International Journal of Pediatric Otorhinolaryngology 88 (2016) 38–41

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: http://www.ijporlonline.com/

# Pediatric head and neck injuries due to golf cart trauma

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ARTICLE INFO

*Article history:*
Received 17 May 2016
Received in revised form
19 June 2016
Accepted 23 June 2016
Available online 25 June 2016

*Keywords:*
Golf cart
Trauma

ABSTRACT

*Introduction:* Golf carts are increasingly used off the golf course and are often viewed as innocuous modes of transportation. However, research has shown they can cause significant injuries, particularly to children.

*Objectives:* Analyze golf cart related head and neck injuries in children and adults from a national database.

*Methods:* The National Electronic Injury Surveillance System (NEISS) was queried for golf cart injuries. The NEISS tracks consumer product related injuries from a sampling of approximately 100 emergency departments across the United States. Age, general diagnosis (concussion, fracture, laceration), body-part injured, disposition (hospitalized, discharged), location injury occurred, and mechanism of injury were analyzed.

*Results:* Over an 11-year period, a total of 3433 total patients were identified. There were 1471 children (16 years old or younger), which compromised 42.9% of the cohort. Children were injured at home or on the road 44.7% of the time compared to only 16.6% of adults ($p < 0.003$). Children injured their head or neck 42.6% of the time compared to 28.6% of adults ($p < 0.0001$). Adults who were hit by a car while riding a golf cart or were ejected from the golf cart 44.6% of the time compared to 61.7% of children ($p < 0.0001$). There were 3.9% of children with a face, head, or neck fracture compared to only 2.4% of adults ($p = 0.01$).

*Conclusion:* Children are more vulnerable to golf cart related injuries, specifically to the head and neck.
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## 1. Introduction

Golf carts are small-scale vehicles designed for frequent entry and exit on a golf course. They were originally designed for low speed travel, but current models can now reach speeds of 20–25 miles per hour. They are commonly called golf cars, low speed vehicles, personal transport vehicles, and golf buggies, but for the purposes of this paper they will be designated simply as golf carts. They are often viewed as an innocuous means of travel, however, the number of golf cart-related injuries in the United States has been dramatically increasing [1]. Rising popularity and use in places other than the golf course such as college campuses, airports, and residential areas likely plays a role. Golf carts can even be legally operated on some public roads alongside automobiles [2]. Although they are allowed on public roads, golf cart safety is not regulated consistently by local or state laws. Most of the same safety features seen in automobiles such as airbags, lights, mirrors and doors are lacking in golf carts. In addition, they frequently do not have safety features seen in other recreational vehicles such as seat belts and helmet use is rare.

Many injuries do take place on the golf course and involve adults consuming excessive alcohol [3]. However, research has shown that frequently it is children who are injured, and they most frequently injure their head or neck [1,3]. Watson et al found that from 1990 to 2006 31% of all golf cart injuries involved children under the age of 16 and their head or neck was injured 32% of the time. At one tertiary medical center, Miller et al. reported 60% of golf cart injuries involved children and found that 69% of children injured their head or neck [3]. Previous work with 3 dimensional modeling and crash test dummies has shown that golf carts have some intrinsic safety deficits that put children specifically at risk for injury to their head and neck [2]. This study utilizes a national database to specifically analyze pediatric head and neck injuries.

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http://dx.doi.org/10.1016/j.ijporl.2016.06.041
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## 2. Materials

No institutional review board approval was necessary for this study, as it did not involve human subjects or medical records. The National Electronic Injury Surveillance System (NEISS) is a federally maintained database managed by the U.S. Consumer Product Safety Commission. The NEISS tracks consumer product related injuries that present to a sampling of approximately 100 emergency departments. The emergency departments are distributed across the United States and include both pediatric and adult hospitals of varying sizes. The database contains basic demographic data, general diagnosis (concussion, fracture, laceration/amputation), body-part injured, disposition (hospitalized, discharged), and location injury occurred. Patients were considered children if their age was 16 years or younger and adults classified as over the age of 16. There is a brief explanation of how the injury occurred and mechanism of injury was obtained from this information. If more than one mechanism of injury was possible, whichever occurred first was recorded. For example, if a golf cart was struck by an automobile and subsequently rolled over, the mechanism would be collision with a vehicle. The years 2003–2013 were queried and each entry was reviewed. Only patients that were injured by a golf cart in use were included. For example, patients who were injured while repairing a golf cart were not included. Head and neck injuries were classified as injury to the face, mouth, head, or neck. Statistics were obtained with SPSS Version 23 (Chicago, Illinois).

## 3. Results

Eleven years of data (2003–2013) was analyzed with an average of 312 golf cart related injuries a year (range of 257–359), as noted in Fig. 1. A total of 3433 patients were identified with 1471 children (under the age of 16) and 1962 adults (over the age of 17). Children made up almost half of all patients with 42.9% being injured. Fig. 2 has a breakdown of the age ranges of the children. Of the 806 children with a recorded location of injury 361 (44.8%) occurred at home or on the road. By contrast, of the 1459 adults with a recorded injury location, 242 (16.6%) of injuries occurred at home or on the road as seen in Table 1. Children were statistically more likely to be injured at home or on the road compared to adults ($p < 0.003$).

There were 908 (61.7%) children hit by a car while riding a golf cart or ejected from the golf cart. Only 875 (44.6%) adults that had the same mechanism of injury as noted in Table 1. Children were statistically more likely to be ejected or have their golf cart hit by a car or other golf cart ($p < 0.0001$).

There were 1466 children with a recorded body part injured, 627 (42.6%) injured their head or neck. Among adults, 561 (28.6%) out of 1948 injured their head or neck. Compared to adults, children were statistically more likely to have an injury to the head or neck ($p < 0.0001$). Fifty-eight (3.9%) of children had a face, head, or neck fracture compared to 48 adults (2.4%) with the same injuries. Children were statistically more likely to fracture their face, head, or neck than adults ($p = 0.013$). After being evaluated in the ED, 201 (13.7%) children and 289 (14.7%) adults were transferred for a higher level of care or admitted to the hospital from the emergency department; between the two groups there was no statistical difference ($p = 0.3770$).

## 4. Discussion

These findings support previous research demonstrating that golf carts can cause significant injury to children. As Watson et al. previously showed since the late 1990s golf cart related injuries have increased and cause a significant amount of morbidity across the United States. Our results show that golf cart related injuries remains to be a problem as they have remained elevated since the early 2000s, with an average of 345 injuries reported to the NEISS each year. Watson et al. previously used the NEISS database to

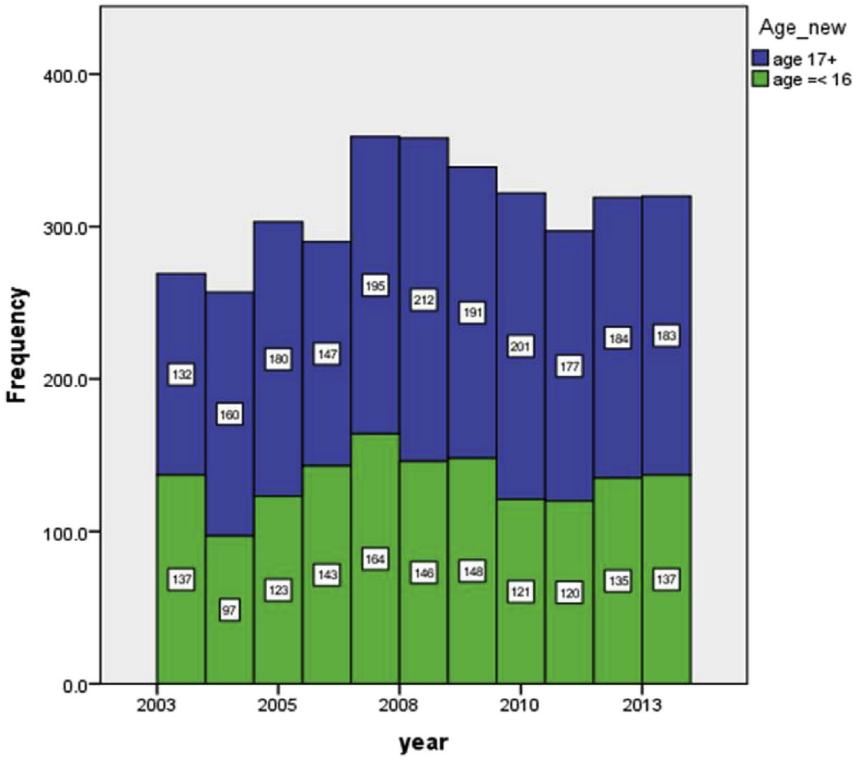


**Fig. 1.** Annual incidence of golf cart injuries among children and adults.

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