Amusement Ride-Related Injuries and Deaths in the United States: 2005 Update

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Executive Summary

This report presents information from the U.S. Consumer Product Safety Commission (CPSC) staff on amusement ride injury and fatality incidents. CPSC has jurisdiction over *mobile rides*, rides that are moved from location to location as part of fairs, carnivals, parties, or other events. It does not have jurisdiction over *fixed-site rides*, rides that are permanently affixed to a site.

The body of this report provides mobile ride injury estimates. To maintain continuity with the past reports and to provide some measure of fixed-site ride injuries, an appendix provides fixed-site ride injury estimates. As in previous reports, inflatable rides, such as inflatable slides and bounces, are considered separately, although many are likely mobile rides.

- In 2004, mobile amusement rides accounted for an estimated 2,500 (95% Confidence Interval: 1,600 – 3,500) non-occupational injuries treated in hospital emergency rooms.

- There was no statistically significant trend, positive or negative, for mobile amusement ride injuries over the period from 1997 to 2004.

- In 2004, inflatable rides, such as inflatable slides and bounces, accounted for an estimated 4,900 (95% Confidence Interval: 1,700 – 8,000) non-occupational injuries treated in hospital emergency rooms.

- Inflatable ride injuries had a statistically significant upward trend over the period from 1997 to 2004.

- From 1987 to 2002, for mobile and fixed-site amusement rides combined, there were an estimated 4.4 amusement-ride fatalities per year. When this report was prepared, CPSC had reports of 5 amusement ride fatalities in 2004 and 5 in 2003. CPSC may become aware of additional fatalities for the years 2003 and 2004.

- When this report was prepared, CPSC had reports of 4 fatalities from inflatable amusement rides. These fatalities occurred from 2002 to 2005.

This analysis was prepared by the CPSC staff, has not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

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Introduction

This report presents information from the U.S. Consumer Product Safety Commission (CPSC) staff on amusement ride injury and fatality incidents. The CPSC has jurisdiction over consumer products. The Consumer Product Safety Act at Section 3(a)(1) includes amusement rides within the definition of consumer product, and describes an amusement ride as:

> ...any mechanical device which carries or conveys passengers along, around, or over a fixed or restricted route or course or within a defined area for the purpose of giving its passengers amusement, which is customarily controlled or directed by an individual who is employed for that purpose and who is not a consumer with respect to such device, and which is not permanently fixed to a site.

This description includes *mobile rides*, rides that are moved from location to location as part of fairs, carnivals, parties, or other events. It excludes *fixed-site rides*, rides that are permanently affixed to a site, such as rides in amusement and theme parks.

This report is chiefly concerned with mobile rides. However, CPSC data sources do not distinguish between the two types of rides without additional analysis. Injury and fatality estimates for fixed-site rides are a byproduct of the analysis used to derive the mobile ride estimates. This report provides fixed-site ride estimates to provide continuity with past reports [1,2,3,4,5,6,7,8,9] and to provide a range of estimates that may be useful to researchers and policy makers in the fixed-site amusement ride area.

There are some methodological concerns relating to the accuracy of the fixed-site injury estimates, due to the geographical constraints of the data collection system, known as NEISS [10], that is the basis for the injury estimates. Fatality estimates are derived from different data sources than the injury estimates and do not experience the concerns relating to the fixed-site injury estimates. For more information on the injury and fatality data sources and estimation, refer to the methodology section of this report and the discussion and analysis of fixed-site injury estimates in the 2003 report [8]. As in previous reports, inflatable rides, such as inflatable slides and bounces, are considered separately, although many are likely mobile rides.

The next section of this report gives the injury estimates for mobile amusement rides and inflatable rides. This is followed by a section on fatalities. The section contains summaries of reported fatalities for mobile, fixed-site, and indeterminate-site rides and for inflatable rides. The section also includes an estimate of the number of fatalities for mobile, fixed-site, and unknown-site rides combined. Following the injury and fatality sections is a section describing the methodologies used for the injury and fatality summaries. The report contains two appendices. The first appendix provides estimates of fixed-site amusement ride injuries and a table of intermediate calculations provided for documentation. The second appendix contains summaries of the recent in-depth investigations on amusement ride incidents.

Injuries

Mobile Ride Injuries

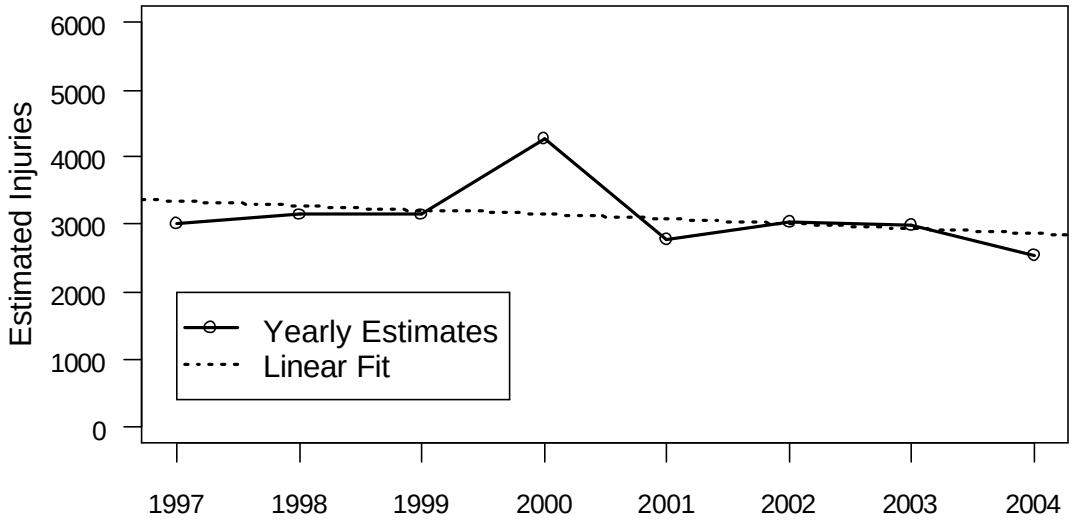
Table 1 and Figure 1 give the annual, non-occupational, injury estimates for mobile amusement rides for the years 1997 to 2004. Figure 1 includes the linear estimate of the trend over the period. There was no statistically significant trend, positive or negative, in mobile amusement ride injuries from 1997 to 2004 (p-value 0.443).

Table 1: Non-Occupational, Mobile Amusement Ride Injury Estimates.

Year	Estimate	95% Confidence Interval
1997	3,000	(1,500, 4,500)
1998	3,200	(1,600, 4,700)
1999	3,200	(1,900, 4,400)
2000	4,300	(2,900, 5,700)
2001	2,800	(1,500, 4,100)
2002	3,000	(1,800, 4,200)
2003	3,000	(1,600, 4,300)
2004	2,500	(1,600, 3,500)

Source: U.S. Consumer Product Safety Commission, NEISS. The estimates are rounded to the nearest 100 injuries and may not sum to the totals due to rounding. The estimates for the years 1997 to 2000 have been recalculated to make them comparable to those for the years 2001 to 2004. See Methodology section.

Figure 1: Non-Occupational, Mobile Amusement Ride Injury Estimates.



Source: U.S. Consumer Product Safety Commission, NEISS. The estimates for the years 1997 to 2000 have been recalculated to make them comparable to those for the years 2001 to 2004. See Methodology section.

Inflatable Ride Injuries

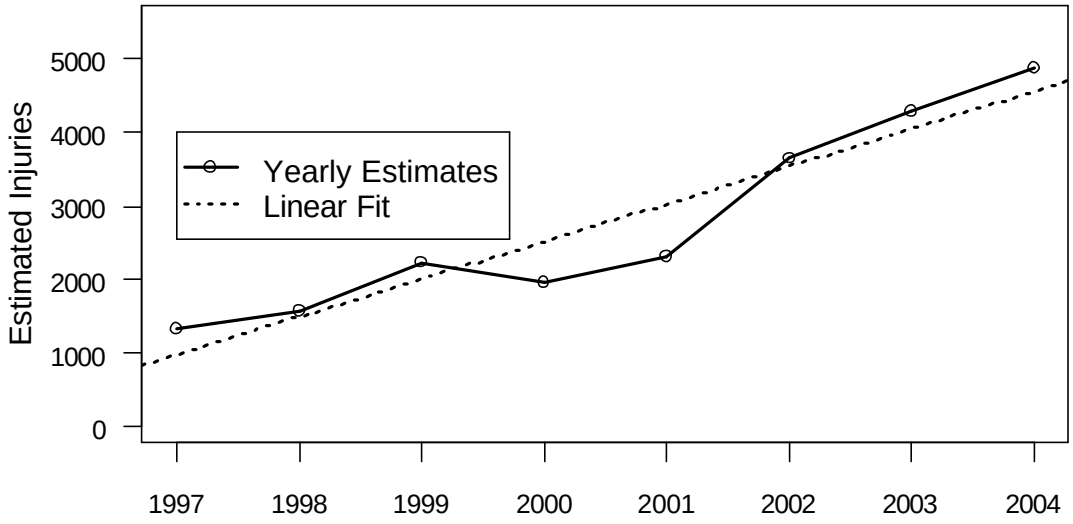
Table 2 and Figure 2 give the annual, non-occupational injury estimates for inflatable rides for the years 1997 to 2004. Figure 2 includes the linear estimate of the trend over the period. There was a statistically significant positive trend for the years 1997 to 2004 (p-value 0.021).

Table 2: Non-Occupational, Inflatable Ride Injury Estimates.

Year	Estimate	95% Confidence Interval
1997	1,300	(300, 2,300)
1998	1,600	(600, 2,600)
1999	2,200	(1,100, 3,300)
2000	2,000	(700, 3,200)
2001	2,300	(900, 3,700)
2002	3,600	(800, 6,500)
2003	4,300	(1,300, 7,200)
2004	4,900	(1,700, 8,000)

Source: U.S. Consumer Product Safety Commission, NEISS. The estimates are rounded to the nearest 100 injuries.

Figure 2: Non-Occupational, Inflatable Ride Injury Estimates.



Source: U.S. Consumer Product Safety Commission, NEISS.

Fatalities

Mobile and Fixed-Site Ride Fatalities

In the period from 1987 to 2002, the period with complete reporting, there were 57 reported non-occupational fatalities from mobile and fixed-site rides combined. Based on the capture-recapture analysis described in the Methodology section, there were an estimated 71 fatalities from 1987 to 2002 for mobile, fixed-site, and unknown-site rides combined. This represents an average of 4.4 estimated fatalities per year.

Table 3 gives the number of reported fatalities for fixed-site, mobile, and unknown-site rides for the period from 1987 to 2004. The reporting for years 2003 through 2004 was incomplete at the time this report was prepared. There were 67 documented fatalities over this period: 46 from fixed-site rides, 13 from mobile rides, and 8 from unknown-site rides. Reporting on known incidents in 2005 is not included because additional information on whether these incidents were ride-related may become available.

Table 3: Reported Non-Occupational Amusement Ride Fatalities, 1987-2004.

Year	Fixed-Site Ride	Mobile Ride	Unknown-Site Ride	Total
1987	4	0	0	4
1988	4	1	3	8
1989	3	0	0	3
1990	0	0	0	0
1991	3	1	0	4
1992	0	2	0	2
1993	1	1	2	4
1994	2	0	0	2
1995	3	1	0	4
1996	2	1	0	3
1997	3	0	1	4
1998	4	2	1	7
1999	6	0	0	6
2000	1	0	0	1
2001	2	1	0	3
2002	1	0	1	2
*2003	3	2	0	5
*2004	4	1	0	5
Total	46	13	8	67

Source: U.S. Consumer Product Safety Commission, DTHS and IPII.
Note: Based on further information, a 2003 fixed-site fatality reported in the 2004 report was determined not to be ride related.
*Reporting for these years was incomplete at the time this report was prepared.

Inflatable Ride Fatalities

CPSC staff is aware of 4 fatalities from inflatable amusement rides in the U.S. These fatalities occurred from 2002 to 2005. Table 4 summarizes these fatalities.

Table 4: Reported Non-Occupational Inflatable Amusement Ride Fatalities.

Document Number	Year	State	Narrative
N0260191A	2002	FL	A 21-year-old male broke his neck and died while jumping in an inflatable bounce.
G0350014A	2003	IL	A 15-year-old male fell head first off an inflatable obstacle course slide and died of traumatic head injury four days after the incident.
X0520106A	2004	MN	An 18-year-old male died after he fell on his head from an inflatable slide.
X0551104A	2005	MA	A 24-year-old female died after falling from a 28-foot inflatable climbing wall and striking her head on the pavement.

Methodology

Injuries

Data on non-occupational, amusement ride-related injuries were obtained from the National Electronic Injury Surveillance System (NEISS) [10]. NEISS is based on a stratified statistical sample of about 100 hospitals with emergency rooms (with 6 or more beds) in the United States and its territories. At NEISS hospitals, data are collected on product-related injuries. For each injury, the data includes codes for product, demographic, and medical information and a short narrative.

CPSC staff reviewed all NEISS injury cases for the calendar years 1997 through 2004 containing the product code for amusement rides. The year 1997 was chosen as a starting point, because it is the year that the NEISS sample last underwent a major update to reflect the current population of U.S. hospitals with emergency rooms. Based on information in the narratives of the cases, CPSC staff classified each injury case into one of six mutually exclusive and exhaustive categories: *not a ride*, *fixed-site*, *mobile*, *unknown-site*, *unknown if ride*, and *inflatable*.

Cases involving coin-operated rides or free-play attractions often found at restaurants or shopping centers, alpine and water slide amusements, wave machines, mechanical bulls, and playground equipment are examples of cases coded *not a ride*. Cases involving roller coasters or "whirling" rides are examples of cases coded *fixed-site*, *mobile*, or *unknown-site* rides. If the case narrative stated the name of an amusement park or that the incident occurred at a park, then the case was coded *fixed-site*. If the narrative stated that the incident occurred at a carnival, fair, or festival, then the case was coded *mobile*. If the narrative gave no site information, then the case was coded *unknown-site*. Cases involving inflatable rides, such as inflatable slides and "moon bounces," regardless of their mobility were coded *inflatable*. Cases involving a "merry-go-round," with no indication of whether it was playground equipment or an amusement ride as defined by the Consumer Product Safety Act, are examples of cases coded *unknown if ride*. Appendix Table A2 contains frequency breakdowns of the six codes.

The *not a ride* and *unknown if ride* cases were removed from the analysis. For each year, the total sampling weight of the *unknown-site* cases was allocated to the *fixed-site* and *mobile* cases in proportion to the observed total sampling weights of the two categories of cases. The *fixed-site* and *mobile* cases with the weights reflecting the allocation of the *unknown-site* cases were used to produce the estimates of the fixed-site and mobile injuries. Likewise, the *inflatable* cases were used to produce the estimates of the inflatable injuries.

The statistical sample design of NEISS was used to derive national estimates of amusement ride injuries and associated 95% confidence intervals. The 95% confidence intervals provide a measure of the statistical uncertainty of the estimates. The 95% confidence intervals have the property that with 95% statistical confidence they contain the actual number of U.S. injuries. The 95% confidence intervals used in this report are

based on the normal approximation and are equal to the estimate plus and minus twice its standard error.

The trends in the injury estimates were evaluated with a regression procedure that accounts for the repeated measurements of each NEISS hospital over time. The procedure is known as a *two-stage analysis* [11]. In the first stage, the trend for each NEISS hospital was estimated with simple linear regression. The sums of the intercepts and slopes, and the associated standard errors, of all U.S. hospitals were estimated from the NEISS hospitals based on the sampling design of NEISS. A two-sided Wald-statistic equal to the ratio of the slope estimate to its standard error was used to test the hypothesis that the slope was equal to zero, implying that there was no trend. The level of statistical significance is given as a p-value. P-values less than 0.05 are generally considered *statistically significant*, which in the present case implies that there is a trend in the injuries. For further discussion of Wald-statistics, statistical significant, and p-values see [12].

A hospital that treated a large number of fixed-site amusement ride injuries left NEISS in 2001. This change in NEISS affected the CPSC fixed-site ride injury estimates and to some degree the mobile ride injury estimates. In order to evaluate the trends in mobile ride injuries independent of this hospital leaving NEISS, the injury estimates for 1997 to 2000 were calculated without the hospital. The remaining hospitals in the sampling stratum of the hospital were reweighted, so that the total weight of the stratum remained the same. This adjustment procedure is performed in NEISS when a hospital fails to report for a given time period. For a detailed discussion and analysis of this issue refer to the 2003 report [8].

Fatalities

CPSC maintains several casualty databases that contain incidents of amusement ride fatalities. These include the Death Certificate file (DTHS) and the Injury and Potential Injury Incident file (IPII) databases. The DTHS file contains coded death certificates purchased from states based on external cause codes that may indicate product involvement. The IPII file is made up of several sources, including newspaper articles, consumer hotline and internet entries, and medical examiner contributions. All records from these files for the period from January 1987 to December 2004 indicating a fatality and containing the product code for amusement rides were reviewed. The review ascertained which records were associated with the same fatality, determined whether the incident was in-scope of the analysis, and coded incidents into fixed-site, mobile, and unknown-site ride incidents. From these databases, the number of documented fatalities was determined. Fatalities from inflatable rides were considered separately.

Because of the limits in obtaining evidence of fatalities, the number of documented fatalities may be an underestimate of the actual number of fatalities. Assuming that the two databases represent statistically independent sources, a method known as *capture-recapture* was used to produce an estimate of the total number of fatalities [13]. Because of the delay in obtaining death certificates, the most recent years were excluded from the capture-recapture analysis. Thus, although the documented number of fatalities covers the period from 1987 to December 2004, the estimated number from the capture-recapture analysis covers only the period from 1987 to 2002.

Because of the relatively small number of observed mobile ride fatalities, it may not be appropriate to apply the capture-recapture methodology to the mobile ride fatalities alone. Therefore, the capture-recapture estimation was applied only to the total of the mobile and fixed-site ride fatalities, including the unknown-site fatalities. As mentioned in the introduction, the use of the fatality databases for fixed-site rides does not present the concerns experienced with the fixed-site injury sources.

Appendix 1: Fixed-Site Ride Injury Estimates and Ride Code Table

As stated in the body of the report, CPSC does not have jurisdiction over fixed-site rides, that is rides that are permanently affixed to a site. However, fixed-site ride injury estimates are included here to provide continuity with past reports and to provide a range of estimates of fixed-site injuries that may be useful to researchers and policy makers in the fixed-site amusement ride area. For example, the fixed-site estimate may be compared to other independent fixed-site estimates [14]. The estimates in this appendix for the years 1997 to 2000 have been adjusted to make them comparable to the estimates for the years 2001 to 2004. The effect of the adjustment is to reduce the estimated fixed-site injuries and increase estimated mobile ride injuries in the years 1997 to 2000. Refer to the 2003 report for details on the adjustment and the unadjusted estimates for the years 1997 to 2000 [8].

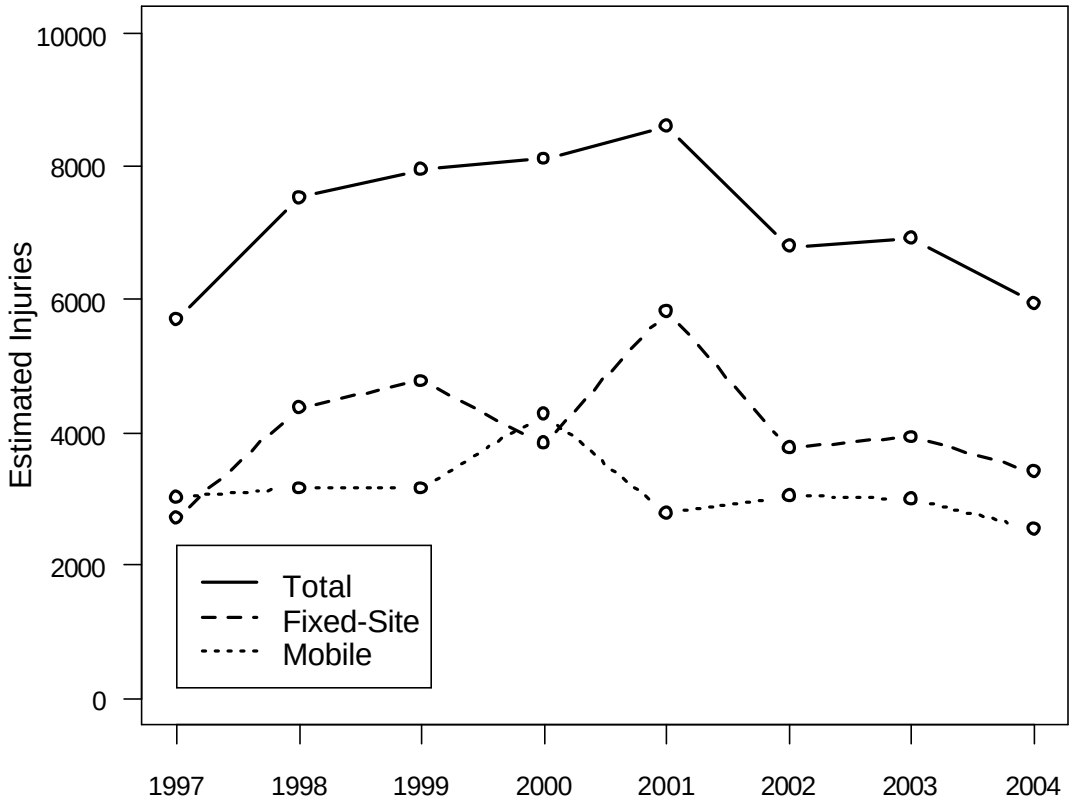
Table A1 and Figure A1 display the mobile, fixed-site, and total injury estimates for the years 1997 to 2004. The p-value for the trend in mobile ride injuries was 0.443, the p-value for fixed-site ride injuries was 0.868, and the p-value for total ride injuries was 0.712. Therefore, there were no statistically significant trends, positive or negative, for mobile, fixed-site, or total ride injuries over the period from 1997 to 2004.

Table A1: Non-Occupational, Amusement Ride Injury Estimates.

	Mobile Ride		Fixed-Site Ride		Total	
Year	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
1997	3,000	(1,500, 4,500)	2,700	(1,700, 3,700)	5,700	(3,700, 7,700)
1998	3,200	(1,600, 4,700)	4,400	(2,800, 6,000)	7,500	(5,300, 9,800)
1999	3,200	(1,900, 4,400)	4,800	(2,600, 7,000)	7,900	(5,600, 10,200)
2000	4,300	(2,900, 5,700)	3,800	(2,200, 5,400)	8,100	(6,100, 10,100)
2001	2,800	(1,500, 4,100)	5,800	(2,800, 8,900)	8,600	(5,300, 11,900)
2002	3,000	(1,800, 4,200)	3,800	(2,500, 5,000)	6,800	(5,100, 8,500)
2003	3,000	(1,600, 4,300)	3,900	(2,200, 5,600)	6,900	(4,900, 8,900)
2004	2,500	(1,600, 3,500)	3,400	(2,000, 4,800)	5,900	(4,100, 7,800)

Source: U.S. Consumer Product Safety Commission, NEISS. The estimates are rounded to the nearest 100 injuries and may not sum to the totals due to rounding. The years 1997 to 2000 have been adjusted to make them comparable to the years 2001 to 2004. See Methodology section.

Figure A1: Non-Occupational Amusement Ride Injury Estimates.



Source: U.S. Consumer Product Safety Commission, NEISS. The years 1997 to 2000 have been adjusted to make them comparable to the years 2001 to 2004. See Methodology section.

For reference, Table A2 provides the weighted counts of the 6 ride classifications discussed in the Methodology section.

Table A2: Weighted Counts of Injuries by Ride Codes.

Year	Not A Ride	Fixed-Site	Mobile	Unknown-Site	Unknown If Ride	Inflat-able	Total
1997	1,789	2,075	2,307	1,324	699	1,404	9,599
1998	2,249	3,140	2,268	2,117	709	1,647	12,128
1999	2,461	3,500	2,315	2,119	848	2,179	13,422
2000	2,031	2,876	3,212	2,010	985	2,032	13,146
2001	3,464	4,358	2,080	2,166	1,307	2,310	15,685
2002	4,117	2,696	2,178	1,919	2,077	3,639	16,625
2003	4,140	2,621	1,995	2,295	1,267	4,283	16,601
2004	4,602	2,590	1,937	1,417	1,705	4,881	17,132
Total	24,852	23,856	18,293	15,367	9,597	22,375	114,339

Source: U.S. Consumer Product Safety Commission, NEISS. The weighted counts for the years 1997 to 2000 have been recalculated to make them comparable to those for the years 2001 and 2004. See Methodology section.

Appendix 2: In-Depth Investigations

Since last year's report to the end of June 2005, CPSC staff completed 11 in-depth investigations of amusement ride incidents. These investigations are not a random sample of incidents, but were initiated based on staff concerns. In general, CPSC staff does not investigate fixed-site ride incidents, unless the ride is also used in a mobile setting. Table A3 provides summaries of the investigations.

Table A3: In-Depth Investigation Summaries.

Task Number	State	Narrative
040614CNE1584	VA	A two-passenger carrier on a mobile ride tipped over on its side and ejected two adult females of unknown ages. The cause of the incident is undetermined. One female bumped her head and received a laceration to her side and the other female injured her leg. Both females were transported to a local hospital.
040726HNE1683	DE	A 38-year-old male and his 13-year-old son were riding on an amusement ride at a fair, when the car/tub they were in fell from the ride and landed on the ground. Both were treated and released from a local hospital with minor neck and back strain. The car/tub came loose and fell from the ride, when a retaining pin came loose and fell along with the two bolts attaching it to the car/tub.
040811HCN0880	OH	Three children were alleged to be injured on a mobile flume ride at a fair. The children stated that they slid forward despite holding on to a handrail. The parents of the children state that the injuries included bruises, cuts, a lost tooth, and a concussion.
040921CNE1763	MA	A ride at a carnival failed causing two adult male riders to be ejected. There were three resultant injuries: one rider suffered a fatal head injury; a second rider was hospitalized with serious injuries; and a third rider (different car) suffered minor injuries.
041004CCN0005	KY	Seven people were injured on a mobile ride when a car left the tracks of the ride. Five were transported to the hospital. The exact cause of the incident could not be determined.
041025CCN0091	IL	A 3-year-old male sustained a severe cut to his face at a fun house amusement attraction. The accident occurred in a twirling or rotating tunnel.
050218CCC1477	NY	A 39-year-old female sustained fractures on an inflated horizontal bungee game. A metal ring and clip hit the victim in the face. EMS arrived, treated the victim, and transported the victim to the hospital.
050223CCC1492	GA	A 21-year-old female and her two children had just gotten off an amusement ride when an ammunition tube that had been modified to be used as a ticket holder was knocked over and fell onto her right heel. She was taken to the hospital via automobile where she was treated for a broken

Task Number	State	Narrative
		bone in her heel.
050328CNE2226	FL	A 21-year-old female and 14-year-old female were injured on a flume ride at a fair when their car failed to stop and struck a wall. The 21-year-old female received a broken jaw and lost some teeth. The 14-year-old female victim received back and neck injuries.
050406CWE5004	AZ	A 6-year-old boy was riding a whirling amusement ride at a fair. He fell off the platform/mat on which he was riding and suffered a broken leg when the platform pinned his leg to the floor of the ride. The boy was hospitalized.
050614CNE2522	DE	Three children, ages 5, 3, and 2, were rocking a Ferris wheel carriage vigorously at a festival. The children managed to unlock the safety bar and tumbled/fell from the ride while it was in operation. One of the children fell on top of a 5-year-old child in the carriage below. All of the children were treated and released from local hospitals.

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