per million injury rate for roller coasters decreases to 1.2 per million rides due to ride motion, and the 0.7 per million injury rate for family and adult rides decreases to 0.4 per million rides due to ride motion. See Table 3 for historic data on injury counts and rates by ride type and injury severity.

About 11% 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 or resulted in a fatality). The remaining 89% were reportable injuries that were other than serious. The proportion of injuries that were serious in 2021 was down from 16% in 2020, but up from 6% in 2019.

Table 3. Summary of Estimated Fixed-Site Amusement Ride-Related Injuries, 2003-2021 (Ridership-based estimates)

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
	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

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	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
2016	Estimated Number of Injuries	1,253	81	723	450	1,253	107	1,146
	Percent	100.0%	6.5	57.7	35.9	100.0%	8.5	91.5
	Injuries per Million Patron rides	0.8	0.4	0.7	0.9	0.8	0.06	0.7
	Getting In/Out	0.3	0.2	0.3	0.1	0.3	0.01	0.2
	Ride Motion	0.5	0.2	0.4	0.8	0.5	0.04	0.5
2017	Estimated Number of Injuries	1,035	75	598	355	1,035	100	935
	Percent	100.0%	7.3	57.8	34.9	100.0%	9.7	90.3
	Injuries per Million Patron rides	0.6	0.4	0.6	0.9	0.6	0.06	0.6
	Getting In/Out	0.2	0.2	0.2	0.2	0.2	0.01	0.2
	Ride Motion	0.4	0.2	0.4	0.7	0.4	0.06	0.4
2018	Estimated Number of Injuries	1,289	120	751	419	1,289	141	1,149
	Percent	100.0%	9.3	58.2	32.5	100.0%	10.9	89.1
	Injuries per Million Patron rides	0.8	0.6	0.7	1.2	0.8	0.08	0.7
	Getting In/Out	0.3	0.4	0.3	0.3	0.3	0.03	0.3
	Ride Motion	0.5	0.2	0.4	0.9	0.5	0.05	0.4
2019	Estimated Number of Injuries	1,294	157	688	449	1,294	82	1,212
	Percent	100.0%	12.1	53.2	34.7	100.0%	6.3	93.7
	Injuries per Million Patron rides	0.8	0.8	0.6	1.3	0.8	0.05	0.7
	Getting In/Out	0.4	0.5	0.3	0.5	0.4	0.02	0.3
	Ride Motion	0.4	0.3	0.3	0.8	0.4	0.03	0.4
2020	Estimated Number of Injuries	341	26	205	110	341	55	286
	Percent	100.0%	7.6	60.1	32.3	100.0%	16.1	83.9
	Injuries per Million Patron rides	0.6	1.0	.5	.9	0.6	0.1	0.5
	Getting In/Out	0.2	0.9	0.2	0.2	0.2	0.01	0.2
	Ride Motion	0.4	0.1	0.3	0.7	0.4	0.09	0.3
2021	Estimated Number of Injuries	1,224	201	640	383	1,224	130	1,094
	Percent	100.0%	16.5	52.2	31.3	100.0%	10.6	89.4
	Injuries per Million Patron rides	0.9	0.9	0.7	1.4	0.9	0.1	0.8
	Getting In/Out	0.3	0.5	0.3	0.2	0.3	0.02	0.03
	Ride Motion	0.6	0.4	0.4	1.2	0.6	0.08	0.05

Survey Response

An estimated 431 facilities with rides operated in 2021. Of these facilities, 179 provided some or all of the data requested (162 provided attendance data, 150 provided ridership data, and 133 provided both attendance and ridership data). An additional 59 facilities responded to the survey, but were unable to provide usable data for the analysis.

Compared to 2020, participation increased 43% among parks providing attendance data and 95% among parks providing ridership data. The majority of responding facilities are IAAPA members, with 167 (93%) coming from IAAPA members and 12 (7%) from non-members.

Table 4 summarizes the number of facilities whose data were used for the attendance-based and ridership-based estimates from 2004-2021. As noted above, park participation in 2020 was sharply down compared to other years because of the COVID-19 pandemic. Fully 21% of responding parks reported not operating at all in 2020. Participation in 2021 fully recovered and surpassed pre-pandemic levels. Compared to 2019, parks providing attendance data increased 9%, while parks providing ridership data increased 14%. It was impractical to find a single set of facilities that reported all data (attendance, ridership, and injuries) as that would have reduced the number of parks included to 133 (the number of parks providing all requested data), resulting in less reliable and valid estimates.

Table 4. 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
2016*	184	175
2017	171	171
2018	155	151
2019	149	131
2020**	113	77
2021	162	150

*Survey expanded to include both U.S. and Canadian facilities.

** Participation in the 2020 survey was negatively impacted by the amusement industry disruptions resulting from the COVID-19 pandemic

Attendance and Ridership Estimates

Both attendance and ridership was negatively impacted in 2020 by the COVID-19 pandemic. Based on IAAPA membership data, as well as survey results, it is estimated that the number of facilities with rides decreased 21% from 436 in 2019 to 346 facilities in 2020 (see Table 5). In addition, the parks that did operate in 2020 did so with reduced capacity. It is estimated that average attendance at operating parks decreased 68%, while number of rides taken decreased by 59%. The combination of these factors resulted in an overall 71% reduction in attendance and a 67% reduction in rides taken.

2021 attendance and ridership has rebounded strongly from 2020, but are still below pre-pandemic 2019 levels. Compared to 2020, attendance has increased 166% and ridership 137%. However, 2021 estimated attendance is still down 24% compared to 2019 and ridership is down 22%.

Table 5. Estimated Number of Fixed-Site Amusement Parks with Rides, Attendance, and Ridership

Year	Estimated Number of Facilities w/Rides in the N.A.	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
2016*	411	383.9	1.68
2017	383	368.6	1.66
2018	421	391.6	1.66
2019	436	399.5	1.67
2020**	346	178.8	0.55
2021	431	303.8	1.30

Source: 2001-2002, Heiden, E.J., & McGonegal, S. (2003). 2001-2002 fixed-site amusement ride injury survey analysis. Injury Insights, June/July 2003. 2003-2020, 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. In 2016, the survey was expanded to include both U.S. and Canadian facilities.

** 2020, the number of operating facilities as well as overall attendance and ridership decreased sharply because of the COVID-19 pandemic.

Methodology

NSC conducted the survey using a master list of amusement/theme parks, family entertainment centers, and tourist attractions thought to have fixed-site rides. The master list is the product of a list of member and non-member parks provided by IAAPA. Additional parks thought to have rides that were on the park list in previous years were added to the IAAPA-provided list in order to have the most complete number of parks. The survey consisted of a notification email that included a link to the survey as well as instructions and FAQs. One week later, a follow-up email was sent to all non-respondents. Follow-up emails were then sent monthly for the duration of the data collection period to all non-respondents. IAAPA staff also contacted select members with multiple locations to further increase the response rate. Injury rates based on the reporting facilities were used to estimate national totals. (See also “Survey Response” in this report.)

The total number of parks in North America with rides was estimated by adjusting the total number of parks (with or without rides) as estimated by Euromonitor Consulting by the percentage of IAAPA member parks with rides.