

IAAPA NORTH AMERICAN RIDE SAFETY REPORT – 2020

**Prepared for
International Association of Amusement Parks and Attractions
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 2020.

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Introduction

Since 2001 the International Association of Amusement Parks and Attractions (IAAPA) has sponsored an annual survey conducted by the National Safety Council (NSC) since 2003 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 are presented below.

2020 Results

A total of 436 U.S. and Canadian fixed-site amusement facilities were invited to participate in the 2020 survey of patron injuries. This total was comprised of 326 IAAPA member facilities and 110 non-member facilities. All facilities received an initial email survey packet and a follow-up, while non-respondents received additional follow-up emails. 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 162 facilities responded to the survey. Of the responses:

- 122 provided some or all of the data requested,
- 29 reported not operating in 2020 because of the COVID-19 pandemic,
- 11 reported having no rides or provided unusable data.

Because of the COVID-19 pandemic impact to the amusement industry, the number of facilities responding to this survey decreased substantially in 2020. From survey responses it is estimated that fully 21% of the parks did not operate at all in 2020, while others operated at reduced capacity. This year's survey resulted in a total of 113 parks providing attendance-based data and 77 parks providing ridership-based data. Of these, 68 parks provided both attendance and ridership data. Compared to 2019, participation decreased 26% among parks providing attendance data and 41% among parks providing ridership data (see "Survey Response" and "Methodology" in this report for more details). Parks participating in the 2020 study represent approximately 33% of

total North American estimated attendance and 46% of the total estimated rides taken. Because the percentage of participating parks participating in 2020 is relatively low (below 50%), the injury estimates made from the sample data should be interpreted with caution. The majority of responding facilities are IAAPA members, with 155 (96%) coming from IAAPA members and 7 (4%) from non-members. The member response represents 48% of all North American IAAPA members with rides.

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 2003-2020. The difference between the two injury estimates has varied from as little as 4 in 2014 to as much as 355 in 2007. In 2020, the attendance-based injury estimate of 314 was 27 injuries less than the ridership-based estimate of 341 injuries. Because of the COVID-19 pandemic the number of operating parks in 2020 decreased while many of the remaining parks operated at restricted capacity. This unprecedented impact to the industry resulted in a sharp decrease in the number of estimated injuries in 2020 from previous years. Because of the added uncertainty caused by the pandemic, comparisons of 2020 results to previous years should be made with caution.

Table 1. Attendance-Based vs. Ridership-Based Injury Estimates, 2003-2020

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

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	
2019	1,299	3.7	1,294	0.8	5
2020**	314	2.5	341	0.6	-27

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 previous years should be made with caution.

Confidence intervals were developed for the estimated 2020 fixed-site amusement ride injury rates for parks in the 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 2020. 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. 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). Because fewer parks operated in 2020 compared to previous years it is not surprising that significantly fewer injuries occurred in 2020 than in any previous year. Because of the disruption to the amusement industry in 2020, comparisons will focus on injury rates that help to control for the year to year changes in attendance and ridership. Comparing previous attendance rate estimates to the 2020 confidence intervals shows that the 2020 attendance-based injury rate estimate is significantly lower than in any previous year measured. Although the ridership-based injury rate also decreased in 2020, the 2020 confidence interval indicates that the decrease is not significant compared to rates measured since 2004.

Table 2. 95% Confidence Intervals of Injury Rates and Counts Assuming a Poisson Distribution, 2020

	Attendance Based Estimates		Ridership Based Estimates	
	Injuries per Million Attendance	Injury Count	Injuries per Million Attendance	Injury Count
Upper Confidence Limit	3.51	450	0.92	507
Estimated Value	2.44	314	0.62	341
Lower Confidence Limit	1.75	227	0.44	244

Compared to 2019, the number of patron injuries in 2020 decreased significantly. Attendance-based estimates show a 76% decrease, while ridership-based estimates

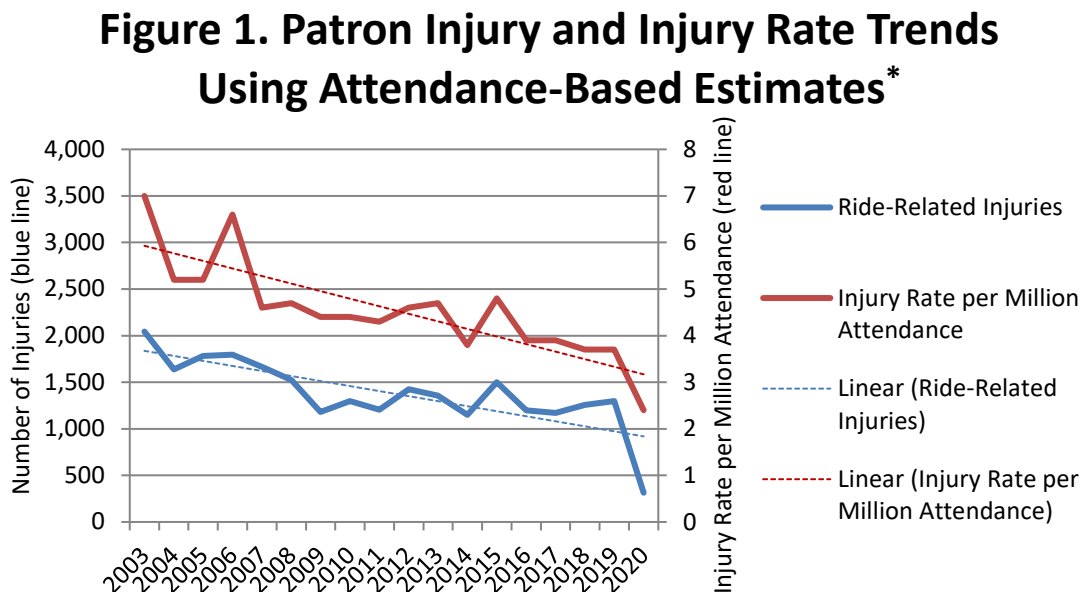
show a 74% decrease. However, with observed attendance also decreasing 71%, the attendance-based injury rate decreased at a slower pace of 34% (see the Attendance and Ridership Estimates section for more details). Similar to attendance, ridership is estimated to have decreased 67% in 2020. With a 74% decrease in injuries combined with a 67% decrease in ridership, the ridership-based injury rate decreased 23%. Figures 1 and 2 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 of patron injuries since 2003. The downward trends of injuries and injury rates are apparent with the downward sloping (dashed line) trend lines. Although the sharp decreases experienced in 2020 magnify these downward trends, the downward injury and rate trends were well established prior to 2020. A summary of the changes between 2019 and 2020 is provided below:

Attendance-based:

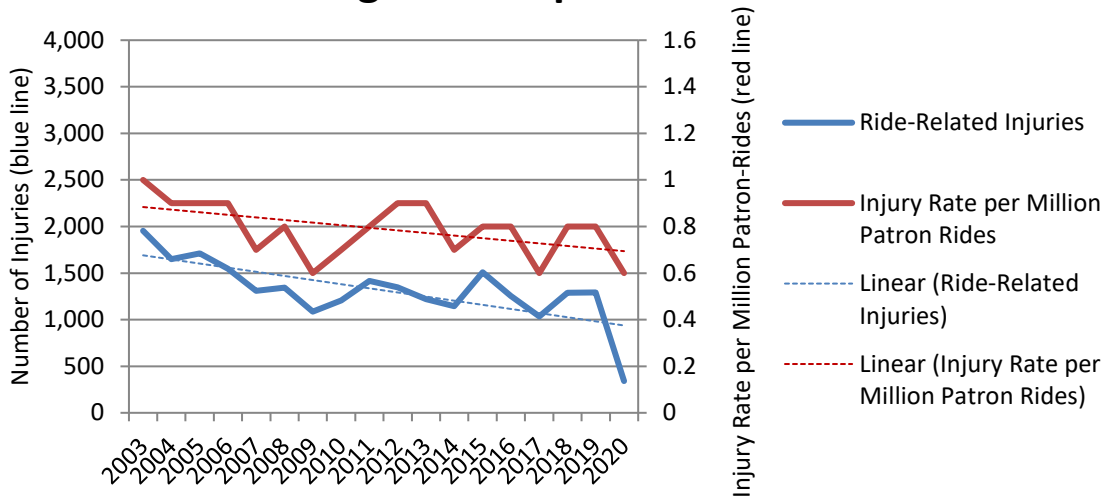
- Injuries down 76%
- Injury rates down 34%
- Attendance down 71%

Ridership-based:

- Injuries down 74%
- Injury rates down 23%
- Number of rides taken down 67%



**Figure 2. Patron Injury and Injury Rate Trends
Using Ridership-Based Estimates***

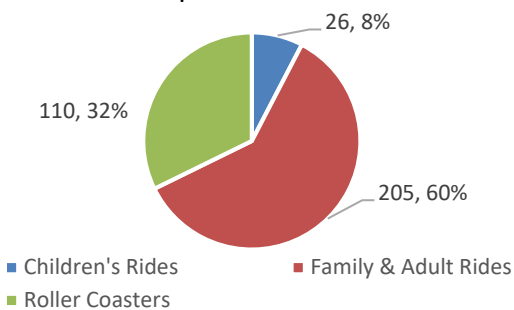


*In 2016, the survey was expanded to include both U.S. and Canadian facilities.

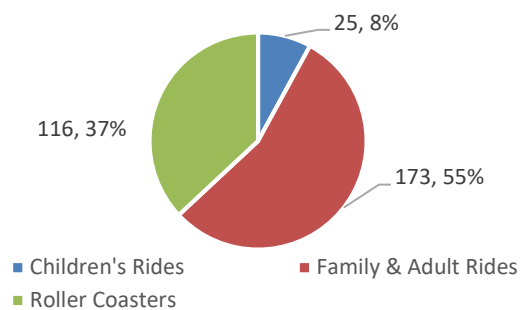
The distributions of injuries by ride type and injury severity for 2020 obtained from the ridership-based estimates were similar to the distributions obtained from the attendance-based analysis for total injuries, serious injuries, and other injuries. The largest portion of injuries for both sets of estimates took place on family and adult rides, followed by roller coasters and children’s rides (Figures 3 and 4). The ridership-based estimate did show a slightly larger percentage of serious injuries than did the attendance-based estimate. The ridership-based estimate shows that 16% of all injuries are serious, while the attendance-based estimate finds that only 13% of injuries are serious (Figures 5 and 6).

Figures 3 and 4

Distribution of Injuries by Ride Type
Ridership-Based Estimate

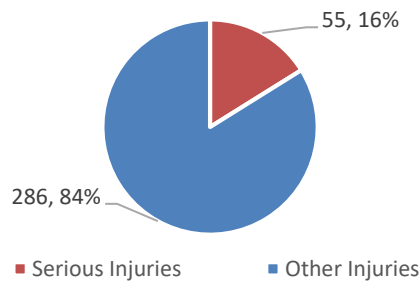


Distribution of Injuries by Ride Type
Attendance-Based Estimate

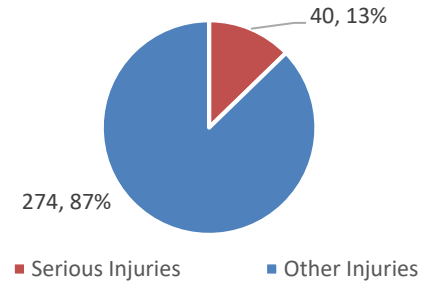


Figures 5 and 6

Distribution of Injury Severity
Ridership-Based Estimate



Distribution of Injury Severity
Attendance-Based Estimate



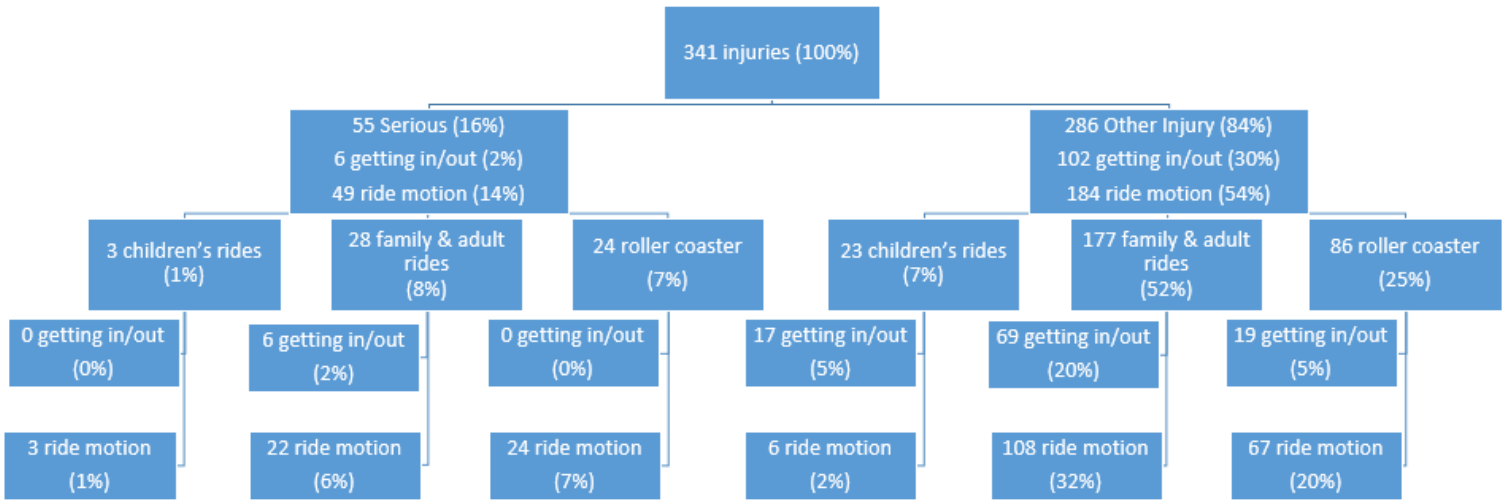
Ridership Analysis

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 in the remainder of the report are based on the ridership analysis.**

Distribution of Injuries in 2020

Figure 7 summarizes the 2020 distribution of injuries in terms of severity, ride type, and location of the incident. A total of 341 injuries were estimated to have occurred on rides in 2020. About 16% 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 84% were reportable injuries that were other than serious, but required medical treatment beyond ordinary first aid. The proportion of injuries that were serious in 2020 was up from 6% in 2019 and 11% in 2018. 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 as well as roller coaster injuries resulted from ride motion. In contrast, the majority of children’s ride injuries occurred while getting in/out of the ride.

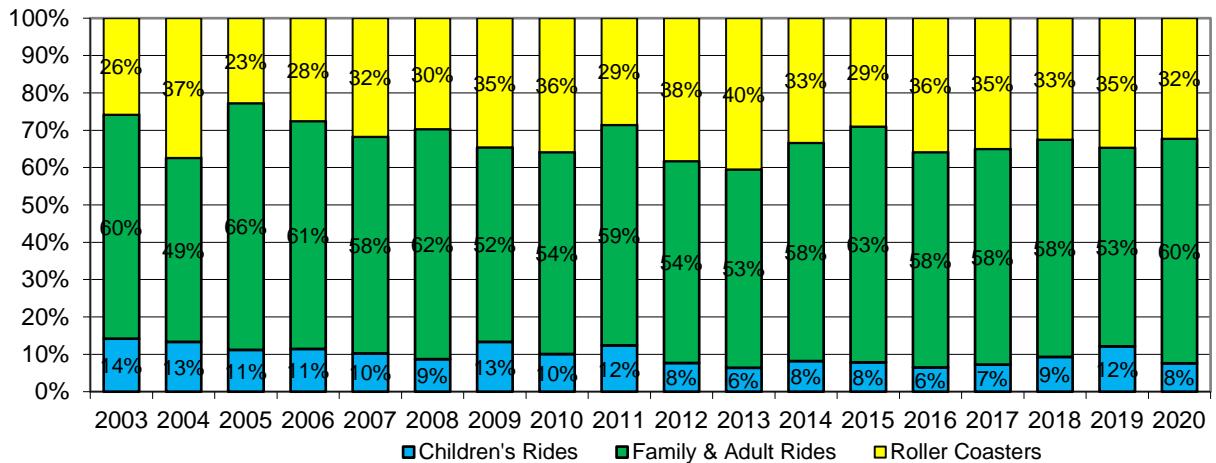
Figure 7. Distribution of ridership-based injuries by severity, ride type, and location, 2020



Historical Distribution of Injuries by Ride Type, 2003-2020

As shown in Figure 8, consistent with long-term historic trends, about 60% of the injuries in 2020 occurred on family and adult rides, 32% on roller coasters, and 8% on children's rides. This relative consistency regarding the proportion of injuries by ride type is particularly notable given the disruptions that the amusement industry experienced in 2020. Even as the total number of injuries significantly decreased in 2020, the proportion of injuries by ride type stayed the same.

Figure 8. Proportion of Injuries by Ride Type, 2003 -2020*



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

Injury Rates

The overall injury rate dropped to 0.6 from 0.8 injuries per million patron rides in both 2018 and 2019. The injury rate per million patron rides in 2020 was 1.0 for children’s rides, 0.9 for roller coasters, and 0.5 for family and adult 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 children’s rides decreases to 0.1 per million rides when counting only those incidents due to ride motion. The overall 0.9 per million injury rate for roller coasters decreases to 0.7 per million rides due to ride motion, and the 0.5 per million injury rate for family and adult rides decreases to 0.3 per million rides due to ride motion.

About 16% 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 84% were reportable injuries that were other than serious. The proportion of injuries that were serious in 2020 was up from 6% in 2019 and is the largest proportion of serious injuries ever recorded.

Table 3. Summary of Estimated Fixed-Site Amusement Ride-Related Injuries, 2003-2020 (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

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
	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
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
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

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
	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

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

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

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

Survey Response

Based on survey responses, it is estimated that 346 facilities with rides operated at least partially in 2020, down 21% from 2019. Of these facilities, a total of 122 provided some or all of the data requested (113 provided attendance data, 77 provided ridership data, and 68 provided both attendance and ridership data). An additional 11 facilities responded to the survey, but were unable to provide usable data for the analysis. Compared to 2019, participation decreased 26% among parks providing attendance data and 41% among parks providing ridership data. The majority of responding facilities are IAAPA members, with 155 (96%) coming from IAAPA members and 7 (4%) from non-members. The member response represents 48% of all North American IAAPA members with rides.

Table 4 summarizes the number of facilities whose data were used for the attendance-based and ridership-based estimates from 2004-2020. As noted above, park participation in 2020 was sharply down compared to previous years because of the COVID-19 pandemic. Fully 21% of responding parks reported not operating at all in 2020. 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 68 (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

*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.

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

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

The National Safety Council (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 original master list was prepared in consultation with IAAPA and Amusement Industry Consulting, Inc. A revised list of member and non-member parks was provided 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 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.)