

Original Contributions

UNICYCLE INJURIES IN THE UNITED STATES

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Abstract—Background: Unicycles are single-wheel machines ridden for transportation or recreation. To our knowledge, no studies have been performed that describe injury rates of unicycle use. **Objective:** The objective of this study was to describe the epidemiological characteristics of unicycle injuries treated in United States (US) emergency departments (EDs). **Methods:** A retrospective analysis was performed using data from the National Electronic Injury Surveillance System (NEISS) of the US Consumer Product Safety Commission from 1991 through 2010. **Results:** An estimated 3360 patients were treated for unicycle injuries from 1991 to 2010, averaging 168 injuries per year in the United States. Ten to fourteen-year-old patients represented 41% of the entire study cohort. Fractures represented approximately one third (32.9%) of all injuries treated. More than half (52.9%) of all injuries involved an extremity. Six of the 85 cases studied involved a head injury; all were aged younger than 18 years. Only 3.53% of all studied cases were admitted for further treatment. The rest were treated in the ED and discharged to home. Fractures were the primary diagnosis in all admitted cases. **Conclusions:** Based on NEISS data, unicycle injuries treated in EDs are relatively uncommon and rarely require admission. Of documented injuries, fractures and extremity injuries are most common. Additional research is needed to understand the underlying mechanisms of these injuries as well as the potential need for helmet use advocacy. © 2013 Elsevier Inc.

Keywords—unicycle; bicycle; injury

INTRODUCTION

The unicycle is a single-wheeled vehicle on which a person's center of gravity is balanced over a solitary wheel.

This typically occurs as the rider pedals directly through the wheel's center hub. The movement is similar to that of a bicycle, but does not have the same level of stability.

Unicycle riding has existed since the late 18th century, but its origins are nebulous. Since the advent of vaudeville entertainment during the early 20th century, there has been a growing enthusiasm among those looking for an alternative method of recreation and transportation. According to a leading retailer of unicycles in the United States (US), there has been a 10-fold increase in annual sales during the period of 2006 to 2013 (Amy Drummond, personal communication). We were unable to find earlier studies of unicycle use or injury data to date. To the author's knowledge, this is the first study to describe the epidemiological factors related to unicycle injuries in the US.

METHODS

Data Source

The National Electronic Injury Surveillance System (NEISS) is a stratified sample of approximately 100 hospital emergency departments (EDs) in the US that report consumer product-related injuries to the Consumer Product Safety Commission. The data are selected from the population of all hospitals that have at least six beds and operate 24 hours a day in the US and its territories. Participating hospitals submit data extracted from ED medical records that are associated with consumer products and recreational activities.

A NEISS coordinator from each participating hospital transcribes patient data relating to a consumer product.

The coordinator assigns a product code based on medical record details. Other aspects of the injury are then documented with the case report associated with the product code. NEISS coders receive specific training and follow-up training to optimize inter-rater reliability. Regular evaluation data are analyzed and evaluated with each participating hospital (1). Participating hospitals are financially contracted to provide fully trained coders to submit approximately 400,000 records annually to the NEISS database (Thomas Schroeder, personal communications). Earlier studies have demonstrated the accuracy of NEISS in identifying injuries (2–6).

Data regarding unicycle injuries (product code 1283) reported through the NEISS from calendar years 1991 through 2010 were retrospectively analyzed. The analyzed NEISS dataset includes variables such as patient age, weight, sex, body injury location, type of injury, locale of injury, and ED disposition. Cases were excluded if the additional case narrative described injury not relating to unicycle use. National injury rate estimates were calculated based on the statistical design of the NEISS, where national estimates and corresponding confidence intervals can be calculated from the data collected in the NEISS.

Data Analysis

Continuous data were presented as mean \pm standard deviation unless otherwise specified. Categorical data were presented as counts and proportions (%) and the statistical comparisons were performed by χ^2 Fisher's exact test, depending on the sparseness of the observed event rates. A 95% confidence interval for the relative risk (RR) was constructed based on the large sample approximation.

Study Variables

Cases were categorized based on NEISS case narratives, and consolidated as needed. Injury type categories included: 1) fracture; 2) contusion or abrasion; 3) strain or sprain; 4) laceration; and 5) dislocation. A consolidated category of "other" injuries was created that included one case each of the following diagnoses: internal organ injury, ruptured testicle, dental injury, and soft tissue avulsion. NEISS categories for body areas injured were consolidated into the following categories: 1) head and neck; 2) upper extremities; 3) lower extremities; and 4) trunk (including pubic region). NEISS categories for the patients' disposition from the ED were: 1) released (treated and released or left the ED without treatment) or 2) hospitalized (admitted, transferred to another hospital, or held for observation). The locales of injuries (among cases where location was documented) were categorized as: 1) home; 2)

street/highway; or 3) other (including school, recreational/sports area, and other public property).

This study was approved by author's hospital Institutional Review Board.

RESULTS

Sample Description

During the 20-year study period (1991–2010), there were an estimated 3360 injuries treated in US hospital EDs related to unicycles (95% confidence interval 2490–4230), averaging 168 patients annually. This estimate is based on a total of 85 included injury cases that were documented from the NEISS database during the study period. Mean age of injury was 21.6 years (median = 14 years; range, 3–60 years; interquartile range, 20 years). Patients aged 10–14 years represented 41% of the entire study population (1378 of estimated 3360).

There was a higher percentage of male patients (67.1%; 2255 of estimated 3360). Among patients for whom the location of injury event was documented (56% of total), the majority of injuries occurred at home (41.6%; 791 of estimated 1897) (Figure 1).

Type of Injury

Fractures were the most common type of injury overall (32.94%; 1107 of estimated 3360), and also among patients 10–14 years of age (31.0%; 427 of estimated 1378) (Figure 2). Strains and sprains were also common among the entire cohort (28.24%; 949 of estimated 3360), as well as those younger than 18 years of age (29.0%; 400 of estimated 1378).

Extremities were the most commonly injured body area, and upper extremity injuries were more prevalent among the entire cohort (52.9%; 1779 of estimated 3360), as well as those 10–14 years of age (88%; 1213 of estimated 1378) (Figure 3). Nonextremity areas (head/neck and trunk/pelvis) were more likely to endure contusions and abrasions compared with extremities (RR = 3.17; 95% CI 1.21–8.27).

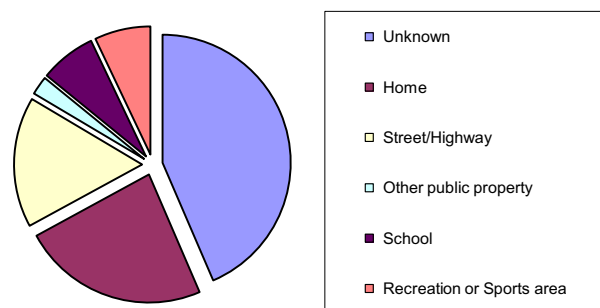


Figure 1. Unicycle injuries according to location of where injury occurred, United States, 1991–2010.

Type of Injury, entire cohort, n=85

Type of injury, ages 10-14 years, n=35

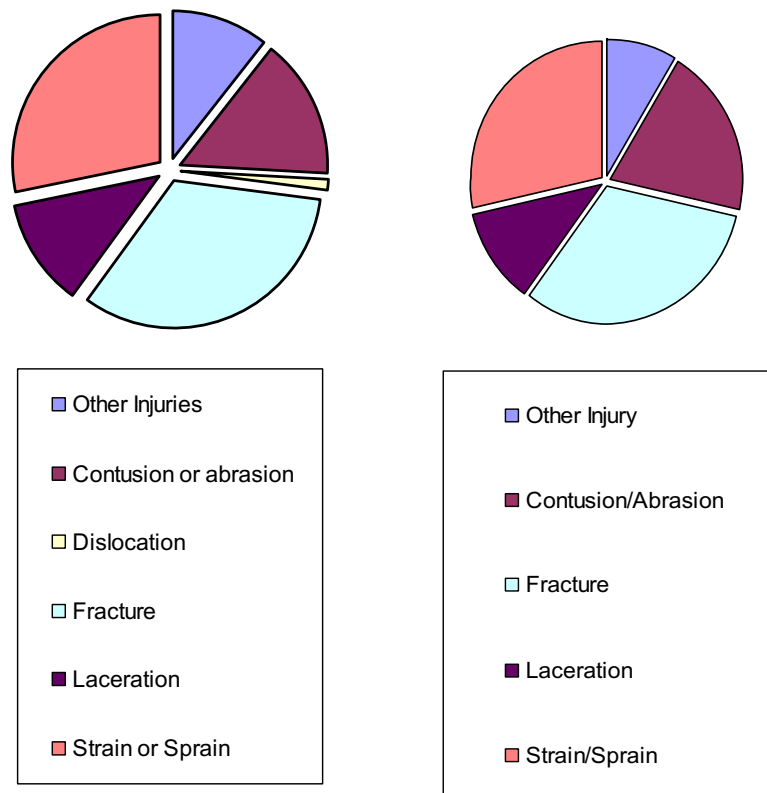


Figure 2. Unicycle injuries according to type of injury for entire cohort and for cases 10–14 years of age.

There were six documented head or neck injuries. One patient was wearing a helmet and one was not. The remainder had no documentation of helmet use. However, all head injuries were noted among patients younger than 18 years of age.

Among all laceration injuries, 27% (903 of estimated 3360) occurred on the lower extremity, and 4.4% (147 of estimated 3360) occurred on the upper extremity. Lower extremities were more likely to sustain lacerations than upper extremities (RR = 6.06; 95% CI 1.36–27.08).

Disposition from the ED

Among the 85 cases in the study cohort, only 3 (3.53%, 119 of estimated 3360) were admitted. All three cases were fractures. The remainder of cases, including those incurring “other” injuries, were treated in the ED and discharged to home.

DISCUSSION

To the author’s knowledge, there are no other studies concerning unicycle injuries. This study describes the

prominent characteristics of unicycle injuries. There were estimated 3360 injuries resulting from unicycle use during the period of 1991–2010. Even with this relatively small number of ED visits, there were a very small number of patients admitted.

We were unable to find studies to compare with this query. However, interesting comparisons can be made with reports on bicycle injuries. Unlike this study, where the majority of injuries were related to the extremities, bicycle injury research mostly shows a tendency toward head and neck injuries (7–16). In this unicycle study, very few injuries required admission to the hospital, and none of the admitted patients had head or neck injuries.

All of the admitted cases were fractures, and all of the injuries classified as “other” injuries were discharged to home. The high fracture percentage appears consistent with typical unicycle use. With loss of control, the unicyclist is likely to fall on an outstretched hand to regain stability. This presumption is also consistent with the data showing upper extremities as the most likely injured body part. In addition, one typically learns unicycling by holding a steady shoulder-level horizontal surface,

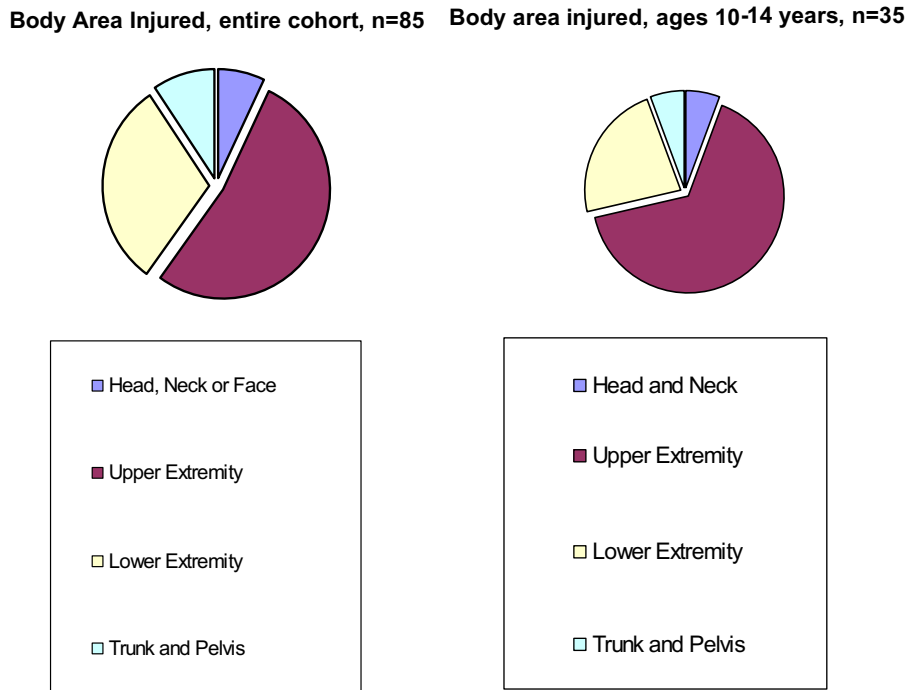


Figure 3. Unicycle injuries according to body area injured for entire cohort and for cases 10–14 years of age.

such as a fence or post. It is conceivable that using such aids can be potentially hazardous.

Another interesting contrast between this and bicycle-related studies is that there were no patients in this study with any documented collision with a motor vehicle. The reasoning is likely that unicycling is not an activity one typically performs on roads shared with cars. Rather, if used as a transportation device, it is typically ridden on a sidewalk, which reduces the proximity to motor vehicles. Otherwise, its use is usually in a closed area for learning or performing.

The only significant comparison seen in this study shows that lacerations were much more likely to be found on lower extremities compared with upper extremities. Ankle injuries have been described resulting from pedal and crank scraping. This type of injury occurs enough that ankle protection is recommended for the learning unicyclist. However, one cannot conclude from the limited data available that such ankle injuries are responsible for the increased lacerations in the lower extremities.

This study does not consider the type of unicycle used in each case. Although the basic premise is that a rider pedals while centering his/her weight over the single wheel, there are considerable variations on this concept. The anecdotal evidence suggests that unicycling is typically safer than bicycling and other wheeled activities. This is because when the rider loses balance, he/she can land on the feet when falling either forward or backward.

This study also does not consider what type of riding is performed by the injured. Until approximately the

mid-20th century, unicycling had been primarily the domain of acrobats and circus performers. With the increased production of consumer-level models (Amy Drummond, personal communication), more people have been able to master the riding technique. With increased popularity, there is also the desire of some to experiment with new techniques, riding styles, stunts, and performance aspects.

Much like any wheeled activity, helmet use is encouraged. However, without knowing the true prevalence of head injuries in proportion to overall unicycle use, one cannot confidently advocate for helmet use while unicycling. Although there exists mounting evidence for bicycle helmet use, such research is based on readily available retrospective data on helmet use while using bicycles (17–23). More data on helmet use while unicycling will help elicit a more solid recommendation.

Limitations

The overall small number of cases within the database limits this study. Because the unicycle is somewhat of an esoteric machine, it may not be easily documented in medical records. Because data entry is performed by multiple individuals from multiple institutions, one could possibly misidentify a unicycle as a bicycle (or other device) instead. The incidence of unicycle injuries, therefore, could be under-reported. However, given that NEISS has a dedicated product category for unicycles, and that the participating hospital institutions are

knowledgeable in the database requirements, under-reporting appears less likely with these data.

The most difficult aspect of interpreting the injury rate is that there are no data regarding overall unicycle use in the US or anywhere in the world. Therefore, despite the seemingly small number of injuries associated with unicycle use, one cannot determine how likely one is to injure him- or herself when using a unicycle. To know the denominator of total unicycle users is instrumental in understanding whether the device is a significant safety hazard or not.

Such information of overall use would be very useful in attempting to analyze why 10- to 14-year-olds were more prone to injury than other age groups. One speculation is that this represents an age group that is just strong enough to learn and try a new physical challenge. Another possibility is that this is the age that might be more vulnerable to issues of balance, and thus, more prone to losing control. This higher percentage could also represent the predominant users.

CONCLUSIONS

In summary, this study shows that unicycling injuries are relatively infrequent in the US. Young teenagers are more likely to be injured than any other age group. Extremities are more likely to be injured when compared with other body parts. Also, extremity fractures were more commonly endured than other unicycling injuries. Head injuries were relatively rare. Very few injuries required an inpatient admission. More data concerning overall unicycle use are needed to help determine the actual injury frequency among riders.

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ARTICLE SUMMARY

1. Why is this topic important?

Unicycle use has increased in popularity in recent years. Because we were unable to find previous studies on the injury rates for unicycling, there is also no guidance concerning safety advocacy.

2. What does this study attempt to show?

This study attempts to show the patterns of injury consistent with unicycle use based on The National Electronic Injury Surveillance System data from 1991 to 2010.

3. What are the key findings?

There were approximately 168 unicycling injuries in the United States per year. Young teenagers were more likely to be injured than other age groups. Extremity fractures were the most common diagnosis. Almost all studied cases were sent home after the emergency department visit.

4. How is patient care impacted?

By understanding unicycle injury rates, one begins the discussion about whether safety measures are required for its use. For instance, because head injury rates are so low, does this allow for more leniency toward helmet use? Because extremity fractures are the most common injury, will arm/leg padding reduce the rate? Additional studies that delineate overall unicycle use in the United States will help to determine if these injury rates are actually rare.