

# Amusement Ride Accidents Involving Falls and Ejections

by Kathy Fackler  
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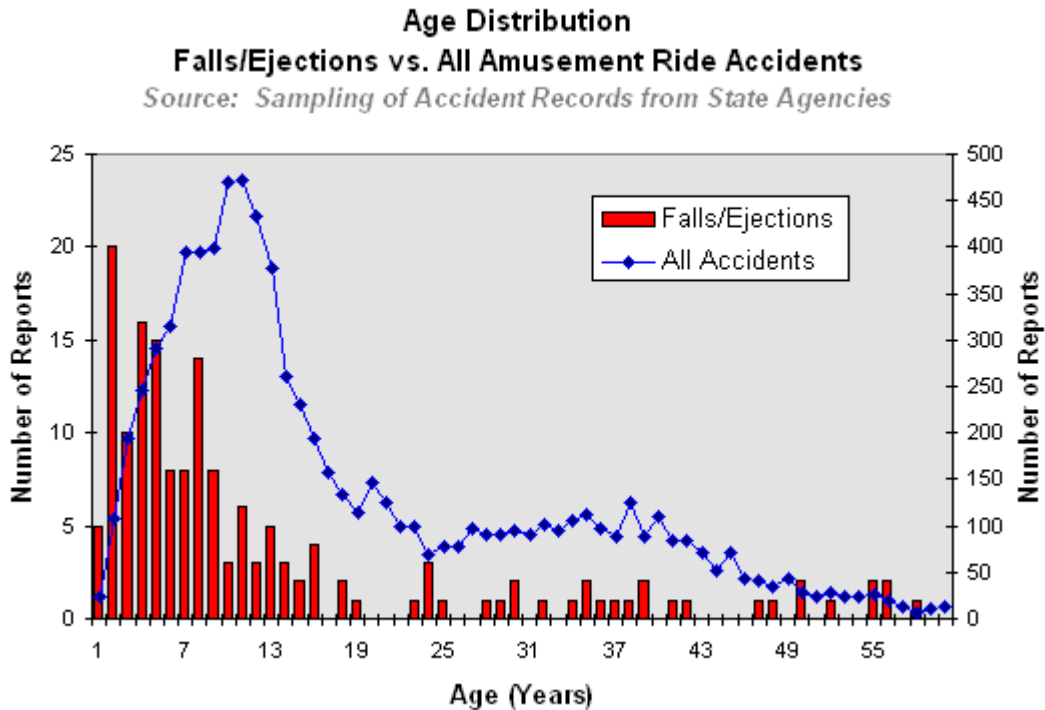


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## Overview

Few accidents in the amusement ride world carry greater potential danger than falls from moving rides. Various factors contribute to falls, but age is, by far, the greatest predictor of risk in this category. Two thirds of falls and ejections involve children under ten.



## Data Sources

### **Saferparks Database - Falls/Ejections Data Set**

The graphs and analytical information in this section were drawn from the Saferparks Database, which contains approximately 10,000 amusement ride accident reports provided by state and federal regulatory agencies in response to public records requests.

*Note: The Saferparks Database provides some insight into causal factors and common patterns for ride-related accidents, but readers should be aware of its limitations. The records provided to Saferparks do not represent a complete or consistent record of amusement ride accidents and should not be relied upon as a robust statistical source. Accident records were provided by approximately one third of U.S. states; date ranges are limited to a couple years in most cases; reporting criteria and level of detail varies widely. Some records include findings from government investigators but, in most cases, the accident descriptions are provided by the ride owner/operator and may reflect bias.*

The Falls/Ejection Data Set includes 188 records in which the narrative description indicated a patron fell or was forcefully ejected from a mechanical amusement ride during the ride cycle. The data set covers 182 separate incidents, fourteen patron deaths, and 192 patron injuries including 2 patrons who were hit by riders who fell from another car. In most cases, the patron separated completely from the vehicle. In some cases, the patron was able to stay within the car or hold on to the outside until the ride could be stopped in a safe position.

- This category includes:
  - Cases where a patron loses restraint within a fully-enclosed spinning car and bangs around inside the cage.
  - Cases where a child falls completely off the seat onto the floor of a moving carrier (e.g., spinning cups or submarining underneath a fixed lap bar onto the floor).
- This category does not include:
  - Falls during load/unload or in the queue.
  - Injuries caused by extending hands/arms outside the car unless the action resulted in at least a partial fall or ejection.

### **Supplemental Source - Accident Reports from the Press**

News reports serve as an important additional source of information on falls and ejections from thrill rides because the news media's jurisdiction isn't limited by the scope of regulatory laws or exemptions, press reports are easier to access than government records, and press reports provide more information than is generally included in regulatory logs. A quick search through the website [rideaccidents.com](http://rideaccidents.com) revealed almost three dozen serious falls and ejections involving children that were not part of the Falls/Ejections Data Set drawn from the government records in the Saferparks Database. Those reports were used to

initialize a News Reports table that will be used as a supplementary information source within the Saferparks Database.

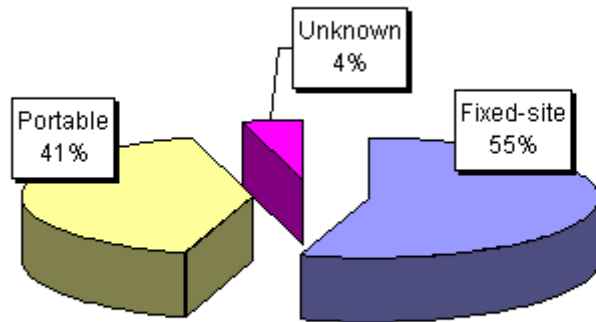
### **Saferparks Ride Type Categorization**

Saferparks assigns a ride type to accident records based on the name or description of the ride provided in the government record. (Note that categorization occurs on a time-available basis; approximately 25% of the records in the Saferparks Database have not been coded.) Records in the Falls/Ejection Data Set include the following ride types:

- **Whirling/Spinning Rides** - This category encompasses a wide range of rides, primarily full-sized, in which spinning motion is central to the experience and tends to contribute significantly to the conditions surrounding the fall. Teacups are included (kiddie and full-sized), as was a family dark ride with cars that spin.
- **Kiddie Rides** - This category is an equally diverse grouping in terms of makes/models, but the rides are simpler and slower than whirling/spinning rides, intended for use by very young children, often riding alone. Fall reports in this area almost universally involve injury to a child kindergarten age or younger and a narrative description like "child stood up while ride was moving and fell out".
- **Coasters** - This category includes traditional roller coasters, water coasters, and some "kiddie coasters" if the accident report narrative indicated a forceful ejection.
- **Carousels** - This category includes anything described in the regulatory report as a full-sized carousel or merry-go-round. These carry children and adults, and are large enough that parents can stand next to small children as they ride to help guard against falls.
- **Water Rides** - This category includes log flumes, rafting rides, boat rides, and bumper boats. These rides are generally designed without restraints, as they can create a serious hazard if the watercraft overturns. The lack of restraints can lead to falls, which can become serious when combined with the water, submerged conveyors, and crush potential between the boat and the side of the waterway.
- **Swing Rides** - These rides consist of a group of swing seats suspended from long chains in a circle. As the machinery spins, centrifugal force causes the swings to bell outward. Kiddie versions were grouped with larger versions in this category because the fall pattern is related to the ride action and carrier design rather than the size of the machine.
- **Sky Rides** - These are ski-lift style rides that consist of bench chairs that scoop up 1-3 riders at a load point, carry them into the air across some distance, and lower down near the ground at the end so passengers can disembark. Sky Rides do not have conforming restraints, but some have a metal bar that can be lowered in front of the passengers as a psychological comfort and reminder to stay seated.
- **Wheels** - This category includes Ferris wheels, double Ferris wheels, and giant gondola wheels.
- **Cars** - This category includes rides where patrons get inside their own gas-powered vehicle on a track, and the patron driver controls the accelerator.

- **Bungees** - This category includes amusement devices where patrons are strapped into an enclosure or a harness and propelled on a restricted path via bungee cords.
- **Other** - The Falls/Ejections Data Set included two falls from trains (not noted as kiddie rides), two falls from dark rides, one fall from a freefall ride, and one containment failure on a go-kart. These records did not figure prominently into the patterns for falls/ejections, but are mentioned here for completeness.

## Summary of Findings

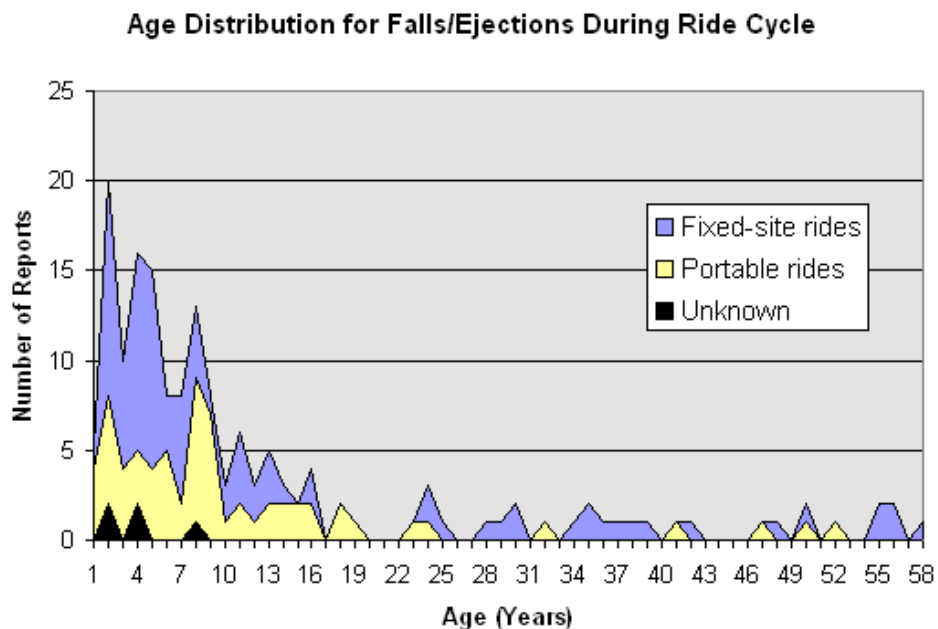


**Falls/Ejections During Ride Cycle (All Ages)  
by Ride Siting**

Falls and ejections occur on both amusement park and carnival rides. Amusement parks report more coaster ejections and falls involving very young children on kiddie rides than carnivals do, and carnivals report more accidents involving 8- and 9-year-olds falling from whirling rides than amusement parks do. Beyond that, the reports show a fairly even mix.

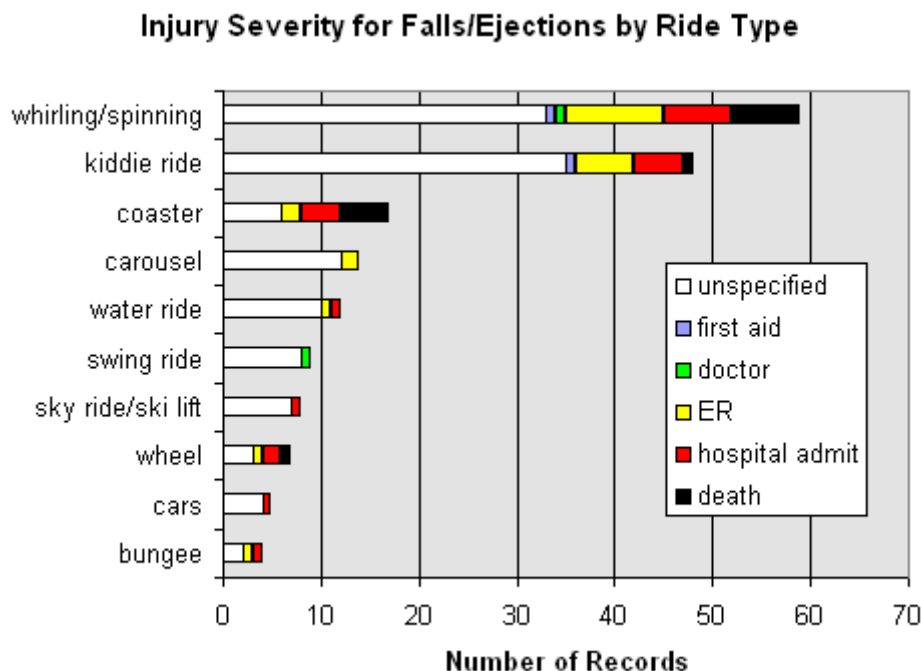
### Age Distribution for Falls/Ejections

Children are at highest risk for falls and ejections during the ride cycle. Two thirds of all falls/ejections involve children under 10 years of age.



### Ride Types Most Commonly Implicated in Falls/Ejections

The ride types most commonly found in reports of falls/ejections were whirling/spinning rides and kiddie rides. Whirling/spinning rides and coasters were associated with the highest number of fatalities in this category.



The "whirling/spinning" category encompasses a wide range of rides, primarily full-sized in which spinning motion is central to the experience and tends to contribute significantly to the conditions surrounding the fall. The category "kiddie ride" is an equally diverse grouping in terms of makes/models, but fall reports in this area almost universally involve injury to a child kindergarten age or younger and a narrative description like "child stood up while ride was moving and fell out".

### Fatalities

- Fourteen patrons (7%) were reported killed: 7 on whirling/spinning rides, 5 on coasters, 1 on a giant gondola wheel, and 1 on a kiddie train.
- Equipment failure was found to be the cause of 5 deaths.
- In 6 cases, the restraint system was insufficient to protect the riders. 3 children were killed in falls from Sizzler/Scrambler rides and 1 toddler was killed falling off a kiddie train. 2 overweight adults were forcefully ejected from high-acceleration coasters with lap-only restraints.
- One woman fell from the top of a giant gondola wheel. Investigators ruled it a suicide.

- One woman was fatally ejected from a full-sized coaster. Investigators concluded she released her lap belt during the ride cycle.
- One 50-year-old man was fatally ejected from a Sizzler in Texas, a state that does not investigate accidents. The death was not reported by the ride owner per Texas law; a one-line report was added to the state insurance logs seven years after the man died.

### ***Injury Severity and Hazard Exposure Severity***

Although most records provided by the state regulatory agencies lack the level of detail and/or independent verification to fully analyze severity of outcome or severity of hazard exposure during the event, the data set does provide some insight into the health consequences of containment failures, particularly in regard to children.

#### ***Medical Treatment Required***

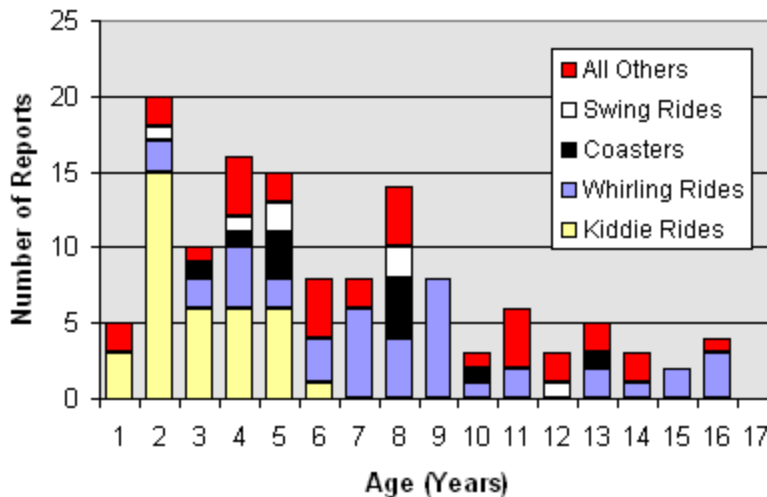
- 12% of the reports noted that injuries were severe enough to require immediate in-patient hospital admission.
- 13% reported that injured patrons were sent by ambulance to an emergency room.
- Two reported that injured patrons were taken to a doctor.
- Two reports indicated that on-site first-aid was provided.
- The remaining 66% of the accident reports did not indicate what level of medical treatment was required.

#### ***Primary Hazard Exposure for Children***

- **Kiddie rides** account for 25% of fall and ejection accident records. This accident category affects children age 6 and under, and peaks for 2-year-olds.
  - 71% of the kiddie ride accidents in the Falls/Ejection Data Set resulted in head injuries, ranging from minor to major, and including one fatality.
  - 23% of the records reported that the child was hit by, run over by, and/or dragged by the ride machinery after falling out.
- **Whirling/spinning rides** account for 31% of fall/ejection accident records. Falls from whirling/spinning rides peak at age 9.
  - 57% of the accident reports involve children age 9 and under.
  - 78% of the accident reports involve children age 16 and under.
  - In 65% of the cases involving children under age 12, the restraints provided on the ride remained latched, but failed to contain/restrain the child.
- **Coasters** (includes kiddie coasters, family coasters, and major coasters) account for 9% of fall/ejection accident records.

- 65% of coaster falls/ejections involve children. Half of those injured were between the ages of 3-5; the other half were between 8-13.
- 45% of child ejections from coasters were attributed to equipment or operator failure.

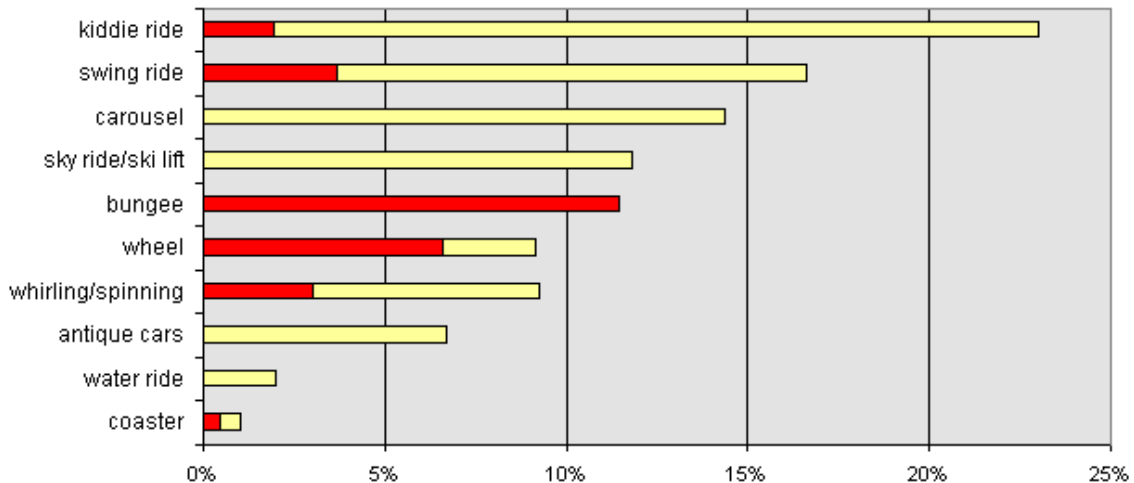
**Child Falls/Ejections During Ride Cycle Age Distribution by Ride Type**



**Relative Weight of Falls/Ejections by Ride Type**

**Percentage of Accidents Involving Falls/Ejections (All Ages)**

*Red = equipment or operations failure noted in report (excludes operator inattention)*



This graph shows the relative weight of fall/ejection accidents within the larger scope of all accident records for that ride type. Falls account for almost one quarter of the

accidents reported on kiddie rides. By contrast, falls and ejection account for only 1% of coaster accident/injury reports.

### **Equipment Failure and Operational Failure**

The red segments indicate the percentage of reports for that ride type which noted equipment or operational failures as causal factors. *Note that many of the accident descriptions in regulatory records provided to Saferparks lack the level of detail and/or independent verification necessary to code this information reliably. Equipment and operational failures may have played a causal role in more of these accidents than is indicated in the preceding graph.* Equipment failure includes cases where a lap bar opened during the ride cycle, but does not include cases where patrons unlatched belts or unhooked chains (i.e., kiddie ride and swing ride patterns).

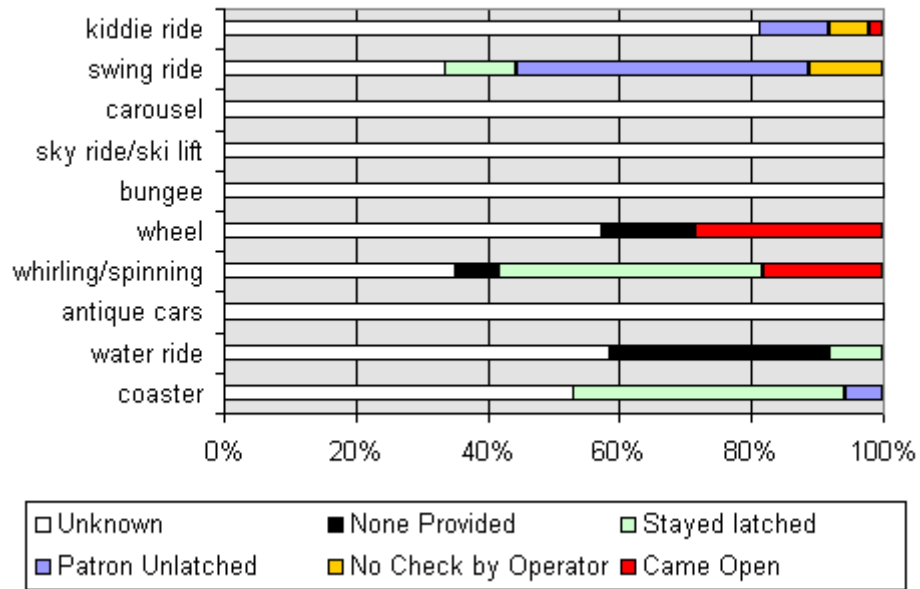
Saferparks chose not to code notations of simple operator inattention as operational failures because operator inattention is not a primary trigger for falls/ejections from amusement rides, nor is close visual attention by the operator a reliable method of preventing such accidents. For every accident record noting operator inattention as a causal factor (i.e., the operator didn't respond quickly enough when the child began to fall), there was a matching case where the operator did everything he/she could and the child fell out anyway.

In order to be effective, intervention needs to occur long before a child gets into a dangerous position on a moving machine. Ride operators should remain alert while on the job, but studies show that humans have limited capacity for vigilance, and may not respond smartly and quickly when something unexpected and dangerous occurs in real time. Amusement rides should be designed in such a way that they can be safely operated by inexperienced, minimally-trained workers and safely used by inexperienced, untrained children and adults.

### **Restraint Status**

The following graph shows available information on the status of the patron's restraint before, during, and after the fall or ejection. Most regulatory records do not include this information. "None provided" means that no restraints were provided on the ride (e.g., teacups, water rides). "Stayed latched" means that the patron came out from under or over a latched restraint. "Patron unlatched" means that the patron unlatched the restraint before falling. "No check by the operator" means the report noted that the ride operator failed to check the restraint prior to starting the ride and the patron fell because the restraint was unsecured. "Came open" means the report noted that the restraint came open during the ride cycle.

### Falls/Ejections (All Ages) - Reported Restraint Status

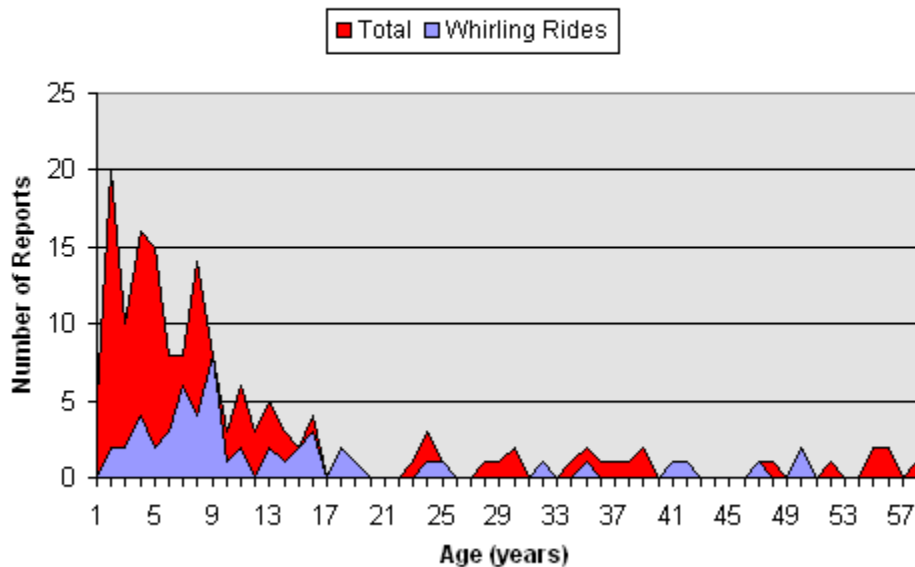


## Analysis by Ride Type

### Whirling/Spinning Rides

The "whirling/spinning" category encompasses a wide range of rides in which spinning motion is central to the experience and tends to contribute significantly to the conditions surrounding the fall. Teacups are included (kiddie and full-sized), as was a family dark ride with cars that spin.

**Age Distribution - Falls/Ejections During Ride Cycle  
Whirling/Spinning Rides vs. All Rides**



- **Whirling/spinning rides account for 31% of accidents and 50% of the fatality reports** in the Falls/Ejection Data Set. Falls from whirling/spinning rides peak at age 9.
- **Children are the primary risk group.** 57% of the accident reports involve children age 9 and under. 78% of the accident reports involve children  $\leq 16$ .
- **Poor restraint fit was the primary hazard for children 11 and under.** *Note: ejections from teacup rides were not included in this measure because most do not come equipped with restraints.*
  - In 65% of those cases, restraints remained latched but failed to contain/restrain the child.
  - 12% of the records cited equipment failure as the cause.
  - 9% cited operator error as a contributing factor.



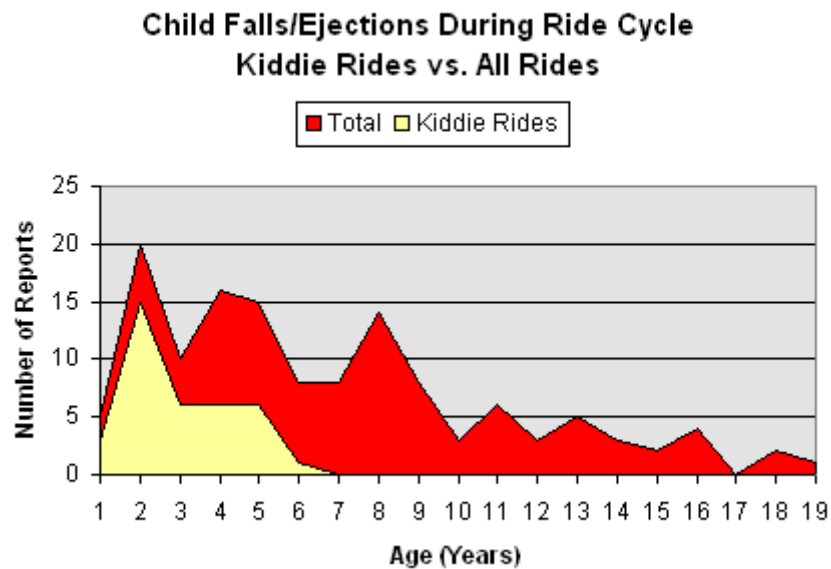
- **Teenage children (age 13-16) accounted for 14% of falls/ejections** from whirling rides. 38% of those reports noted equipment or operations failures as the cause. The remaining records for this age group did not include detailed findings from regulatory investigations.
- **Equipment or operations failure was noted as the cause of half the falls/ejections involving adult patrons.** Most of the remaining adult ejection records came from Texas, a state that does not investigate amusement ride accidents.
- **Almost half (46%) of the records noted head injuries** ranging from minor to fatal.
- Falls and ejections account for 9% of all government accident reports provided to Saferparks for whirling/spinning rides.

Amusement Ride	Gov. Reports	News Reports	Sum Reports	Victims' Ages <i>(includes fatal &amp; nonfatal)</i>
Sizzler	8	2	10	3, 5, 6, 9, 9, 18, 41, 50, child of unspecified age, 2 adults (ride came apart)
Himalaya	6		6	3, 10, 14, 15, 18, patron of unspecified age
Scrambler	4	1	5	4, 6, 7, 9, 35
Teacups (various)	4		4	2, 6, 11, child of unspecified age
Wipeout	4		4	4, 6, 42, patron of unspecified age
Paratrooper	3		3	7, 25
Rock N Roll	3		3	9, 15
Skymaster	3		3	8, 9, 13
Zipper	1	2	3	9, 9, 11, 14, 14
Octopus	1	1	2	4, 7, 16
Psycho Swing	2		2	11, 16
Roll-o-Plane	1	1	2	19, child of unspecified age
Sidewinder	2		2	5, 8
Breakdance	1		1	8
Gee Wizz		1	1	8
Gyroscope/Spiroscope	1		1	9
Hard Rock		1	1	13
Hat Dance	1		1	4
Hawk	1		1	50
Hurricane	1		1	13
Hustler	1		1	7
Kamikazi 2 (Bansai)	1		1	24
Kite Flyer	1		1	2
Rainbow		1	1	4
Remix	1		1	47
Spinning dark ride	1		1	4
Spider	1		1	16
Tilt-a-Whirl	1		1	7
Top Spin		1	1	12
Twister	1		1	8
Whirlwind	1		1	32
Whirly Gig	1		1	9
Wind Shear		1	1	9

## Kiddie Rides

The "kiddie ride" category encompasses a wide range of rides that are intended for use by very young children, often riding alone. Fall reports in this area almost universally involve injury to a child kindergarten age or younger and a narrative description like "child stood up while ride was moving and fell out".

**Kiddie rides account for 25% of fall and ejection accident records.** This accident category primarily affects children age 5 and under, and peaks for 2-year-olds.



- **71% of the kiddie ride accidents in the Falls/Ejection Data Set resulted in head injuries**, ranging from minor to major, and including one fatality.
- **23% of the records reported that the child was hit by, run over by, and/or dragged by the ride machinery after falling out.**

### ***Restraints and Hazard Exposure on Kiddie Rides***

Few regulatory reports on kiddie ride accidents provide information on the type of restraint, if any, provided on the ride, and whether the child 1) unlatched the restraint, 2) fell out of a latched restraint, or 3) fell off while riding unrestrained. Restraints used on kiddie rides vary widely, as shown in the photos below. Hazard exposure on kiddie rides can include:

- Falls from heights
- Moving parts of large (impact) and small (entrapment) size
- Accelerations that may not look significant to adults, but can challenge a toddler's or preschooler's ability to stay safely positioned within a moving vehicle.

- 8% of the records cited equipment or operator failure as the cause.
- 23% of all kiddie ride accident reports provided to Saferparks involved falls during the ride cycle.



## Coasters

The "coaster" category includes traditional roller coasters, water coasters, and some kiddie coasters if the accident report narrative indicated a forceful ejection.

- Coasters account for 9% of fall/ejection accident records.
- **65% of coaster the falls/ejections involved children.**
  - Half of the children ejected from coasters were between the ages of 3-5.
  - The other half were between 8-13.
  - 45% of child ejections from coasters were attributed to equipment or operator failure.
- Of the ejection reports involving adult patrons:
  - 50% involved significantly overweight patrons on high acceleration coasters with lap-only restraints.
  - One of the adult ejections was caused by equipment failure/sabotage.
  - The remaining two adult coaster reports cited misconduct as the cause of the ejection.
- **Falls and ejections account for only 1% of all coaster accident reports** provided to Saferparks.

## Carousels

This category includes anything described in the regulatory report as a full-sized carousel or merry-go-round. These carry children and adults, and are large enough that parents can stand next to small children as they ride to help guard against falls.

- Carousel accidents account for 7% of the records in the Falls/Ejection Data Set.
- 71% of the records reported children falling. One report noted that a mother fell and broke her wrist while trying to keep her child from falling. Falls involving children encompassed a wide age range (age 1-13 years).



## Water Rides

This category includes log flumes, rafting rides, boat rides, and bumper boats. These rides are generally designed without restraints, as they can create a serious hazard if the watercraft overturns. The lack of restraints can lead to falls, which can become serious when combined with the water, submerged conveyors, and crush potential between the boat and the side of the waterway.

- Water Ride accidents account for 6% of the records in the Falls/Ejections Data Set. Age distribution was not skewed toward young children for this ride type.
- 58% of the accident reports involved patrons (primarily adults and older children) falling into the flume on a log flume or rafting ride, either because they deliberately jumped off early (during a boat jam in one case), or because they lost balance while unloading.
- Two children fell out of bumper boats and into the motor, in one case resulting in a near downing.
- One 6-year-old slipped underneath the lap belt on a rafting ride when the raft hit a bump.

## Swing Rides

These rides consist of a group of swing seats suspended from long chains in a circle. As the machinery spins, centrifugal force causes the swings to bell outward. Kiddie versions were grouped with larger versions in this



category because the fall pattern is related to the ride action and carrier design rather than the size of the machine.

- Swing Ride accidents account for 5% of the records in the Falls/Ejections Data Set
- 67% of the accident reports involved children between the ages of 2-8 falling out of their seats midcycle. The smallest child slipped underneath the restraint; four of the remaining five reports stated that the child lifted or unlatched the restraint.
- In one accident, several riders jumped from their seats when the ride began spinning faster due to a mechanical failure. Eight people were reported injured.
- In another accident, a 12-year-old girl was forcefully ejected because the crotch strap was not latched on a Wave Swing.

### Sky Rides

These are ski-lift style rides that consist of bench chairs that scoop up 1-3 riders at a load point, carry them into the air across some distance, and lower down near the ground at the end so passengers can disembark. Sky Rides do not have conforming restraints, but some have a metal bar that can be lowered in front of the passengers as a psychological comfort and reminder to stay seated.



- Sky Ride accidents account for 4% of the records in the Falls/Ejections Data Set. Age distribution was not skewed toward young children for this ride type.
- Panic, deliberate risk-taking, and patron confusion/mistakes regarding the continuous motion load/unload appear to be the main causal factors. Patron confusion appeared more often in the accident narratives, but panic and deliberate risk-taking are associated with more serious falls (i.e., vertical distance is greater).

### Wheels

This category includes Ferris wheels, double Ferris wheels, and giant gondola wheels.

- Wheel accidents account for 4% of the records in the Falls/Ejections Data Set. Age distribution of accidents within the Data Set was not skewed toward young children for this ride type.
- Equipment or operations failure was noted in 71% of falls/ejections from wheels. Scenarios include lap bars releasing as patrons leaned forward, wheel moving while patrons were being unloaded, and tub



catching on something and flipping the riders out.

- Reports of wheel falls/ejections in the supplemental News Reports involved children ages 5, 6, 6, 9, and 13. Manufacturer recommendations for minimum height limits and accompanied rider rules appear to offer insufficient child safety protection on these devices, which reach great heights and do not provide secure restraints.

### **Car Rides**

This category includes rides where patrons get inside their own gas-powered vehicle on a track, and the patron driver controls the accelerator.

- Car Ride accidents account for 3% of the records in the Falls/Ejections Data Set.
- All accidents involved children (age 2-12) falling out of Antique Cars. Other types of car rides may not present the same risk for child falls due to lower vehicle height, or may have been categorized as kiddie rides in the Falls/Ejection Data Set.

### **Bungees**

This category includes amusement devices where patrons are strapped into an enclosure or a harness and propelled on a restricted path via bungee cords.

- Bungee accidents account for 2% of the records in the Falls/Ejections Data Set. Age distribution was not skewed toward young children for this ride type.
- Equipment or operational failure was noted as the cause of all bungee falls/ejections included in the Falls/Ejection Data Set.

## **Industry Standards for Amusement Ride Restraints**

Industry standards for amusement rides are developed by the ASTM F-24 committee. ASTM F2291, *Standard Practice for Design of Amusement Rides and Devices*, defines minimum requirements for restraint systems on rides designed after 2003. There are no explicit standardized restraint requirements for amusement rides designed prior to the adoption of F2291 in 2003. Industry standards for amusement rides do not require that older rides ever be brought up to modern safety standards. New rides manufactured to pre-2003 designs are not required to meet modern safety standards as long as any design-related failures or safety issues have been mitigated. The term "design-related" is not defined; interpretation is left up to each manufacturer and/or regulatory body.

### **Minimum Standards for Restraints on Rides Designed After 2003**

- **Acceleration-based Restraint Requirements** - In order to comply with industry standards, rides designed after 2003 must be provided with restraint devices in cases where patrons could be lifted or ejected from their seat or riding positions by the acceleration of the amusement ride or device, or by seat inclination, or by other events related to the motion/position of the vehicle (e.g., emergency braking or stops in an inverted position). Five minimum levels of restraints, called classes, are defined in F2291. Restraint levels range from none at all (Class 1) to individually-adjustable restraints with redundant locking function (Class 5). Selection of restraint class is guided by design accelerations, but may be adjusted (either up or down) according to the design analysis.
- **Kiddie Ride Restraint Requirements** - In addition to the requirements based on acceleration, kiddie rides designed after 2003 are required to provide either a fully enclosed compartment or a latching restraint, unless the design analysis indicates that a restraint is not appropriate (e.g., on a water ride). The final latching position must be "adjustable in relation to the patron(s)". Depending upon interpretation, that could mean adjustable in relation to each patron, or adjustable in relations to the group of patrons in the seat. Kiddie rides are formally defined as rides designed primarily for use by children up to 12 years of age, but current usage of the term denotes a younger cutoff (i.e., rides used primarily by children up to 7 years of age).

### **Child Restraint Standards**

The current design standard, ASTM F2291, does not include explicit requirements for age-appropriate containment and restraint of young children on all rides. The ASTM F-24 industry standards committee formed a task group in 2005 to determine whether additional requirements are necessary.