



## Pediatric Abdominal and Thoracic Equestrian Injuries-Single Center Experience

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### Abstract

**Introduction:** Recent years have witnessed an increase in the popularity of equestrian sports and therapeutic riding. The aim of the study was to report the prevalence and causes of different types of abdominal and thoracic equestrian injuries in children and to raise clinician awareness of the risks and necessary safety measures.

**Methods:** Background and injury-related data were collected from the medical files of all hospitalized patients over 17-year period at Schneider Children's Medical Center of Israel (SCMCI), a tertiary pediatric medical center for trauma. Patients transferred to the department of neurosurgery for evaluation of isolated head injuries were excluded.

**Results:** The final study cohort consisted of 74 children (44 boys and 30 girls) aged 2-17 years (mean age 11.3 years). Twenty-two patients (34%) had multiple trauma, for a total of 100 injuries: Head trauma in 31 patients (33% of all injuries), limb trauma in 29 (31%), abdominal trauma in 21 (23%) and chest trauma in 13 (13%). Surgery was performed in only 2 patients, with a diaphragmatic tear and with a complete left liver laceration associated with a portal vein and IVC laceration and a pancreas transection. Most of the injuries (83%) were caused by falling off a horse and the remainder by being kicked (14%) or bitten (3%) by a horse. The patients who fell off a horse were more prone to multiple trauma. No death was reported.

**Conclusions:** Equestrian activities can be associated with a risk of severe injury to both riders and handlers. Awareness of equestrian injuries from the public and from the primary care physicians is a paramount step to their prevention.

### Introduction

Man's relationship with horses started thousands of years ago, when horses were practically the only means of transportation. Today, in developed countries, people engage in horseback riding mainly for recreation, competition purposes or equine assisted therapy. The rising in popularity of equestrian sports in recent years, especially in urban communities, has been accompanied by an increase in horse-related injuries [1-6]. In the 5-14 year age group, the predicted annual incidence is 56/100,000 children [7]. However, data on the nature, causes and actual frequency of equestrian injuries in the total population, and the pediatric population in particular, remain sparse.

Children on horseback are 1.5 meters above the ground with minimal passive or active safety mechanisms which place them at high risk of severe trauma relative to other sports.

Most equestrian accidents occur when the horse's

fight or flight instinct is triggered under conditions of physical or mental stress. This can occur even with the best trainers and riders. The most common accidents are falling off or being thrown off by a horse, followed by being kicked, bitten or stepped on by a horse when dismounted, or being dragged after falling off a horse because a leg was caught in the stirrup [8].

Israel has not been immune to the growing interest in horseback riding. The aim of this retrospective study was

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**Table 1:** Age distribution among equestrian trauma patients.

Age (years)	Male	Female	Total (%)
0-5	6	2	8 (11%)
6-10	10	8	18 (24%)
11-15	24	17	41 (56%)
16-18	4	3	7 (9%)
Mean (years)	10.11	11.7	11.3

to present the long-term experience of a major pediatric medical center with equestrian injuries severe enough to require hospitalization. The findings are intended to increase clinician awareness of the characteristics of equestrian trauma in children and the need for safety/preventive measures.

## Material and Methods

The study was conducted at the department of Pediatric and Adolescent Surgery of SCMCI, a tertiary pediatric medical center in central Israel. We reviewed the files of all patients admitted at the emergency department and requiring an hospitalization from 1998 to 2017 for treatment of an injury that occurred while riding or handling a horse. The files of patients without hospitalization or presenting isolated neurosurgical injuries were excluded. Data on patient- and injury-related parameters were recorded. The study was approved by the Institutional Review Board of Schneider Children's Medical Center of Israel and of Rabin Medical Center (0251-16-RMC).

## Results

Of the 81 patients who met the study criteria of children requiring hospitalization (those not hospitalized presented minor traumas and were excluded), 7 were immediately transferred to the neurosurgery department because of an isolated head injury and were excluded from our analysis. The neurosurgery cases were excluded due to incomplete data. The final study group consisted of 74 children aged 2-17 years, 44 boys (average age 10.11 years) and 30 girls (average age 11.7 years) (Table 1). Twenty-five patients (34%) had multiple trauma, for a total of 114 injuries, as follows:

- Head injury, 36 patients (32% of all injuries), mainly concussions and soft-tissue injuries;
- Blunt abdominal injury, 26 patients (23% of all injuries), including abdominal wall contusions in 17, ruptured spleen in 6, lacerated liver in 2 (with pancreas transection and portal vein and IVC laceration in 1) and diaphragmatic tear in 1. Only two patients required emergency surgery. The patient with a torn diaphragm underwent a laparotomy with a diaphragmatic suture. The patient with a complete left liver laceration, portal vein laceration and pancreas transection underwent a laparotomy, a left atypical hepatectomy, a suture of IVC and portal vein and a distal pancreatectomy;

**Table 2:** Distribution of mechanism in equestrian injuries.

Affected organ	Mechanism of horse accident			Total injuries (%)
	Falling from	Kicked by	Bitten by	
Head	35	0	1	36 (32)
Chest	15	1	0	16 (14)
Abdomen	16	10	0	26 (23)
Limbs	31	3	1	35 (31)

- Limb injury, 35 patients (31% of all injuries), mainly upper limb fractures in 25;
- Blunt chest injury, 16 patients (14% of all injuries), including chest wall contusion in 11, rib fracture in 3 (right lung contusion with minimal pneumothorax in 1), scapular fracture in 1. The most common cause of injury was falling off a horse (62 patients, 84% of cohort patients), followed by being kicked (10 patients, 13%) or bitten (2 patients, 3%) by a horse. Of the 25 patients with multiple trauma, 22 (88%) had fallen off a horse and 3 (12%) had been kicked. The distribution of mechanism of injury by site affected is shown in (Table 2).

## Discussion

Although pediatric equestrian injuries have a relatively low incidence [9,10], they tend to be more severe than injuries caused by other pediatric sports activities and even, in some cases, motor vehicle crashes [1,4,5,9,11]. A recent increase in the incidence of horse-related injuries is described in the pediatric population [9,11-13]. Therapeutic riding has also increased the number of children dealing with horses these last ten years and thus the incidence of injured children [14]. Equine-assisted therapy includes a spectrum of treatments that includes activities with horses and other equines to encourage physical, occupational, and emotional growth in people with Attention Deficit Hyperactivity Disorders (ADHD), cerebral palsy, depression, autism, developmental delay, genetic syndromes (such as Down syndrome), traumatic brain injuries, behavioral issues, abuse issues, post-traumatic stress, drug and alcohol addiction, and other mental health problems [14,15].

Equestrian sports are also associated with a higher rate of upper body/upper limb injury than road accidents, probably because this part of the body hits the ground first when a person falls off a horse. Furthermore, falling off a horse was the main mechanism of injury in 84% of cases, in accordance with the world literature [3,9,12,16]. There was a relationship between the mechanism and the severity of injury, with a much higher multiple trauma rate associated with falling off a horse than being kicked by a horse. In addition, most of the head traumas (35/36,

97%) were caused by falling off a horse, whereas all the patients who were kicked presented abdomino-thoracic injuries, apparently owing to the large surface area of that region.

Contrary to literature from around the world, in the present series males (59%) were more frequently involved than females in horse-related injuries. This finding was also reported in another local publication [12]. The suspected reason concerns the Arabic and Bedouin population in our country in which only males ride horses.

The mechanisms of equestrian accidents involve three parameters: The horse's physical dimension and behavior, the rider's behavior and experience, and the interaction between the two. The average horse has a weight of about 600 kg and height of approximately 150 cm. Its speed can reach 45 km/h, its calculated stepping power is 7 kg/cm<sup>2</sup>, and kick power up to one ton [10,11,16,17]. These numbers emphasize the high energy level to which children are exposed when riding and handling a horse. Studies have shown a correlation between the individual horse demographics and the severity of injury: The older the horse, the lower the risk of fatality, and the taller the horse, the greater risk of fatality [9]. Furthermore, riders and handlers must be wary of the instinctive tendency of horses to rapid flight under physical or mental stress, and attempt to prevent such situations. For example, they should never approach a horse from immediately behind or in front where it has blind visual fields and they should make use of its keen sense of hearing to announce their arrival and to let the horse know of their presence continuously. To avoid being kicked, riders and handlers should not get in the way of the horse's forelegs when leading it and not get too close to its hind legs when walking behind it. Although even maximally skilled riders have accidents, some injuries are due to poor riding technique: Wrong position of the legs, inappropriate center of gravity and stiffness of the body. There is a close interaction among these factors, with an alteration in one leading to an imbalance in the others. Thus, when selecting an instructor, parents should investigate their safety record first, even before inquiring about their knowledge, availability and accessibility [4].

As in other sports, passive preventive measures are a major factor in reducing the severity of injury. A properly fitted helmet should be worn at all times (even by bystanders, themselves the subject of a significant number of accidents) [7,11,13,18,19]. Proper clothing, knee and elbow pads and riding boots are necessary as well [16]. The stirrup should be a few centimeters wider than the boot and be equipped with a release bar to prevent drag injury should the rider fall off [7]. For children, the release bar should be individually adapted to account for their lighter weight [4]. The lack of helmet use is associat-

**Table 3:** Medical contraindications and possible limiting factors for equestrian sports in children.

<p><b>Contraindications:</b></p> <ul style="list-style-type: none"> <li>• History of cervical fracture or dislocation</li> <li>• Congenital absence of odontoid process</li> <li>• Temporary paralysis of any cause</li> <li>• Head injury with permanent impairment</li> <li>• Congenital narrowing of the spinal canal</li> <li>• Patients with frequent, uncontrolled seizures</li> </ul>
<p><b>Possible limiting factors:</b></p> <ul style="list-style-type: none"> <li>• Repeated concussion</li> <li>• Brachial injury</li> <li>• Lumbar injury</li> <li>• Herniated intervertebral disk</li> <li>• Recurrent injury to cervical or lumbar ligaments or muscles</li> </ul>

ed with more serious injuries [13] and these injuries can cause long-term morbidity. Knowing that up to 21% of riders will sustain a serious injury, safety education and prevention measures like wearing an adequate protective helmet are essential [3,5,11-13].

Several medical conditions contraindicate equestrian sport activities (Table 3) [20] and all children must undergo a medical checkup before beginning training. At that time, the pediatrician should educate the parents and the child about the potential dangers of the sport and ways to avoid injury [5,16]. It is noteworthy that children previously involved in a horse-related accident are at higher risk of another accident [2,5]. By providing the proper information, the pediatrician can play an important role in making equestrian sports safe for children.

The limitations of our study are those of a retrospective study and that it does not include the isolated neurosurgical cases, leading to an incomplete profile of the equestrian injuries presenting to our trauma center. This study focuses on thoracic and abdominal traumas sustained in children handling and riding horses.

Besides good riding technique, to avoid horse-related injuries, rider and handler must be knowledgeable in the nature, behavior and physical characteristics of horses. Children should undergo a medical checkup before beginning training and use proper protective gear at all times. Pediatricians may play an important role in educating patients and parents in the dangers of horse riding and means of preventing serious injury.

### Conflict of Interest

All the authors declare that they have no conflict of interest.

### Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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