Amusement Ride-Related Injuries and Deaths in the United States: 2004 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. Fatalities from mobile, fixed-site, and indeterminate-site rides are included in the body of the report.

- In 2003, mobile amusement rides accounted for an estimated 3,000 (95% Confidence Interval: 1,600 – 4,300) 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 2003.

- In 2003, inflatable rides, such as inflatable slides and bounces, accounted for an estimated 4,300 (95% Confidence Interval: 1,300 – 7,200) non-occupational injuries treated in hospital emergency rooms.

- Inflatable ride injuries had a statistically significant upward trend over the period from 1997 to 2003.

- From 1987 to 2001, for mobile and fixed-site amusement rides combined, there were an estimated 4.5 amusement-ride fatalities per year. When this report was prepared, CPSC had reports of 3 amusement ride fatalities in 2004, 4 in 2003, and 2 in 2002. CPSC may become aware of additional fatalities for the years 2002 through 2004.

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 ride*, rides that are permanently affixed to a site.

CPSC data sources do not distinguish between the two types of rides without additional analysis. Previous reports have presented injury and fatality estimates for both fixed-site and mobile rides, because they are derived from the same sources [1,2,3,4,5,6,7,8]. However, there are some methodological concerns relating to the accuracy of the fixed-site injury estimates. Starting with the 2003 report [8], fixed-site injury estimates are presented only to provide continuity with past reports and are given in an appendix. Note that the 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 methodology of the injury and fatality data sources and estimation, refer to the methodology sections 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 remainder of this report is organized as follows: (1) the injury methodology and estimates for mobile amusement rides and inflatable rides; (2) the fatality methodology and estimates for mobile and fixed-site amusement rides; and (3) summaries of the recent in-depth investigations on amusement ride incidents. The appendix provides estimates of fixed-site amusement ride injuries and a table of intermediate calculations provided for documentation.

Injuries

Methodology

Data on non-occupational, amusement ride-related injuries were obtained from the National Electronic Injury Surveillance System (NEISS) [9]. 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 2003 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 are removed from the analysis. For each year, the total sampling weight of the *unknown-site* cases is 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 are used to produce the estimates of the fixed-site and mobile injuries. Likewise, the *inflatable* cases are used to produce the estimates of the inflatable injuries.

The statistical sample design of NEISS is 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 are 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* [10]. 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 [11].

A hospital that treated a large number of fixed-site amusement ride injuries left NEISS in 2001. This change in NEISS affects 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 recalculated 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].

Starting with this report, the product code for "play tents" (1322) was reviewed for the calendar years 1997 through 2003, since cases involving inflatable rides were found in this code. This review resulted in a revision of previously published inflatable ride estimates. Also, a small number of additional amusement ride injury cases in the product code for amusement rides (1293) in the period from 1997 to 2003 were identified. This has resulted in a very small revision to the previously published amusement ride injury estimates.

Results: Mobile Ride Injuries

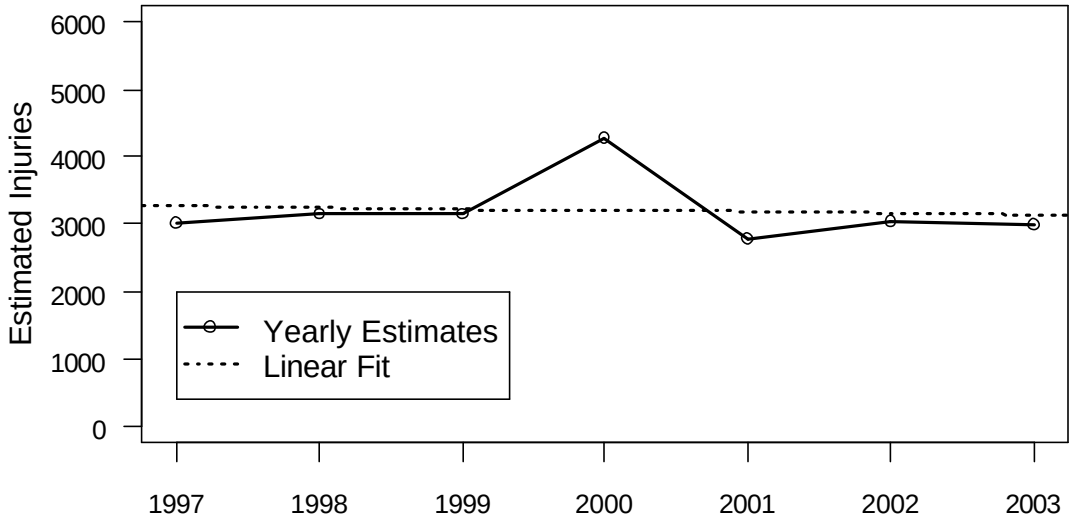
Table 1 and Figure 1 give the annual, non-occupational, injury estimates for mobile amusement rides for the years 1997 to 2003. As noted in the methodology section, the estimates for the years 1997 to 2000 have been adjusted to account for the noted hospital leaving NEISS. Figure 1 includes the linear estimate of the trend over the period. There was no statistically significant trend, positive or negative, in mobile amusement ride injuries from 1997 to 2003 (p-value 0.828).

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)

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 2003. See Injury 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 2003. See Injury Methodology section.

Results: Inflatable Ride Injuries

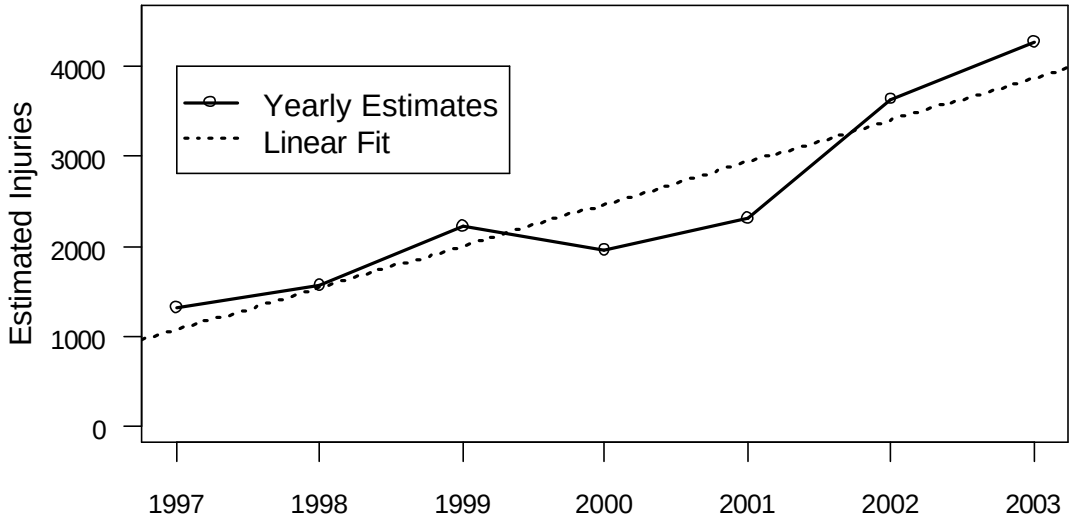
Table 2 and Figure 2 give the annual, non-occupational injury estimates for inflatable rides for the years 1997 to 2003. Figure 2 includes the linear estimate of the trend over the period. There was a statistically significant positive trend for the years 1997 to 2003 (p-value 0.033).

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)

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

Methodology

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 June 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. As in past reports, fatalities from inflatable rides are not included.

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 [12]. 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 June 2004, the estimated number from the capture-recapture analysis covers only the period from 1987 to 2001.

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 is 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.

Results: Mobile and Fixed-Site Ride Fatalities

In the period from 1987 to 2001, the period with complete reporting, there were 55 reported non-occupational fatalities from mobile and fixed-site rides combined. Based on the capture-recapture methodology, there were an estimated 68 fatalities from 1987 to 2001 from mobile and fixed-site rides combined. This represents an average of 4.5 estimated fatalities per year.

Table 3 gives the number of documented fatalities for fixed-site, mobile, and unknown-site rides for the period from 1987 to June 2004. The reporting for years 2002 through 2004 was incomplete at the time this report was prepared. There were 64 documented fatalities over this period: 46 from fixed-site rides, 10 from mobile rides, and 8 from unknown-site rides.

Table 3: Documented 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	4	0	0	4
*2004	3	0	0	3
Total	46	10	8	64

Source: U.S. Consumer Product Safety Commission, DTHS and IPII.
*Reporting for these years was incomplete at the time this report was prepared.

In-Depth Investigations

Since last year's report to June 2004, CPSC completed 16 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 3 provides summaries of the investigations.

Table 3: In-Depth Investigation Summaries.

Task Number	State	Narrative
030605HNE7927	NY	A three-year-old male suffered a minor head injury when he was thrown from a mobile amusement ride after he stood up. The child was dragged by a metal connecting bar. The victim was admitted to a hospital for two days for observation.
030620CCN0650	IL	A four-year-old girl bounced in an inflatable portable basketball bounce that was rented for a party. She caught her front tooth on the two-inch mesh and lost the tooth.
030703CCN0675	MO	A nine-year-old female was thrown from a swing-type amusement ride. About five minutes after the ride started, the victim began yelling to her mom for help. Statements indicate that the victim slipped under the safety devices on her seat and fell to the ground. She was transported to a local hospital where she was diagnosed as having multiple abrasions and lacerations. She was treated and released.
030718CWE6002	CA	The victim allegedly received facial and dental injury after being struck in the mouth area by a steel pin that fell from a mobile amusement ride sign during the ride sequence.
030721HCN0738	KY	A 10-year-old girl sustained minor neck injuries when she fell off the platform for a child roller coaster that was set up at a county fair. The child was exiting the ride platform when the ride was believed to have been restarted by another child standing next to the control panel.
030731HWE4337	CA	The victim sustained undisclosed injury while using a mobile amusement ride designed to drop riders free fall from a tower structure to safety nets below. The nets were not fully deployed before the victim fell resulting in her striking a foam mat on the pavement beneath the safety nets.

Task Number	State	Narrative
030807CCN0789	MN	The incident happened at a county fair where the ride was in operation. While it was running, the fiberglass bonnet of one of the cars flew off. The bonnet bounced off the inside of the guardrail that surrounds the ride. No one was injured.
030827HEP9026	NC	A 58-year-old female sprained her ankle while attempting to jump on a moving merry-go-round amusement ride at a public park. The victim aggravated a pre-existing condition. She was treated at the emergency room and released the same day.
031202CCC1211	FL	A 15-year-old male started climbing on a rock climbing amusement display at a trade show without the harness and then fell to the ground when he was about 2 1/2 feet high. He suffered bruises on his buttocks.
040121CNE1250	FL	Three children, a 12-year-old female, an 11-year-old female and a 7-year-old male were riding a carnival ride when the stem of one of the sweeps holding the three children broke completely off from the top arch of the sweep. The children, who were buckled into the carriers of the ride, were thrown to the ground. The 12-year-old female suffered a broken arm. The 11-year-old female suffered a concussion and a broken leg. The 7-year-old suffered a cut on his chin and lost a couple of teeth.
040203CAA1399	FL	Four individuals suffered minor burns to their arms when a fire occurred on an amusement ride. One of the individuals also suffered hydraulic fluid contact on an eye. Three individuals were treated at a hospital and released and the fourth treated at the scene. The cause of the fire incident appeared to be hydraulic oil from separated hoses and connectors that came in contact with sparks from the brush assembly.
040304CNE1368	FL	Six persons (a 10-year-old male, a 14-year-old female, a 16-year-old female, a 12-year-old female, a 28-year-old female, and a 29-year-old male) were exiting an amusement park ride when the ride's platform collapsed. All suffered minor bruises and were treated and released.
040324CCC1535	PR	Four victims were riding inside the cage of a spinning ride when the arm supporting the cage severed and struck the victims in the cage.

Task Number	State	Narrative
040405CCC1578	TN	A 15-year-old male, a 54-year-old female, and a 50-year-old female were the only ones riding an amusement ride that turned in a complete circle. As the ride approached an approximate 210 degree angle, the over-the-shoulder safety harness for the 50-year-old female failed. She was ejected from her seat and fell approximately 60 to 65 feet hitting a piece of the ride and finally landing on a concrete pad face up. She was pronounced dead at the scene by medical personnel.
040420HCN0537	KS	A 13-year-old girl was seriously injured when she fell 35 feet from a Ferris wheel at an amusement park. The handle bar on the seat flew open, and as she reached for the bar, she lost her balance and fell, striking a light fixture and two other seats. The accident occurred on a fixed-site ride, which is also made in a mobile version. The girl was riding with two 13-year-old boys, who admitted to rocking the seat while the ride was being loaded. One of the boys nearly fell out also. The victim was hospitalized with head lacerations, a broken jaw, and missing teeth.

Appendix: 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 [13]. 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 2003. 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].

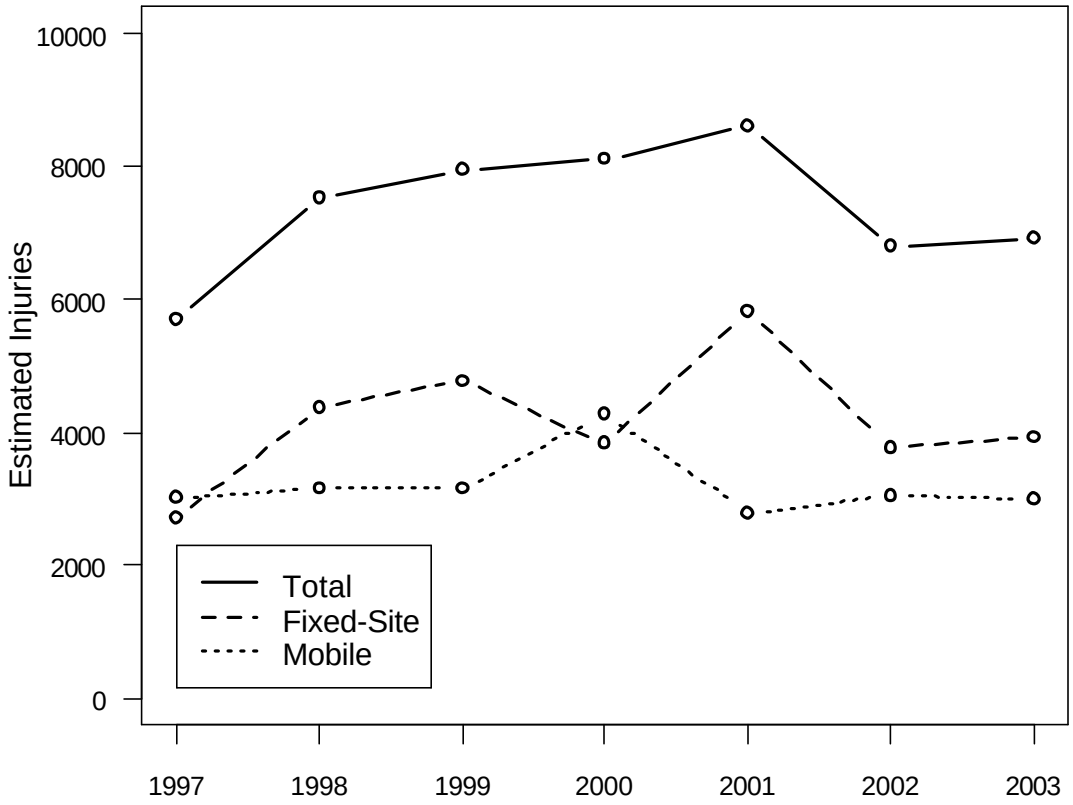
Table A1 and Figure A1 display the mobile, fixed-site, and total injury estimates for the years 1997 to 2003. The p-value for the trend in mobile ride injuries was 0.828, the p-value for fixed-site ride injuries was 0.444, and the p-value for total ride injuries was 0.551. Therefore, there were no statistically significant trends, positive or negative, for mobile, fixed-site, or total ride injuries over the period from 1997 to 2003.

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)

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 2003. See Injury 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 2003. See Injury Methodology section.

For reference, Table A2 provides the weighted counts of the 6 ride classifications discussed in the Injury 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
Total	20,251	21,265	16,355	13,950	7,892	17,494	97,207

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 2003. See Injury Methodology section.

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